Office for National Statistics

Article

Developing supply and use tables for UK natural capital accounts: 2023

How we developed supply and use tables for UK natural capital accounts, which contain experimental estimates of the flow of goods and services generated by nature through the economy.

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1 . Main points

- The UK economy's reliance on goods and services provided by nature is well known but nature's contribution to economic output is not fully understood.
- Nature's contribution is not explicitly recorded within supply and use tables, which describe the flow of goods and services through the economy.
- Our experimental natural capital account supply and use tables increase that understanding by estimating the flow of goods and services, generated by nature, through the UK economy.
- The direct gross value added of nature to the UK economy in 2020 is estimated to be £51 billion; this is larger than the equivalent estimate for the construction of buildings, telecommunications, or insurance services industries.
- Further work is required to facilitate more detailed approaches to understanding and estimating the wider reliance of the UK economy on nature.

This article does not contain official statistics. It is published as research into a potential new method for producing supply and use tables for UK natural capital accounts. We advise appropriate caution when using these data.

2 . Background

Natural capital accounting produces estimates of the economic value of our environment. This is measured in terms of the stocks and flows of goods and services nature provides, also known as ecosystem services. All countries' economies rely on the goods and services produced by nature, with many different sectors and industries making use of these valuable assets.

At the Office for National Statistics (ONS), we currently produce natural capital accounts covering 13 ecosystem services, across eight broad habitats. These ecosystem services can be split into three types:

- provisioning services – these are products from nature such as food, water, energy, and materials
- regulating services – these include carbon sequestration and air pollution removal, which help to maintain the quality of the natural environment
- cultural services – these are the non-material benefits we obtain from natural capital, such as tourism, recreation, and aesthetic experience

Natural capital accounts form part of the environmental accounts, which are "satellite accounts" to the main UK National Accounts.

The System of National Accounts (SNA) includes ONS supply and use tables, which show the relationships between the components of value added, industry inputs and outputs, and product supply and demand in the economy. They help us to understand the supply of goods and services to economic units.

This article presents natural capital accounts supply and use tables, developed in line with United Nations (UN) System for Economic-Environmental Accounting (SEEA) guidance. The tables presented alongside this article are similar to those produced for the SNA, using ecosystem accounts data from the natural capital accounts.

Integrating natural capital accounting data into supply and use tables raises two main challenges.

Firstly, the SNA has a strict production boundary within which goods and services are supplied by economic units, either for their own final consumption, or the consumption by other economic units. Some regulating and cultural services fall outside of this boundary as their goods and services are not consumed by industries to generate tangible products, rather they are used through final consumption by government or households.

Determining which ecosystem services appear within this production boundary is challenging. The methodology driving the valuation of an ecosystem service may or may not rely on market-based values, and the destination of the flow of value (benefit) and flow of monetary value may diverge. Furthermore, the concept of ownership of ecosystem assets complicates assignment of value to an economic unit.

The supply and use tables we produce here simplify these complexities by assigning products from provisioning services as being within the production boundary, and services from regulating and cultural services as being outside of this boundary.

Secondly, existing supply and use tables do not explicitly identify flows from natural capital ecosystem services, where they are present within the tables. This means that it is not possible to determine what proportion of the supply of goods and services originate from the ecosystem services we can estimate.

The tables presented in this article show the supply of products from different habitats, or ecosystem assets, to the wider economy, and how these products are consumed through intermediate consumption and final consumption. Determining this relationship can help us to understand the UK economy's reliance on ecosystem services, and the risks borne by climate change and other environmental issues to the flow of ecosystem services to the wider market.

Supply and use tables can also help to contextualise the natural capital accounts. Our estimates of the value of ecosystem services represent the equivalent of a wholesale value. Onward uses of products using these ecosystem services also generate additional value. For example, timber is used by multiple industries to produce new products, such as furniture and fence posts. Our tables help to untangle the complex paths of supply and use of these goods and services to uncover the potential wider value they contribute towards.

This work contributes towards the "inclusive wealth" concept as described in the Dasgupta Review of the Economics of Biodiversity, published on GOV.UK, by beginning to integrate natural capital accounts into the System of National Accounts. This forms part of our workplan, shown in our Natural capital accounts roadmap. We have published other work on inclusive wealth, including our Inclusive Capital Stock, UK: 2019 and 2020 article.

These supply and use tables are published as experimental research, and present annual (flow) data for a single year, 2020. These data, presented in 2020 prices, are taken from our UK natural capital accounts: 2022 article, which provides estimates of the ecosystem services that we are currently able to value. Because of methodological improvements, the annual and asset value estimates for the oil and gas ecosystem service match the value given for the UK in our more recent England natural capital accounts: 2023. These tables present the flows and uses of domestically produced products derived from ecosystem services within the UK.

