Monetary Valuation of UK Timber Resources

Authors: Jawed Khan, Peter Greene and Kah Wei Hoo; Office for National Statistics

Abstract

The monetary value of UK timber resources at 1 April 2011 is estimated to be £6.7 billion. Using the Net Present Value method, applying the HM Treasury declining social discount rate and taking different age classes of timber resources into account, this paper presents the first experimental estimates of UK timber resources. These estimates are incorporated into an accounting structure to develop the first experimental monetary asset account (balance sheet) for UK timber resources for 2011-12. This paper also provides the methodology and assumptions used to estimate the value of UK timber resources and provide suggestions on improving these estimates over time.

Introduction

In November 2011, in response to the Natural Environment White Paper (NEWP) commitments, the Office for National Statistics (ONS) published a paper "Towards a sustainable environment – UK Natural Capital and Ecosystem Accounting" to outline its approach to deliver the 'early changes by 2013' to the UK Environmental Accounts. The paper suggested that a pilot study to produce a woodland asset account should be prioritised in the first instance. In December 2012, ONS published a roadmap "Accounting for the value of nature in the UK" to incorporate natural capital into the UK Environmental Accounts. As part of the roadmap, ONS set out a timetable to develop woodland non-monetary and monetary asset accounts.

This paper values UK timber resources as at 1 April 2011 and presents the first experimental monetary account for UK timber resources. The monetary accounts have major advantages over non-monetary accounts in terms of aggregation because they are presented in one common monetary unit, and are easier to summarise to get an overall view. ONS has published the following experimental statistics as a first step towards providing comprehensive physical and monetary asset accounts for UK woodland:

1) Measuring UK woodland area and timber resources
2) Measuring UK woodland ecosystem assets and ecosystem services
3) Land use in the UK

The monetary value of UK timber resources is not the total value of UK woodland; it is just the value of the timber resources that are located in UK woodland. Often woodlands are seen predominantly in terms of timber resources i.e. the volume of standing timber, but woodlands are used in the production of a wide range of products and hence woodland and timber resources are not equated[1]. The total value of UK woodland as an asset is the sum of both the timber assets and other woodland ecosystem assets.

[1] Source: SEEA Central Framework

In the UK all timber resources can be regarded as available for wood supply. Therefore, we have included all the timber resources within UK woodland in our valuation. By assuming all timber is available for wood supply, this paper is not making an assumption that woodland in the UK is only managed for timber. The focus of this paper is to value the timber resources as an asset regardless of whether they provide other ecosystem services. The valuation of ecosystem services is beyond the scope of this paper. ONS is undertaking work to value the ecosystem services provided by woodland and these values are likely to be explored as part of that work.

The monetary valuation of UK timber resources will feed into the total natural capital estimates that ONS are developing. As part of the roadmap, the ONS has also set out a timetable to fast-track work to improve the valuations of the natural capital element of the estimates of national wealth published by the World Bank and the Inclusive Wealth Report[2] – the so-called "top-down approach". This update is provided in a paper "Towards Wealth Accounting – Natural Capital Estimates within Comprehensive Wealth" that ONS has published alongside this paper.

As discussed in the paper "Towards a sustainable environment – UK Natural Capital and Ecosystem Accounting", the conceptual model adopted by the UK and the international statistical community for environmental accounts is the United Nations' System of Economic and Environmental Accounts (SEEA), a satellite system of the System of National Accounts (SNA), meaning that accounts produced under this standard bring environmental and economic information together within a common framework.

A multi-year process of revision to SEEA was initiated by the United Nations Statistical Commission (UNSC). The revised SEEA consists of three parts:

- The Central Framework of agreed concepts, definitions, classifications, accounting rules and tables which, following a period of global consultation, has been adopted as the international statistical standard for environmental-economic accounts by the UNSC in February 2012
- Experimental Ecosystem Accounting, which following a global consultation has been endorsed by the UNSC as international guidance in February 2013
- Extensions and Applications, which outlines applications of environmental economic accounting.

