ACCOUNTING FOR FOREST CARBON

ECCM Technical Document 11

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Carbon Accounting

INTRODUCTION

Whether dealing with national carbon balances or individual project activities, it is necessary to select an appropriate methodology to account for carbon sequestration through forestry and land use. This document reviews carbon accounting methodologies and their application under the following systems:

- **National accounting**: national scale forestry and land-use activities under articles 3.3 and 3.4 of the Kyoto Protocol
- **Kyoto Flexible Mechanisms**: Joint Implementation (JI) and Clean Development Mechanism (CDM) offset projects (Articles 6 and 12 respectively) of the Kyoto Protocol
- **Voluntary Offset Projects**: voluntary actions not regulated by the Kyoto Protocol

CARBON ACCOUNTING METHODS

There are three main ways to account for the carbon sequestration impact of a forestry activity:

- carbon sequestration (measure in tC)
- average carbon storage – the area under the carbon storage curve divided by a specified time period (measured in tC)
- cumulative carbon storage – the area under the carbon storage curve, expressed in tonne carbon years (tC.years)

Carbon sequestration

The ECCM model (ECCMv3.1) predicts carbon sequestration by a forest by extrapolating empirical data (Forestry Commission, 1980), as illustrated in Figure 1. The annual flux (or uptake) of carbon (the dashed line in Figure 1, measured on the right hand axis) rises rapidly during the early growing phase of the stand, up to a peak of around 3.5 tC/year in this example. It then declines as the trees mature and competition for light and nutrients increases. This is the measure that is used to credit projects under the Kyoto Protocol by taking the total change in carbon stock over a specified crediting period. The total long-term change in carbon stocks over the project lifetime, in this case 100 years, is shown by the vertical double-head arrow on the right hand side of Figure 1.

Average carbon storage

Under some carbon forestry projects, particularly in the US, the total long-term change is claimed. Other projects claim the average long-term change over the project lifetime, particularly where harvesting causes fluctuations in storage. The area under the carbon storage curve is divided by the time period specified for carbon crediting. Particularly when claiming credit at the beginning of a project, this method provides a more realistic picture of the long-term benefits of a forestry project than simply claiming credit for what will be stored after 25, 50 or 100 years.

Cumulative Carbon Storage

There are a number of issues with crediting total long-term carbon sequestration, particularly if credit is claimed at the beginning of a project. Carbon emissions from fossil fuel burning remain in the atmosphere for decades, contributing to global warming. Given the long-term nature of carbon uptake, potential or predicted uptake by trees over 25, 50 or 100 years if difficult to justify in relation to emissions released at the start of the project. The global warming effect of a GHG emission emitted to the atmosphere ought to be set against the long-term net cooling effect of carbon sequestration through forest growth.

A method for reconciling emission and sequestration processes, proposed by Tipper and de Jong (1998; 2000) compares the total atmospheric warming effect of a given quantity of CO_2 emissions with the net cooling effect provided by a forestry scheme within a 100 year timeframe. The offset potential of a project is described by the area under the carbon accumulation curve (in units of tonne carbon years) as shown in Figure 1. A conversion factor, derived from the dynamics of the carbon cycle, permits the conversion of tonne carbon years (accumulated over 100 years) into carbon offsets. This method reconciles the effects of carbon emissions at the start of project with the effects of carbon sequestration over the project lifetime. This method is analagous to the long-term average storage over 100 years and has in fact been superseded in many technical documents by average storage.