3 . Linking suppliers with habitats

The United Nations System for Economic-Environmental Accounting (SEEA) framework for Ecosystem Accounting provides guidance for developing a limited supply and use table, like those found in the System of National Accounts, but instead using ecosystem accounts data.

This allocates the goods and services produced each year into which assets, or habitats, they arise from. The products derived from ecosystem services are created by ecosystem assets and are supplied to the market by industries.

Table 1: Annual value of natural capital, by habitat and type of service, £ million, UK, 2020

Habitat	Provisioning Services (£ million, 2020 prices)	Regulating Services (£ million, 2020 prices)	Cultural Services (£ million, 2020 prices)	All Services (£ million, 2020 prices)
Urban	60.9	-167.0	14,983.6	14,877.5
Marine	8,325.9	0.0	0.0	8,325.9
Woodland	372.7	5,624.3	2,231.0	8,228.0
Freshwater, wetlands and floodplain	6,961.1	-834.4	1,550.2	7,676.8
Enclosed farmland	7,668.9	-3,465.7	2,372.1	6,575.2
Coastal margins	0.0	16.2	2,721.1	2,737.3
Mountain, moorland and heath	878.6	7.7	608.0	1,494.2
Semi-natural grassland	378.9	247.2	749.2	1,375.3
Total	24,647.0	1,428.3	25,215.0	51,290.3

Source: UK natural capital accounts from the Office for National Statistics

Notes

1. These estimates are additive, where the sum of habitats is equal to the total value of ecosystem services. As a result, they may differ to the ones found within the natural capital habitat accounts, which are thematic by design. In our habitat accounts, the value of an ecosystem service may originate from two or more habitats because of the difference between the location and the type of habitat providing the ecosystem service. For example, the urban cooling ecosystem service of woodlands in urban areas can be attributed to both woodland and urban habitats.

2. Negative values in this table are a result of several factors. Firstly, the negative values are because of habitat apportionment of the carbon sequestration service, with habitats emitting carbon (equivalent) rather than sequestering carbon (equivalent) not providing a net positive annual value. The negative values are also a result of the annual value of coal ecosystem service. This is because of how this estimate is produced, where the residual resource rent value of the coal itself is negative after capitals and taxes and subsidies have been deducted.

3. Further data showing annual value by service type and habitat can be found in the accompanying supplementary datasets.

Currently, our estimates of the annual value of ecosystem services do not explicitly account for changes in the condition of each habitat, as explained in our Habitat extent and condition, natural capital, UK: 2022 bulletin. By linking these habitats with the economy, we hope to be able to link the impact of changing habitat conditions to the economy in the future so that we can understand the resulting supply chain effects.

4 . Following uses of natural capital through the economy

The supply of goods and services from ecosystem assets are consumed by various industries and sectors across the economy. Some goods and services are intermediately consumed to make other products, with each step adding value to the original product that was supplied.

Our supply and use tables estimate which industries and sectors initially make use of products derived from ecosystem services, showing their path through the economy. For provisioning services, to be able to track the progress of domestic ecosystem assets through the economy, we need to determine which intermediate users rely on different ecosystem services. This requires a level of data granularity of industry expenditure on products beyond which is currently unavailable.

Instead, we use 2020 supply and use data to apportion intermediate consumption based on industry use of the product class under which the ecosystem service falls. For example, the intermediate consumption of timber removals is determined from the use of products of forestry and logging.

We then analyse the domestic use tables, shown in Office for National Statistics (ONS) input-output analytical tables – product by product dataset to ensure that the industries selected use domestically produced products, which are derived from the ecosystem services we measure. Domestic use tables data for 2020 are not yet available, so we have used data for 2018 to inform estimates of intermediate consumption.

We have also had to apply some judgement to determine which industries to include as intermediate consumers. For example, in this additional step, we estimate the intermediate consumption of the timber, supplied by the logging and forestry industry, derived from the ecosystem service of timber removals. This raw form of timber may be used within the manufacture of paper and paper products, and products of wood and cork. However, it seems unlikely that this timber would be used in crop and animal production before it has been processed by a different industry.

Within the 2020 supply and use tables, the "Crop and Animal Production, Hunting and Related Service Activities" industry consumes 8.6% of the total products of Forestry and Logging. In this example, this percentage has been removed and redistributed across the industries we believe would intermediately consume this raw form of timber in Table 2.