ONS aim is to develop a monetary asset account for timber resources in accordance with SEEA Central Framework; however, ONS has taken a flexible approach in implementing SEEA as it acknowledges that countries can show flexibility in implementing the standards depending on their specific needs. Therefore, this paper implements SEEA whenever possible and adopts a flexible approach on developing an experimental monetary asset account for timber resources.

This paper starts with a brief discussion on valuation of environmental assets. It then provides the methodology used to value UK timber resources and applies the NPV approach to estimate the resources at 1 April 2011. The next two sections discuss the results and provide sensitivity analysis

[2] The Inclusive Wealth Report, published in June 2012, is a joint collaboration between the United Nation University International Human Dimensions Programme and the United Nations Environment Programme

respectively. It then presents an initial experimental monetary asset account for UK timber resources for 2011-12. The next section provides a comparison with the international studies and the final two sections discuss the frequency of the account and future work on addressing the data gaps.

Valuation of environmental assets

The scope of environmental assets in SEEA Central Framework is defined through a focus on the individual components that comprise the environment. There are seven individual components of the environment that are considered environmental assets in SEEA Central Framework. One of them is timber resources[3]. Environmental assets provide a series of benefits to individuals and to society; therefore, not only the current benefits should be valued, the future stream of benefits over the asset life should also be valued.

Valuation of timber resources

Ideally, observable market prices should be used to value timber resources and the ideal source of these prices are values observed in markets in which each asset traded is completely homogeneous. SEEA Central Framework indicates that it is important to value an environmental asset in situ – the asset itself as it is in the ground – rather than after its removal. The timber resources in this paper are valued in situ and theoretically the value of the timber resource is the discounted future stumpage price paid by the buyer to the owner of the forest for standing timber.

The average price of coniferous standing sales[4] (per cubic metre over bark) by the Forestry Commission, 2013 is available for Great Britain. Coniferous species account for over 90% of all timber harvested in the UK, and the Forestry Commission accounts for around half of all coniferous timber sold. Assuming that broadleaved species, which are not traded as regularly, have the same stumpage price as coniferous species, this paper has used the average price of Forestry Commission coniferous standing sales as the average stumpage price for all timber. Since the future flow of benefits of timber resources need to be valued, the NPV method given below is used to estimate the discounted future stream of income to value UK timber resources.

Net Present Value (NPV)

This section discusses in detail the NPV method that is used to value the timber resources.

There are three aspects of the NPV that require explanation:

1) The measurement of returns on environmental assets
2) Pattern of expected resource rent and asset life
3) Choice of discount rate

[3]The other six are mineral and energy resources, land, soil resources, aquatic resources, other biological resources and water resources

[4] Average prices for Forestry Commission sales of coniferous standing timber are published in the Forestry Commission's National Statistics release "Timber Price Indices"

1) The measurement of returns on environmental assets

SEEA defines the returns on environmental assets in terms of economic rent. This is the surplus value accruing to the extractor, or user, of an asset calculated after all costs and normal returns have been taken into account. In the context of environmental assets, the surplus value is referred to as the resource rent.

SEEA suggested that the resource rent for timber resources could be estimated more directly by using estimates of the stumpage price[5]. However, using stumpage price as the resource rent presents a risk that the management cost and normal return is not deducted. Alternatively resource rent could be estimated by the widely used residual value method which is estimated by deducting the user cost of produced assets from gross operating surplus after adjustment for any specific subsidies and taxes. However, this requires a number of assumptions and the data are currently not available.

The stumpage price, as discussed above, is used in this paper as the unit resource rent (URR) of UK timber resources. The URR is assumed to be constant over the asset life, so the volatility of the URR could affect the expected resource rent. To smooth out these URR fluctuations, the following five year average is applied:

$$\boldsymbol{Adjusted\ URR = \frac{URR_{t-2} + URR_{t-1} + URR_t + URR_{t+1} + URR_{t+2}}{5}}$$

Where t is the current time period

The value of timber resources as at 1 April 2011 is based on the stumpage price of conifers in real terms (2011 prices) as follows:

Table 1: Stumpage price of conifers sold by Forestry Commission

Year to	31-Mar-09	31-Mar-10	31-Mar-11	31-Mar-12	31-Mar-13
Average price per cubic metre overbark	9.66	9.99	13.87	13.99	12.99

Source: Timber Price Indices: Data to March 2013, Forestry Statistics

The data in Table 1 feed into the equation above and gives an adjusted URR of £12.10. The adjusted URR is used to estimate the expected resource rent for the timber resources.