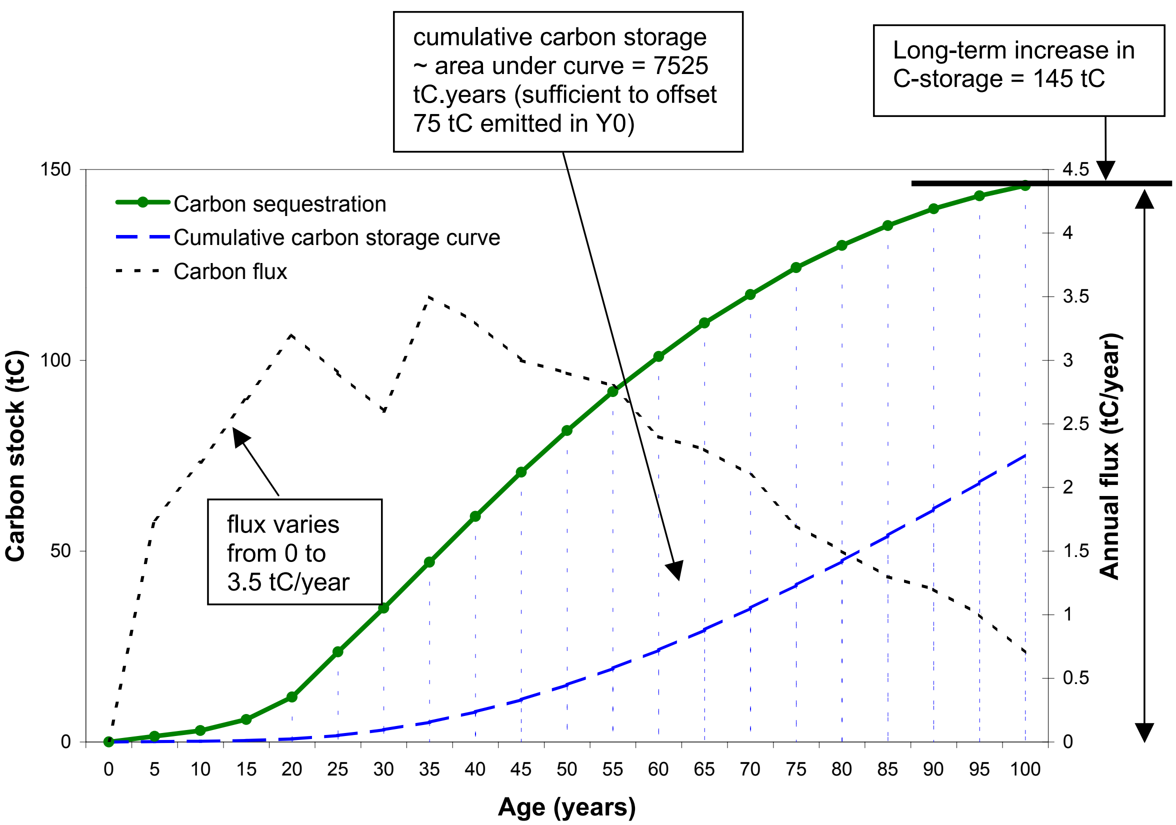

Figure 1: Expected uptake and storage of carbon in the biomass of a 1 ha stand of Oak (Yield Class 4) over 100 years established on grassland
(source data from Forestry Commission 1980; Cannell and Dewar, 1995)

CARBON ACCOUNTING AND CREDITING

National Carbon Accounting

Under Article 3.3 of the Kyoto Protocol carbon sequestration and emissions through afforestation, reforestation and deforestation since 1990 are accounted for in national carbon inventories. Afforestation, reforestation and deforestation will be accounted by changes in carbon stocks (ie, the total flux) during 2008-2012 and will contribute to the national emissions targets.

Under Article 3.4, additional land use activities may also be included in national accounting. These are:

- Forest management;
- Cropland management;
- Grazing land management; and
- Re-vegetation.

For the first commitment period, 2008-2012, a country may also choose to account for carbon sequestration by forest management, up to specified limit. Accounting for other activities is based on changes in carbon stocks during the 5 year commitment period, 2008-2012, less changes in carbon stocks in 1990 times 5 (known as “net-net” accounting).

Carbon Accounting for JI and CDM Projects

Detailed definitions and rules for JI and CDM projects are currently being drawn up by the UNFCCC. Attention has focussed on CDM projects as there are particular concerns about allowing developed countries to meeting their emissions targets by using forestry and land use projects in developing countries. These issues include non-permanence, additionality and leakage as well as socio-economic and environmental concerns. Options are being considered to address these issues (UNFCCC 2003a; UNFCCC 2003b). CDM accounting will use the change in carbon stocks approach and give credit for either:

- <u>Total stock approach</u>: carbon credits are issued either for the total change in carbon stocks over the crediting period once carbon sequestration has been verified (see Figure 2).
- <u>Average stock approach</u>: carbon credits are issued either for the average change in carbon stocks over the crediting period once carbon sequestration has been verified (see Figure 3).
- <u>Delayed approach</u>: once the carbon sequestration has been verified the carbon must remain in the biomass for a further period before credits are issued (see Figure 4).