Future development could involve more robust methods for determining which intermediate consumers to include.

Table 2: Monetary-use table for timber removals, £ million and percentage (%), UK, 2020

Industry or sector	Industry code	Use of Products of forestry, logging and related services (Percentage)	Redistributed use of Products of forestry, logging and related services (Percentage)	Intermediate consumption of timber removals (£ millions)
Crop And Animal Production, Hunting And Related Service Activities	A01	8.6	0.0	0.0
Forestry And Logging	A02	14.5	15.9	59.4
Manufacture Of Wood and Products Of Wood and Cork, Except Furniture; Manuf. Of Articles Of Straw	C16	23.7	26.0	97.0
Manufacture Of Paper And Paper Products	C17	10.2	11.2	41.8
Electric power generation, transmission and distribution	D351	34.6	38.0	141.6
Buying and selling, renting and operating of own or leased real estate, excluding imputed rent	L68BXL683	0.3	0.0	0.0
Repair Of Computers And Personal And Household Goods	S95	0.1	0.0	0.0
Households		8.0	8.8	32.8
Total		100.0	100.0	372.7

Source: UK natural capital accounts and input-output supply and use tables from the Office for National Statistics

Notes

1. Details of which intermediate consumers are included for other services can found in the supplementary datasets published alongside this bulletin.

There are no intermediate consumers for cultural and regulating services, excluding tourism and recreation and amenity value, as these benefits go straight to households or government.

5 . Using supply and use tables for natural capital

Gross value added (GVA) is the value generated by any economic unit engaged in the production of goods and services. Using natural capital supply and use tables, we can produce estimates of the potential GVA of ecosystem services provided by UK natural capital.

Traditionally, GVA is calculated by subtracting intermediate consumption from market output as explained in our guide to the UK National Accounts: March 2020 methodology. As we are unable to determine the industry's market output and intermediate consumption that relies directly on ecosystem services, this approach cannot be used.

Instead, we can use an alternative approach to generate GVA estimates for provisioning services, which are captured within existing supply and use tables. In this case, we assume the ratio of output to intermediate consumption of the industry consuming ecosystem services is equal to the same ratio for ecosystem service products. We then attribute a proportion of this industry's GVA to an ecosystem service product, based on the share of the industry's supply, which originates from ecosystem services. This approach can be seen within Table 3.

Table 3: Proportion of industry supply that can currently be attributed to natural capital, UK, 2020

Ecosystem service	Industry	Ecosystem service annual value (£ millions)	SUT Industry Supply (£ millions)	Ecosystem service contribution to SUT industry supply (Percentage)
Agricultural Biomass	A01	7,301.6	30,767.0	23.7
Timber Removals	A02	372.7	1,650.0	22.6
Fish Capture	A03	302.1	1,803.0	16.8
Mineral Extraction	B05	963.8	5,762.0	16.7
Fossil Fuel Production - Oil and Gas	B06	7,012.5	21,053.0	33.3
Fossil Fuel Production - Coal	B08	-110.7	222.0	-49.9
Renewable Energy Generation	D351	1,986.8	93,290.0	2.1
Water Abstraction	E36	6,818.2	11,041.0	61.8

Source: UK natural capital accounts and input-output supply and use tables from the Office for National Statistics

Notes

1. The residual resource rent value of coal fossil fuel production is negative, leading to a negative percentage of supply value. This is because of how this estimate is produced: the residual resource rent value of the coal itself is negative after capitals and taxes and subsidies have been deducted.

We can extend this approach to industries that we estimate to be intermediately consuming ecosystem service products to create additional value added.

For these industries, we determine what proportion of their total intermediate consumption is the use of ecosystem service products. We can then attribute this proportion of the industry's GVA to ecosystem service products.

Table 4 gives an example of this for the ecosystem service of timber removals.

Table 4: Proportion of industry intermediate consumption that can currently be attributed to natural capital timber removals, UK, 2020

Industry	Industry code	Consumption of ecosystem services (£ millions)	SUT Industry Consumption (£ millions)	Ecosystem service contribution to SUT industry consumption (Percentage)
Forestry And Logging	A02	59.4	854.0	7.0
Manufacture Of Wood and Products Of Wood and Cork, Except Furniture; Manufacture Of Articles Of Straw	C16	97.0	5,345.0	1.8
Manufacture Of Paper And Paper Products	C17	41.8	7,189.0	0.6
Electric power generation, transmission and distribution	D351	141.6	70,156.0	0.2

Source: UK natural capital accounts and input-output supply and use tables from the Office for National Statistics

Notes

1. Some natural capital consumption is attributed to households, which have been excluded from this table.

These approaches assume that the output and intermediate consumption of ecosystem services by a given industry reflect the wider output and intermediate consumption of the entire industry. However, as industry classes often include a range of individual products and services, this is unlikely to be the case.