2) Pattern of expected resource rents and asset life

The critical factor in the valuation of timber resources is determining the expected pattern of the resource rent. Expected patterns are not observed and hence assumptions concerning the flows must be made. The pattern of the expected extraction of timber resources would determine its asset life.

[5] Source: SEEA Central Framework Chapter 5, Page 181

In general, the URR is very volatile but in the absence of any robust forecasts of future patterns, it is not possible to incorporate future price changes in the Net Present Value model. Therefore, the URR (stumpage price) is held constant based on the current estimates of adjusted URR. There are a number of ways to determine the patterns of the expected resource rent for timber resources:

1) One way is to project the future extraction. However, in the absence of information on future cost, prices and extraction rates it is not possible to estimate a reliable extraction projection. The Forestry Commission is running a project on the production forecast of timber resources. The medium term (25 years) forecast for conifers has been released recently while forecasts for broadleaves and longer term forecasts are still in progress. A long term projection is needed due to longer timber rotation, if this option is chosen

2) A second way is to assume that the current extraction rate and the natural growth rate are constant. If this option is chosen, the possibility of over-exploitation and afforestation may not be captured in the value

3) A third way is to consider the age structure of the timber resources. Generally, timber resources have different growth rates – higher growth rates when they are young, constant rate close to harvesting, and declining growth rate after maturity. Considering these growth patterns, an optimum harvesting age can be derived using the Faustmann rule or the maximum mean annual increment concept.

The Faustmann rule gives the present value of the income stream of the forest rotation and provides the optimal harvesting age. This rule is popular in the economics of forest management, as it takes into account the economic efficiency and gives an optimal age of timber resources which maximises the return of timber. However, this method requires a number of assumptions and information on the value of forests, expected prices and associated costs, which are not readily available.

The mean annual increment is the average annual increase in the volume of a tree at a certain age. The maximum mean annual increment concept is based on different growth rates in timber resources throughout its life span. However, the average age of the maximum mean annual increment is currently not available for UK timber resources. Further work needs to be carried out to determine an average age of the maximum mean annual increment across different species in UK woodland. For this paper we have assumed that the harvesting age is in the 41-60 class. The mid-point for this class is 50 years and this is assumed as the harvesting age in this monetary asset account. The selection of this harvesting age has been supported by the sensitivity analysis (discussed later). From the analysis, it was found that within the parameters of the model set out in this paper the optimal harvesting age class is 41-60. This supports our selection of a harvesting age of 50 years.

Since timber grows until it is harvested, the expected volume of standing timber for each age class is assumed to be fixed at the harvesting age. Table 1 shows the various age classes for UK timber resources. The stocked area and actual volume of timber in that area for each age class is shown in column 2 and 3 respectively. The last column shows the estimated volume per hectare for each age class, calculated by dividing the actual volume of timber by stocked area of the respective age class. Since the harvesting age is assumed to be between 41–60 years, the expected volume per hectare at harvest for each age class is fixed at 304 m^3 overbark/hectare for the NPV calculations in Table 2.

It can be seen from Table 2 that there are timber resources in the UK that are older than the harvesting age - known as overdue timber - with volume above 304 m^3overbark/hectare. This additional volume is not considered in the valuation of the timber resources.