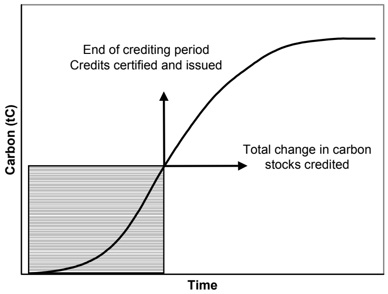

Figure 2: Total stock approach
Derived from UNFCCC 2003a

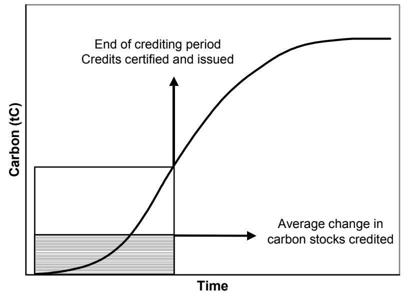

Figure 3: Average stock approach

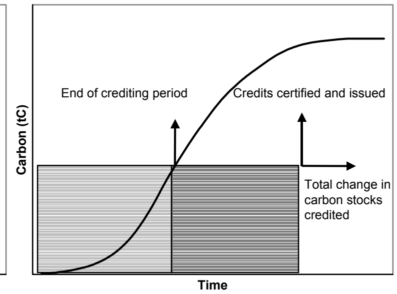

Figure 4: Delayed approach

The most appropriate crediting period for forestry and land use projects is part of this debate. The crediting period for non-forestry CDM projects is either 7 years with the option of renewal twice (ie, a maximum of 21 years) or 10 years with no option of renewal. This allows projects to select the crediting period most appropriate to their activity, expected project lifetime and estimated baseline, e.g. the baseline could predict that in 10 years an activity would have occurred in the absence of the project, such as conversion to biomass energy if fossil fuels were to increase; emissions reductions created by early implementation during that 10 year period can be claimed.

In the case of forestry and land use projects, the benefits in terms of sustainability and biodiversity of longer timescales are recognised. The potential for crediting periods of 5 years which are renewable up to 10 times (ie, a maximum of 50 years) are being considered, although much more limited periods may be selected. Decisions on the extent to which renewals will be allowed will await the definition of modalities for the second commitment period.

The discussion above applies to CDM modalities. Rules for JI projects have not yet been defined, but are likely to follow a similar path. The Netherlands government has already implemented a pilot CDM/JI purchase scheme, carboncredits.nl and the Finnish government is also piloting a CDM/JI purchase scheme.

Voluntary carbon accounting

A voluntary carbon market has developed in the run-up to ratification of the Kyoto Protocol. Projects in this period have been viewed as a “learning-by-doing” exercise with varying carbon accounting methodologies being used. In general, under voluntary schemes the purchaser determines the accounting methodology and crediting period. For example a purchaser may be prepared to make a phased payment for carbon accumulated over 100 years. Another purchaser may be prepared to make an up front payment for carbon sequestered over 25 years with a guaranteed project lifetime of 50 years. Project initiators need to address the requirements of the market.

Under voluntary schemes, some payment is generally made up front as projects usually require an initial injection of funds to get them underway. The purchaser may also define the project lifetime and accounting methodology.

	Forestry and Land Use Activities Included	Accounting Method	Accounting / Crediting period	Credits issued	Project Lifetime
National Accounting	• Afforestation, reforestation and deforestation • Forest management • Cropland management • Grazing land management • Re-vegetation	Change in carbon stocks relative to 1990 baseline Change in carbon stocks relative to 1990 baseline with country-specific limits Net-net accounting of change in carbon stocks	First commitment period, 2008-2012 First commitment period, 2008-2012 First commitment period, 2008-2012		N/A
Flexible mechanisms • JI	• Afforestation, reforestation • Forest management	Change in carbon stocks over crediting period (or average change)	TBC (potentially 5 year blocks with option for renewal or limited to 2008-2012)	TBC. Either at end of crediting period or delayed for set period after end of crediting period (partial advance payment under some national schemes)	TBC
• CDM	• Afforestation, and reforestation	Change in carbon stocks over crediting period ((or average change)	TBC (potentially 5 year blocks with option for renewal or limited to 2008-2012)	TBC. Either at end of crediting period or delayed for set period after end of crediting period (partial advance payment under some national schemes)	TBC
Voluntary Accounting	Varied: Mainly afforestation, reforestation and prevention of deforestation	Varied: • total change in carbon stocks • average change in carbon stocks • cumulative carbon storage	Varied: Generally between 25 and 100 years	Varied: • Payment at project initiation • Phased payment	Varied: Generally between 25 and 100 years

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