Table 5 depicts estimates of GVA associated with these output and intermediate consumption approaches. These estimates offer an indication of GVA that relies directly on the supply and use of ecosystem service products, from a national accounting perspective.

Table 5: Estimates of gross value added of provisioning ecosystem services within the system of national accounts, UK, 2020

Provisioning ecosystem service	Output approach GVA (£ millions)	Intermediate consumption approach GVA (£ millions)
Agricultural Biomass	2,890.3	1,042.0
Timber Removals	179.8	188.3
Fish Capture	101.4	120.6
Fossil Fuel Production – Coal	-44.4	-17.1
Fossil Fuel Production – Oil and gas	3,813.2	1,996.1
Mineral Extraction	331.9	573.7
Renewable Energy Generation	492.7	1,117.7
Water Abstraction	5,027.3	4,878.1
Total	12,792.2	9,899.5

Source: UK natural capital accounts and input-output supply and use tables from the Office for National Statistics

This approach does not include estimates of the GVA from non-provisioning services as they do not all feature within the System of National Accounts production boundary. Instead, we present an alternative approach to estimate the GVA of all the ecosystem services we are currently able to value.

The United Nations System for Economic-Environmental Accounting framework for Ecosystem Accounting provides guidance for integrating ecosystem services within supply and use tables, including methods to interpret GVA from ecosystem assets. This guidance calls for the value added of an industry to be divided between the industry itself and the ecosystem asset. To achieve this from an ecosystem accounting perspective, the GVA of an ecosystem service is set equal to its supply. These services are then consumed by an industry to generate additional supply and the remaining value added.

Table 6: Estimates of gross value added of ecosystem services, UK, 2020

Ecosystem service		GVA (£ millions)
Provisioning services		
	Agricultural Biomass	7,301.6
	Timber Removals	372.7
	Fish Capture	302.1
	Mineral Extraction	963.8
	Fossil Fuel Production - Coal	-110.7
	Fossil Fuel Production - Oil and Gas	7,012.5
	Renewable Energy Generation	1,986.8
	Water Abstraction	6,818.2
Regulating services		
	Air Pollution Removal	2,393.6
	Carbon Sequestration	-1,411.8
	Noise Mitigation	16.6
	Urban cooling	429.9
Cultural services		
	Amenity Value	2,816.4
	Health benefits from Recreation	6,826.0
	Tourism and Recreation	15,572.6
	Total	51,290.3

Source: UK natural capital accounts from the Office for National Statistics

This results in an estimated total GVA of the UK economy relying directly on the ecosystem services we can currently evaluate, of £51 billion in 2020. If this estimate of the "economic output of nature" were to be considered as a traditional industry, it would be larger than construction of buildings, telecommunications, or insurance services industries.

This approach estimates the potential GVA from ecosystem services that is directly reliant on natural capital. However, the supply chains of many industries could not operate without natural capital. Therefore, the GVA that relies in some part on ecosystem services is likely to be much larger than the £51 billion estimate.

6 . Developing supply and use tables for UK natural capital accounts data

UK natural capital accounts, supply and use supplementary tables
Dataset|Released 21 March 2023
Supply and use tables for UK natural capital accounts, which contain experimental estimates of the flow of goods and services generated by nature through the economy.

7 . Glossary

Asset

A natural asset is a resource that can generate goods or services to humans into the future. The valuation of the natural asset estimates the stream of services that are expected to be produced over a reasonably predictable time horizon.

Ecosystem services

Ecosystem services are the living (biotic) components of the Earth that provide services to humans, such as woodland.

Final consumption

The expenditure on those goods and services used for the direct satisfaction of individual needs or the collective needs of members of the community, as distinct from their purchase for use in the productive process. It may be contrasted with actual final consumption, which is the value of goods consumed, but not necessarily purchased, by that sector (see also intermediate consumption).

Gross value added

The value generated by any unit engaged in production and the contributions of individual sectors or industries to gross domestic product. It is measured at basic prices, excluding taxes less subsidies on products.

Intermediate consumption

The consumption of goods and services in the production process. It may be contrasted with final consumption and capital formation.

8 . Future developments

Following these initial steps to integrate our estimates of natural capital ecosystem services into the supply and use tables found within the National Accounts, further work is needed to accurately estimate value added of the natural environment in economic output.