Table 2: Calculating volume per hectare[6]

Age Class	Stocked area	Actual volume	Volume per hectare
Unit	hectare	million cubic metres overbark	m^3/hectare
0-20	622,176	15.46	25
21-40	865,776	173.64	201
41-60	**645,676**	**196.20**	**304**
61-80	284,676	91.44	321
81-100	134,876	54.61	405
100+	126,276	53.96	427
Total	2,679,454	585.31	

3) Choice of discount rate

A discount rate is required to convert the expected future stream of resource rents into prices for the current period. 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. There are two broad types of discount rates – market (individual) discount rates and social discount rates.

Market discount rates are usually higher than social discount rates as individuals or enterprises tend to demand a quicker return from ownership of an asset. The use of a market discount rate provides a stronger comparison across different types of assets and the trade off between assets can be considered. On the other hand, social discount rates place a higher relative importance on income earned by future generations.

Since environmental assets are of long term value to society, they should be valued from a societal perspective. Therefore, this paper applies the social discount rate from the HM Treasury Green Book (Table 3).

Table 3: Social Discount Rate

Period of years	0-30	31-75	76-125	126-200	201-300	301+
Discount rate	3.5%	3%	2.5%	2%	1.5%	1%

Source: HM Treasury's Green Book

[6] Sources: National Forest Inventory Report:

- Standing volume of broadleaves in woodland in Great Britain
- Standing timber volume for coniferous trees in Britain

Application

This section applies the above methodology to estimate UK timber resources at 1 April 2011. The following NPV formula is used:

$$\boldsymbol{Total\ Value\ of\ UK\ timber\ resources} = \boldsymbol{\Sigma \frac{resource\ rent}{(1+r)^t}} = \boldsymbol{\Sigma \frac{avq}{(1+r)^t}}$$

p = Unit resource rent (stumpage price)

av = Represent the expected volume of standing timber at the harvesting age

r = Social discount rate

t = Asset life (harvesting age minus age class)

The unit resource rent (p) of £ 12.10 is multiplied by the expected volume of standing timber (q) of respective age class to estimate the future receipts. The expected volume of standing timber is calculated by multiplying stocked area with volume per hectare at harvesting age. Estimates of stocked area at 31 March 2011 by age classes, and actual timber volume is taken from the NFI (Table 2). As discussed earlier, the volume per hectare is fixed at 304 m^3overbark/hectare for all age classes. This ensures that the expected natural growth for age classes 0-20 and 21-40 are accounted in the NPV model.

A midpoint for all the age classes is calculated to obtain the asset life corresponding to each age class. The midpoint for harvesting age class (41-60) is 50 years and therefore, 50 years is used as the harvesting age. To estimate the asset life of timber resources in each age class, the midpoint is subtracted from the harvesting age. For example, for class 0-20 the midpoint is 10, which is subtracted from the harvesting age of 50 years to obtain an asset life of 40 years. Timber resources above 50 years are valued at their expected volume of 50 years instead of their actual volume.

A social discount rate as shown in table 3 is then applied to discount the future receipts to estimate the value of timber resources at each age class. Since the harvesting age is set between the 40 and 60 age class, the future receipts from 60+ age classes are not discounted, as these trees could (by assumption) be harvested now. The total receipts from all age classes of timber resources give the total value of UK timber resources.

Table 4: Monetary value of UK timber resources at 1 April 2011

Age structure	Stumpage price per cubic metres **£**	Stocked area ***hectare***	Volume per hectare at harvesting age m^3/ha	Midpoint of age class	Asset life[7]	Discount Rate	Value for each age class	Value for each age class **£** ***million***
	p	a	v		t	r		
0-20	12.10	622,176	304	10	40	3%	$\frac{pav}{(1+r)^t}$	701
21-40	12.10	865,776	304	30	20	3.5%	$\frac{pav}{(1+r)^t}$	1,600
41-60	12.10	645,676	304	50	0	0%	$\frac{pav}{(1+r)^t}$	2,374
61-80	12.10	284,676	304	70	0	0%	$\frac{pav}{(1+r)^t}$	1,047
81-100	12.10	134,876	304	90	0	0%	$\frac{pav}{(1+r)^t}$	496
100+	12.10	126,276	304	100	0	0%	$\frac{pav}{(1+r)^t}$	464
						Total value of stock	$\Sigma\frac{pav}{(1+r)^t}$	6,682

It should be noted that the above valuation does not take account of any restocking after harvesting.

