Growing stock, biomass and carbon

Background paper to the Kotka V Expert Consultation

1 Introduction

Growing stock has been part of the Global Forest Resources Assessment since the first assessment published 1948. Reporting on forest biomass was introduced in FRA 1990 and maintained in FRA 2000. For FRA 2005, it was decided to expand biomass reporting to also cover carbon stocks, and to use the same set of variables and definitions as established by the IPCC good practice guidance for land use, land-use change and forestry (IPCC-GPG) from 2003.

Growing stock estimates are relevant for wood supply analysis, and by looking at trends, changes in growing stock per hectare indicate whether the forests are becoming less or better stocked, of which the first could be an indicator of forest degradation. Growing stock data also constitute for most countries the basis for further estimating biomass and carbon stocks.

Biomass estimates are first and foremost relevant as a basis for estimating carbon stocks, but they are also relevant as a basis for estimating the potential of the forests as raw material source for energy production, as the energy content of biomass is directly correlated to its dry weight.

Carbon estimates, and particularly the estimates of changes in different carbon pools, are highly relevant for the international conventions and processes related to climate change, such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

The Kyoto Protocol and the UNFCCC oblige all member countries to assess and report national greenhouse gas emissions, including emissions and removals of carbon reflected as stock changes in forests. To that end, IPCC has created guidelines, methods and default values for all parameters needed in assessing carbon stocks and their changes in forests (IPCC, 2003). Thereby, it has furnished all countries with the means for estimating and reporting emissions and greenhouse gas removals, irrespective of the availability of country-specific data. Striving for synergies and streamlined reporting by countries to international organizations, FRA 2005 incorporated relevant parts of the IPCC guidelines into its own guidelines for country reporting.

2 Analysis of variables related to the productive functions

2.1 Variables included in FRA 2005

The following variables on growing stock, biomass and carbon were included in FRA 2005:

- Growing stock

- Above-ground biomass
- Below-ground biomass
- Dead wood

- Carbon in above-ground biomass
- Carbon in below-ground biomass
- Carbon in dead wood
- Carbon in litter
- Carbon in soil

Growing stock also form part of the background paper related to the productive functions of forest. Some key issues related to growing stock estimates are replicated here, as they are of relevance for the discussions related to biomass and carbon estimates.

2.2 Data availability

Including four countries for which country-specific FAO estimates were made for missing reference years, 146 countries reported a complete time series for above-ground biomass, below-ground biomass as well as carbon stocks in these two fractions. For dead wood, 107 countries reported data, and for carbon in litter and soil only a small number of countries reported (54 and 43 respectively).

While biomass and carbon in biomass were well reported upon, data on carbon of the other fractions are weak.

Category	number of countries	% of total forest area
Biomass / carbon in biomass	146	92.8
Dead wood / carbon in dead wood	107	80.3
Carbon in litter	54	59.6
Carbon in soil	43	49.9

All countries reporting on biomass and carbon except one (Australia), also reported on growing stock. A few countries that reported on growing stock did not report on biomass and carbon.

2.3 Definitions and conversion factors

As mentioned above, the definitions of categories for reporting on biomass and carbon used in FRA 2005 follow exactly the definitions established in the IPCC-GPG. Furthermore, the default conversion factors (basic density, biomass expansion factors, root-shoot ratios, dead-live rations, carbon fraction, litter and soil carbon content) were taken directly from the IPCC-GPG document.

The following table shows what methods/conversion factors the reporting countries have used for estimating biomass and carbon:

151	countries reported on biomass and carbon for at least one of the reporting years, out of which:
87	countries used IPCC-GPG factors exclusively;
41	countries used IPCC-GPG factors in combination with factors from other sources;
13	countries used national data – either direct estimates or national conversion factors;
5	countries used factors/models from FAO and FAO/UNECE publications;
5	countries based their reported values on expert estimates only.

The table shows clearly that the countries rely heavily on the use of conversion factors and models for their estimates of biomass and carbon. Only 13 countries out of 151 have national data on biomass and carbon stocks.

2.4 The new IPCC guidelines for greenhouse gas reporting

IPCC has recently published a draft set of new guidelines for greenhouse gas reporting. The new guidelines show a clear intention to harmonize terminology with FAO. Among other, and despite the definition of Forest in the Marrakesh Accords, they new guidelines suggest to use the *"most recent ... forest cover classifications, developed by the Food and Agriculture Organization"*. The also include for reference the definitions of forest and other wooded land used for FRA 2005. Furthermore, the new guidelines state that "*the terminology used in the methods for estimating biomass stocks and changes need to be consistent with the terminologies and definitions used by the Food and Agriculture Organization (FAO). FAO is the main source of activity data and emissions factors for forest and other land-use categories in Tier 1*[1] *level calculations*."

