

## **How much biomass travels on board the planet Earth?**

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How much biomass is there on Earth? Unlike many questions we face, this question has one right answer, and it is up to scientists to try to get as close to this answer as possible and to communicate how close we are. Is it important to know this quantity? From the standpoint of the carbon budget, it is very important, but from a biodiversity standpoint, total biomass is not much of an indicator at all, as it is the quality, not quantity of biomass that matters.

In October 2001, the FAO published the comprehensive study Global Forest Resources Assessment 2000, the so-called FRA (FAO Forestry Paper 140). In the year 2000, the FAO/ECE had already published the report Forest Resources of Europe, CIS, North America, Australia, Japan, and New Zealand (Geneva Timber and Forest Study Papers, No. 17, the UN, New York and Geneva). The bottom line in the results of those reports is that the total biomass of the forests of the world is 422 billion tons. This is the estimate for dry, above-ground, standing woody vegetation, both dead and alive.

Assuming that one fifth of tree biomass is below-ground, and thus adding 105.5 billion tons to account for the roots, an estimate of 527.5 billion tons can be obtained including the biomass both above and below ground. This implies 263.75 billion tons of carbon, assuming the standard estimate that half of dry biomass is carbon. This global number, 263.75 billion tons, cannot be very accurate. Especially the tropical forests are extremely complicated to measure, and the quality of measurement systems varies between countries. Assuming an uncertainty range of  $\pm 20\%$ , an estimate of 210 to 320 billion tons of carbon can be obtained (billion tons = Gt, = Pg =  $10^{15}$  g).

This estimate is lower than previous estimates. The IPCC reports suggests that it is 331 GtC (SAR; 1995, p. 777), or 359 Gt C (SRLUCR, 2000 p. 31; or TAR WG 1, 2001 p. 192; or WG 3, 2001 p. 305). If the new FRA data are correct, the carbon pool of global forest vegetation has been over-estimated in IPCC by 11 to 149 Gt. An even larger over-estimation has been published in Houghton (1996) which reports a global estimate of 510 GtC for the carbon pool in forest vegetation. This is almost twice as high as the respective estimate based on FRA data. The reason for the large discrepancy is that previous estimates were based on subjective measurements and extrapolations whereas the new estimate is based on actual inventory data. Of the total, it is estimated that there is perhaps 50 GtC in trees outside of forests and 300 in forests.

[Insert Slide 4 - the different estimates of biomass]

It is very important to evaluate and carefully assess the FRA results. The FAO study is based on direct field observations and is a collaborative effort of 238 contributors representing 72 nationalities. No other data published earlier were based on such

extensive and comprehensive fieldwork. Any criticism of the methods should immediately be expressed and published. Unless the results can be rejected, the scientific community must revisit some conclusions that have been drawn based on overly high estimates for the carbon pool in forest vegetation.

First, the carbon emissions from deforestation since 1800 may have been lower than had been estimated earlier. If the average woody biomass per hectare is less than we thought, the world forests in 1800 contained less biomass than we have believed, and were unable to lose as much carbon into the atmosphere as we have thought. Secondly, for the same reason, the current emissions of carbon from deforestation can be lower than estimated in IPCC and other reports. Finally, the estimate of 100 Gt as the potential for carbon mitigation in land use and forestry, as published in IPCC SAR and TAR, may be overly optimistic. This value, 100 Gt, is quite high compared to the new estimate for forest vegetation, 210-320 GtC. How can we ever achieve 100 GtC in sequestration and substitution if the current pool in forest vegetation is no larger than 210-320 GtC? In addition, if carbon emissions from forests are lower than previously believed, more emissions must have come from fossil fuel burning than was thought. This has obvious implications for mitigation strategies.