Results

The monetary value of UK timber resources is estimated to be £6.7 billion at 1 April 2011 by applying NPV under the following assumptions:

- The stumpage price is the same across all the timber resources
- A 5 year average unit resource rent is constant across the account asset life
- The net return or resource rent is received when the timber is harvested. The harvesting age is 50 years and all timber is available for wood supply
- As the timber grows until it is harvested, the expected volume of standing timber for each age class is fixed at harvesting age
- Non-uniform social discount rate

The valuation of timber resources in this paper is undertaken on all standing timber. All the standing timber stock is being valued as if it is used solely as timber without considering the other ecosystem services they provide. Therefore, the value derived in this paper is an asset value of timber resources when they are being removed and used as timber products. The ecosystem services, other than removal, provided by UK woodland will be captured in a separate ecosystem service account.

Table 4 shows that the estimated monetary value of timber resources above 60 years of age is around £2 billion. This value is based on the assumption that the timber is overdue and could be harvested at anytime. This approach is consistent with SEEA Central Framework and the System of National Accounts (SNA), which states that any asset which is used for economic production has an economic value. The timber resources above 60 years are available for wood supply and therefore

[7] Calculated by taking the harvesting age less age class.

they need to be valued. The asset value derived in this paper is based on the SNA principle and could be incorporated into the UK Environmental Accounts.

However, there is a possibility that these timber resources are unlikely to be harvested and might have been grown for other purposes than timber, for example, to provide other ecosystem services, or both. Therefore, as discussed in the introduction section, the value derived in Table 4 for timber resources does not take into account the value of the other ecosystem services that they provide. In fact, the value that society attributes to these trees is likely to be much higher; however, that is beyond the scope of this paper.

Sensitivity analysis

Table 5 shows how the valuation estimates change with a change in discount rate. By holding everything else constant and using a constant 4% social discount rate, the value of timber resources decreases by £372 million. A decrease of 0.5% in the social discount rate to 3% increases the value of timber resources by £163 million; whereas, a decrease of 1.5% in the social discount rate increases the value of timber resources by £877 million.

Table 5: Value of UK timber resources as at 1 April 2011

Discount rate Percentage	Timber Value £ million
4	6,310
3	6,845
2	7,559

Similar analysis is carried out in Table 6 for a change in harvesting age. A change in harvesting age class from 41-60 to 61–80 decreased the value of timber resources by £2 billion and by changing the age class to 21–40 decreased the value of the timber resources by £0.9 billion. This supports the assumption that the optimal harvesting age is between 41–60 years.

Table 6: Value of UK timber resources as at 1 April 2011

Harvesting age class	Volume per hectare m^3/hectare	Value of timber resources £ million
81-100	405	4,093
61-80	321	4,825
41-60	**304**	**6,682**
21-40	201	5,751

Monetary asset account for UK timber resources

This section presents the first experimental monetary asset account for UK timber resources for 2011-12. The opening balance is the monetary value of UK timber resources at 1 April 2011 estimated by the NPV method in the earlier section. The monetary asset account is shown in Table 7 and the methodology to construct this table is given in Appendix A.

A brief description of the price in situ is discussed below as this relates to the valuation of flows within the account structure.

Methodology

The physical data used for the calculations is given in Appendix A.

Prices used to flow values

SEEA suggested that the valuation of flows of timber resources (including removals, natural growth and new planting) should be undertaken using the price in situ. Therefore, an average discounted price of timber resources, also known as the price in situ, is calculated. This is derived by dividing the discounted total value of timber resources (Table 4) by the total current volume of timber resources at 1 April 2011 (Appendix A).

Price in situ = £6,682 million/585.31 million cubic metres overbark = **£11.42** per cubic metre overbark.

The price in situ, at £11.42, is applied to each of the categories in the additions to and reductions in stock.

