

Calculating the carbon sequestration value of trees

IMS was asked to provide guidance on estimating the carbon sequestration impact of planting trees as part of a relatively small construction project.

This report provides a brief overview of the topic and a simple calculation for estimating the carbon sequestration value of trees.

Assumptions and caveats:

Calculating the carbon sequestration value of trees relies on assumptions and models which have an inherent degree of uncertainty.

The value depends on a large number of factors including: tree species, age, whether the trees are thinned or not, and on external factors that can affect the growth and life of the tree. Assumptions have been made based on a 'typical' tree planting scenario.

In addition, simplifying the calculations has involved making further assumptions which inevitably increase the level of uncertainty.

IMS therefore recommends the calculation method suggested in this document is used as guidance only, and not for reporting in official documents.

Summary of method:

Using the [guidance](#) provided by the UK Forestry Commission IMS has made a series of assumptions and built a 'standard' scenario for a tree planting initiative on a construction project. IMS has then calculated the carbon sequestration value of that scenario and estimated that the carbon sequestration value of one tree (sycamore, ash, birch) over a period of 50 years is approximately **0.1574 tCO₂e**.

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Overview

There are numerous methods available to estimate the carbon sequestration value of trees. Most involve complex calculations as the value is related to a high number of variables including tree species, age, whether clear-felling or thinning are performed etc.

In addition, very few methodologies or examples are available for small scale initiatives that involve planting a small number of trees to enhance a project or add amenity value. Most methods are based on re-forestation scenarios and tend to provide estimates based on the size of forested area rather than 'by tree'. Therefore, IMS has developed a simple methodology for Morgan Sindall Group Affordable Housing division to apply to get a rough estimate of the carbon sequestration value of small scale tree planting initiatives.

Examples of estimates of a single tree carbon sequestration include a research by the University of Edinburgh which shows that an oak tree living for 100 years will take up 1.5 tonnes of CO₂. Other quoted work estimates that five "Kyoto compliant" trees will absorb one tonne of CO₂ over 30 years.

An important, and relatively recent, contribution to the methods available is the UK Forestry Commission's 'Carbon Lookup Tables' and related guidance document. The tables provide a pre-calculated estimate of the carbon uptake of trees over a period of time, considering the tree species, initial spacing (which depends on the species) and other factors such as thinning.

The 'Carbon Lookup Tables' are geared towards forestry projects and consider medium-large scale tree planting and take into consideration factors such as the carbon emissions generated by forest management activities. However, with care and the appropriate assumptions they can be used as a starting point to develop a simplified calculation to estimate the carbon sequestration value of smaller projects.

Methodology

The Carbon Lookup Tables can be used as follows:

Step 1: Determine the input information:

This mainly refers to determining the tree species and whether clear-felling and/or thinning are applicable.

Step 2: Determine the relevant time period

This refers to the period of time carbon sequestration will be 'claimed' by the company (an appropriate way for construction projects to estimate this is based on the building expected life-cycle).

Step 3: Consider other carbon emissions sources and for existing carbon stock

Consider whether any other carbon emissions sources should be accounted for in the calculations. For example, in a forestry project, both emissions from on-going forest

management activities and establishment activities should be accounted for within the carbon sequestration calculations. This may not be applicable if, for example, it is assumed management activities subsequent to the planting will be negligible.

Another aspect that should be taken into account is the carbon stock before the start of the project, unless this is included in other carbon calculations performed for the project.

Step 4: Allowing for uncertainty (applying 'buffers')

As explained in the Forestry Commission's [guidance document](#), a buffer of 20% should be applied in all calculations to account for the precision of the model's predictions.

Further uncertainty should be accounted for because of external factors affecting the permanence of the trees such as fire risk, pests and diseases, etc. This means an additional buffer of between 15% and 30% should be considered (see guidance document for more details).

Tree planting scenario

By applying this methodology to a set of assumptions we consider to be typical of a tree planting project in construction we can calculate an approximated carbon sequestration value for the typical tree planted on a project.

The scenario assumes the following:

- Tree species: sycamore, ash, birch (mix or pure species)
- Planted on 1 ha, with spacing 1.5m
- Yield class: 12 (according to tables)
- No plans to thin or clear-fell at any time
- Claiming carbon from year 0 to year 50
- Assuming a permanence buffer of 15% (lowest)

Soil carbon and carbon stock before planting of the trees are not included in this simplified calculation.

It has also been assumed that emissions from management activities will be null or negligible.

Example calculation

A Cumulative carbon sequestration from lookup table (tCO2e/ha)	B = 80% of A Cumulative Carbon Sequestrn Less 20% model precision (tCO2e/ha)	C Risk buffer for permanence (15%) (tCO2e/ha)	D= C-B Net carbon sequestration (tCO2e/ha)	Trees planted in a ha with assumed spacing	Approximate cumulative carbon sequestrn <u>per tree</u> over 50 years (tCO2e)
1028.8	823.04	123.456	699.584	4444 ¹	0.1574

The result of this calculation can be used to estimate the carbon sequestration value of a tree over a period of 50 years. As explained above, this simplified calculation assumes no emissions from management activities, doesn't include any emissions from the set of the project, and doesn't take into account soil carbon, which depends on the site location and previous land use.

It is important to remember this figure is based on a set of assumptions on what a tree-planting initiative as part of construction would involve, and should therefore be used as guidance only. For more specific calculations, we recommend using the resources below.

Resources

All the calculations in this documents are based on the UK Forestry Commission's '[Carbon Lookup Tables](#)' and [related guidance](#). The Forestry commission made available a number of other resources for a more accurate calculation, including the Soil Carbon Lookup table and Soil Carbon and the Woodland Carbon Code.

For more accurate estimates based on actual conditions (actual tree species, spacing, soil etc.) the guidance documents and lookup tables are available at: <http://www.forestry.gov.uk/forestry/inf-d-8jue9t>.

¹ The figure we have used was calculated by the FAO (Food and Agriculture Organization of the United Nations) and can be found [here](#).