In addition, the new IPCC guidelines contain more elaborated tables with conversion factors, taking into account new studies. Among other, could be mentioned that the biomass expansion factors (BEF) now can be used for directly converting growing stock to above-ground biomass, without first converting growing stock to stem biomass by applying a wood density.

[1] Tier 1 is the lowest level of reporting, when only limited information on greenhouse gas emissions and removals is available. Here two methods are described, the *Gain-Loss Method* and the *Stock-Difference Method*, the latter can use FRA data on carbon stocks.

3 Some issues related to growing stock, biomass and carbon reporting

Below are discussed some of the issues related to biomass and carbon reporting that need to be discussed at the Kotka V Expert Consultation and for which guidance is needed in order to improve the reporting for FRA 2010.

One important issue is related to the need for harmonizing / reconciling information reported to FRA with information reported to UNFCCC and the Kyoto Protocol, avoiding as much as possible overlap in country reporting, reducing the reporting burden and ensuring that reported figures are consistent between the two processes.

Reporting under the UNFCCC, the Kyoto Protocol and to FAO is overlapping, but not necessarily identical. For FRA 2005, countries reported *carbon_stocks* for the years 1990, 2000 and 2005. UNFCCC mandates reporting *carbon stock changes*. One of the methods in the IPCC guidelines estimates net emissions as the difference between periodic carbon stocks.

In a further difference, UNFCCC members report on "managed forests" only. The Convention defines neither "forest" nor "managed forest". However, IPCC considers as managed forests "*all forests under direct human influence*", or "*forests subject to the process of planning and implementing practices for stewardship and use aimed at fulfilling relevant ecological, economic and social functions*" (IPCC, 2003). Given this broad definition, all of many a country's forests may well be "managed forests".

Several countries have suggested that FRA should drop the reporting on biomass and carbon, making the reporting to UNFCCC and the Kyoto Protocol as the main source of global information on biomass and carbon stocks and trends.

Conversely, there are also suggestions that FRA should be the main process responsible for gathering country information on biomass and carbon stock and carbon stock changes, and that UNFCCC and the Kyoto Protocol could use the FRA information instead of duplicating them in their reporting requests, or at least in their methodology suggest to countries to use the most recent FRA data in the case of Tier 1 level estimates.

A few countries deliberately did NOT report any biomass and carbon data to FRA 2005, as they did not want to release any data on biomass and carbon that could possibly interfere with the ongoing reporting to UNFCCC, the latter of considerable political importance for some countries.

In this discussion there are also factors related to the reporting years and reporting periodicity that need to be dealt with. Furthermore, the possibilities for each of these processes to obtain as good information as possible on biomass and carbon must be evaluated.

It is expected that the Kotka V Expert Consultation will give further guidance on how to harmonize the reporting to FRA with the reporting requirements to UNFCCC and the Kyoto Protocol.

Regarding the content of the reporting, FRA 2005 requested countries to report on biomass and carbon stocks for both forest and other wooded land. The information on carbon stocks of other wooded land is very weak (only about 50 countries and territories reported on carbon in biomass from other wooded land). One reason is of course that growing stock data for other wooded land is weak and in many cases not available at all.

Considering that the main use of the carbon estimates are for the international processes and conventions related to climate change**, it is important to analyze and evaluate whether carbon reporting for other wooded land is needed at all, and if so – how do we proceed to get better data for other wooded land**.

Stock change estimates from FRA represent a combination of stock changes due to land use change and stock changes in forest that remains as forest. The latter component, however, suffer from weak data as most countries – particularly developing countries – do not have information on growing stock per hectare for more than one point in time, and consequently the changes in carbon stock mostly reflect the changes in forest area.

As shown above, countries rely heavily on the use of conversion factors and models for their biomass and carbon estimates. This also implies that the quality of growing stock estimates and good conversion factors and models are key factors for improving the estimates of biomass and carbon stocks. **Regarding growing stock, one important proposal would be to report growing stock down to a minimum diameter of zero cm**., thereby constituting a better basis for the biomass and carbon stock estimates. That will, however, require the development of a methodology to convert growing stock data based on inventories with different minimum diameters to a total growing stock comprising all trees that have reached breast height.

The IPCC guidelines, as well as the FRA 2005 guidelines, allow countries to report on soil carbon stocks down to a soil depth defined by the country. When compiling global estimates, FRA 2005 adjusted all country figures to a standard depth of 30 cm. This raises two questions:

- Would it be better to let the countries do this adjustment themselves, or is it something that is better done centrally by the FRA secretariat?
- What standard soil depth should be used in presenting the final global estimates? 30 cm? 100 cm?