Table 7: Monetary asset accounts for UK timber resources 2011-12

2011-2012	£ million
Opening Balance as at 1 April 2011	**6,682**
Additions to stock	
Natural growth	254
New planting and restocking	82
Total additions to stock	*336*
Reductions in stock	
Removals	132
Fellings residues	15
Natural losses	1
Reclassifications	
Total reduction in stocks	*148*
Revaluation	-
Closing balance as at 31 March 2012	**6,870**

The figures in the above table may not sum due to rounding.

Comparison with other international studies

The World Bank (2011) and the Inclusive Wealth Report (2012) have published estimates for UK timber resources in their respective publications. Table 8 provides a comparison of these estimates with the estimates derived in this paper:

Table 8: Estimates for the value of UK timber resources

	Inclusive Wealth Report (UNEP)	Changing Wealth of Nation (World Bank)	Monetary Valuation of UK Timber Resources (ONS)
Estimates[1] 2011 real prices	£16.8 billion (2008)[2]	£6.8 billion (2005)[3]	£6.9 billion (2012)
Valuation Technique	Price * total volume of timber	NPV	NPV
Unit Resource Price	Shadow price: derived from the market price	market price * rental rate	Stumpage price
Discount Rate	-	4 %	Declining social discount rate
Asset Life (year)	-	25 years	Various

Notes:
1. The numbers in the brackets refer to the year for which the estimates were published.
2. For comparison purposes, using US GDP deflator, $21.1 billion is converted into 2011 prices to get $26.9 billion, which was then converted into GBP. A 2011 conversion rate of £1:$1.6 is used to convert USD to GBP.
3. For comparison, $9.6 billion was converted into 2011 prices to get $10.9 billion and then a 2011 conversion rate of £1:$1.6 is used to convert USD to GBP.

The methodology used in this paper to value UK timber resources estimates the resources at £6.9 billion in 2012 (closing balance), which is close to the value estimated by the World Bank (2011)[8] for UK timber resources for 2005. This is mainly due to the World Bank's methodology being similar to the methodology used in this paper. On the other hand, the value of UK timber resources estimated by the Inclusive Wealth Report is relatively high.[9] This could be due to the shadow prices that were applied to value the timber resources. Furthermore, the value of the stock was not discounted. From the comparison, it could be argued that the monetary value estimated in this paper is not overstated.

Frequency of accounts

The monetary asset accounts presented in this paper are experimental statistics. The ultimate aim of developing these accounts is to incorporate them into the UK Environmental Accounts. The monetary valuation of UK timber resources will also feed into the total natural capital estimates that ONS are developing. In the UK, the volume of timber resources does not change significantly from year to year, but the monetary valuation could change substantially due to a change in the unit resource rent. The monetary valuation of the timber resources is based on a number of assumptions

[8] The Changing Wealth of Nations
[9] The Inclusive Wealth Report, published in June 2012, is a joint collaboration between the United Nation University International Human Dimensions Programme and the United Nations Environment Programme

and estimations, and a change in any of these variables could have a significant impact on the overall value of the timber resources. However, the underlying physical data is only available every five years. Therefore, it is recommended that the monetary asset account of timber resources should be published every five years alongside the non-monetary asset account for timber resources.

Future work

This is a first attempt to estimate the monetary value of UK timber resources. These estimates are experimental statistics and are based on a number of assumptions due to limited information and data on factors such as harvesting age and broadleaves prices. In addition, due to the different characteristics of conifers and broadleaves, it may be possible to portray these separately within the model. This would require separate harvesting ages (from different average maximum mean annual increments) and different average stumpage prices. Constructing an estimate of stumpage price, or another form of price, for conifers and broadleaves may enable the account to reflect their differing values. ONS will work with the Forestry Commission and other experts to determine priorities and explore how best to address these data gaps. Since it has been recommended that the timber monetary account should be updated every five years, the focus during the next five years should be on filling the data gaps to derive more reliable estimates.

Appendices:

Appendix A

Opening stock

The opening balance is the monetary value of UK timber resources at 1 April 2011 estimated by the NPV method in an earlier section.