This requires a deeper understanding of the industries that products from ecosystem services flow to and from. This means supply and use data with greater detail, reflecting the products supplied by ecosystem services. This would also be enhanced by mapping the movement of imported and exported natural capital from other countries into and from the UK through the economy.

We could also develop a time series of these supply and use tables, enabling tracking of changes in the environment's contribution to the UK economy. With sufficient data on the condition of ecosystem assets and their ecosystem service flows, we may also better understand the variations in nature's contribution to the UK economy across time.

Feedback

We welcome feedback on this research and the methods we have used to produce natural capital accounts supply and use tables.

Please email feedback to Natural.Capital.Team@ons.gov.uk. Please include "Natural capital account supply and use tables" in the subject line of your response.

9 . Data sources and quality

We have used a wide variety of sources for estimates of natural capital account supply and use tables, this includes those within our UK natural capital accounts bulletin.

The Office for National Statistics (ONS) and the Department for Environment, Food and Rural Affairs (DEFRA) have published a summary of the principles underlying the UK natural capital accounts.

These accounts have been compiled in line with the guidelines recommended by the United Nations (UN) System of Environmental-Economic Accounting (SEEA) Central Framework and the UN SEEA Experimental Ecosystem Accounting principles. UN guidance in this area continues to develop.

We welcome feedback on this output or any of our approaches to natural.capital.team@ons.gov.uk.

The ONS' natural capital accounts are produced in partnership with Defra.

Strengths and limitations

Because of data availability, the methods described within this article are subject to several limitations.

To apportion the annual value of ecosystem services across habitats, a range of data were used and where required, assumptions were made. These assumptions can be found in the intermediate consumption apportionment table, within the accompanying supplementary tables.

Our Inclusive Capital Stock, UK: 2019 and 2020 article displays the asset values of natural capital alongside other types of capital. This publication highlights the potential for double counting of value as some goods and services derived from ecosystem services may already be present within the values captured in the Blue Book.

The current supply and use tables data published by the Office for National Statistics (ONS) categorise individual products into product classes. These classes are known as Standard Industrial Classifications (SICs) and are outlined in the UK Standard Industrial Classification of Economic Activities 2007. We publish supply and use tables, which include 112 product and industry classes. SICs feature an additional level of detail, including group, class, and sub-class. However, many of the products and industries described in the supply and use tables do not feature this level of detail. This is an example of the SIC structure relevant to the ecosystem service of timber removal:

A02 - Forestry and logging

A02.10 - Silviculture and other forestry activities

A02.20 - Logging

- production of roundwood for forest-based manufacturing industries
- production of roundwood used in an unprocessed form such as pit-props, fence posts and utility poles
- gathering and production of wood for energy
- gathering and production of forest harvesting residues for energy
- production of charcoal in the forest (using traditional methods)

A02.30 - Gathering of wild growing non-wood products

A02.40 - Support services to forestry

The supply and use tables contain figures related to "A02 - Forestry and logging". This class includes four groups, only one of which, "A02.20 - Logging", is relevant to the service of timber removal. We are therefore unable to correctly compare the domestic supply or use of each product with the relevant natural capital value of the ecosystem service. By obtaining supply and use data, which relates directly to the specific product supplied by each ecosystem service, we could accurately track the movement of these products through the production cycle and wider economy.

Furthermore, on the development of natural capital values, we also need to develop a greater understanding of unit prices for services that contain more than one product. For example, the agricultural biomass and mineral extraction services contain multiple products. These products will each have their own unit price, which would be reflected in the supply and use tables.

10 . Related links

Natural capital accounts roadmap: 2022
Article | Released 31 August 2022
Assesses achievements since the publication of the natural capital roadmap, outlines various challenges, and sets out priorities for the next phase.

Woodland natural capital accounts: 2022
Bulletin | Released 15 December 2022
Natural capital accounts containing information on ecosystem services for woodlands in the UK.

UK natural capital accounts: 2022
Bulletin | Released 10 November 2022
Estimates of the financial and societal value of natural resources to people in the UK.

Health benefits from recreation, natural capital, UK: 2022
Bulletin | Released 27 May 2022
Further development of the UK recreation natural capital ecosystem service accounts, including specific methods used to estimate the health benefits gained from nature-based recreational activities.

Habitat extent and condition, natural capital, UK: 2022
Bulletin | Released 3 May 2022
The size of area and condition indicators for eight natural UK habitats, including woodland, enclosed farmland, semi-natural grasslands, and coastal margins. Uses the System of Environmental-Economic Accounting framework for Ecosystem Accounting. Experimental estimates.

11 . Cite this article

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