Additions to stock

The value of additions to stock consists of natural growth from existing timber stock and the new planting and restocking.

- The physical data on natural growth (Appendix A) is multiplied by the price in situ to get the value of natural growth
- Value of natural growth = 22.22 million cubic metres* £11.42 = **£254 million**

The volume of new planting and restocking is not recorded in the physical account as the volume is too small to capture. However, the value of new planting and restocking is considered in the monetary account.

Estimated future volume of new planting and restocking at harvesting age = 23,700 hectares * 304 m^3/hectare (see table 1) = 7.2 million cubic metres.

- Value of new planting and restocking = 7.2 million cubic metres * £11.42 = £**82 million**

Reductions in stock

The reductions in stock consist of removals, felling residues, natural losses and catastrophic losses.

Removals are calculated as the price in situ multiplied by the physical extraction that has taken place between 2011 and 2012 (Appendix A). The extraction data are from the Forestry Commission's Forestry Statistics 2012 publication.

- Value of extraction = = 11.54 million cubic metres overbark * £11.42 = **£132 million**

Felling residues are calculated as the physical felling residues (Appendix A) multiplied by the price in situ.

- Value of felling residues = = 1.28 million cubic metres overbark * £11.42 **= £15 million**

Natural losses are calculated as price in situ multiplied by the physical natural losses (Appendix A).

- Value of natural losses = = 0.12 million cubic metres overbark * £11.42= **£1 million**

Catastrophic losses are not currently calculated as there is no physical data on catastrophic losses for this account.

Revaluation

This category is not considered in this account as only the opening stock is directly calculated and the closing stock is a residual. Hence, only one price is applied to the account.

Closing stock

The closing stock is the residual of opening stock, additions to stock and reductions in stock.

Appendix B

Physical asset account for UK timber resources

2011-2012	million cubic metre overbark
Opening stock of timber resources as at 1 April 2011	**585.31**
Additions to stock	
Natural growth	22.22
Reclassification	
Total additions to stock	**22.22**
Reductions in stock	
Removal	11.54
Fellings residues	1.28
Natural losses	0.12
Catastrophic losses	-
Reclassifications	-
Total reduction in stocks	**12.94**
Closing stock of timber resources as at 31 March 2012	**594.59**

Sources: *Forestry Statistics 2012;*
National Forest Inventory Report:
- *Standing volume of broadleaves in woodland in Great Britain*
- *Standing timber volume for coniferous trees in Britain*

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Glossary

Broadleaves: Trees that do not have needles or cones, such as oak, birch and beech. A few, such as alder, have cone-like structures for their seeds which are not true cones.

Conifers: Trees with needles and cones, such as spruce, pine and larch.

Mean annual increment: Mean annual increment is the average rate of volume production up to a given year, expressed in cubic metres per hectare per year. In even aged stands it is calculated by dividing cumulative volume production by age.

Net Present Value (NPV): A valuation technique that values the future income streams and then discounts these back into today's money as a value of the asset or resource.

Opportunity cost: This is an economic concept, and includes the foregone benefits of the next best alternative that could have been used with the money (or land) invested. In the case of timber, this is likely to be important regarding rotation periods. A longer rotation may produce slightly more timber at a benefit, but it also delays the planting of a new rotation, at a cost.

Overdue timber: The trees which are currently older than the age of harvesting.

Price in situ: This is calculated as the total discounted value divided by the actual volume, which gives a price per volume. This is an average price across age classes and is also discounted (by the average amount of discounting) as it is based on the discounted value. This price in situ can also be called an average discounted price. It is used in the SEEA to value the account flows. The price in situ is therefore theoretically the price that would be paid for the asset in the ground (before any human intervention).

Resource rent: This is thought of as the surplus produced by the resource itself after all costs and normal returns have been taken out.

Standing sales: This is the term used in the UK for timber sales sold as standing timber. This is the value of the timber itself before any harvesting costs and is synonymous with the more international term, stumpage price.