The Wedge from Reduced Deforestation,
Plus Reforestation, Afforestation, and New Plantations

Comments

When evaluating methods of biological carbon sequestration, it is important to remember that ecological carbon reservoirs are dynamic. Each carbon atom taken from the atmosphere by the growth of a newly planted forest will eventually return to the atmosphere when the tissue that contains it dies and decomposes. Thus, biological sequestration occurs only if the size of an ecological carbon pool is permanently increased by a net transfer of carbon from the atmosphere to an ecosystem. For example, suppose that a region of cropland is converted into a mosaic of periodically harvested plantation forests, with an even age distribution of forest stands ranging from those newly harvested to those just before harvest. This conversion will remove carbon from the atmosphere because the total mass of carbon (living and undecomposed organic matter) in a mosaic of plantation forests is larger than the mass of carbon in cropland. The difference in carbon mass (plantation mosaic minus cropland) represents a one-time net transfer of carbon from the atmosphere to the land, even though each patch of forest in the plantation mosaic is periodically harvested.

The dynamic nature of ecological carbon pools also implies that options of biological sequestration cannot be relied upon indefinitely, simply because the sizes of ecological carbon pools cannot be increased forever.

Reduced Tropical Deforestation

The 1.5 billion hectares of tropical forests contain 7-10 wedges worth of carbon in living trees and another 5-9 wedges in soils (S10, S58-S61). When primary forest (forest that has never been logged) is converted to permanent cropland, all of the 120-165 tC/ha in living trees (S10, S59, S60) and up to one third of the 83-150 tC/ha in the top 1 meter of soil is emitted to the atmosphere (S10, S59, S60, S62, S63). Conversion to pasture emits the carbon in trees, but may actually increase soil carbon by up to 10% (S64).

Section 1 of the Supporting On-Line Material and (S10) review the current controversy about the size of the carbon source caused by tropical deforestation. Briefly, a recent satellite survey concludes that a net of ~ 6 million hectares of tropical forest were lost per year in the 1990's (S11 and see S12), whereas surveys based on FAO statistics (S65) conclude that loss rates were twice this high. This leads to a factor of two difference in emissions to the atmosphere: ~1 vs. ~2 GtC/y (S10).

We make the conservative assumption that deforestation emissions are ~1GtC/y and that they will decrease linearly by one half in fifty years (see Section 1, above). Thus, half a wedge could be achieved by cutting deforestation to zero in fifty years. On the other hand, if deforestation losses were 2 GtC/y, then elimination of deforestation by 2054, relative to elimination of half of deforestation by 2054, would create a full wedge. Previous studies that rely on relatively large estimates of deforestation losses (S62, S63) have also concluded that approximately one wedge could be filled by reduced tropical

deforestation by 2050.

Approximately 40% of current tropical deforestation is in Latin America, and approximately 30% each in Africa and Asia (S63). According to S66, the primary causes of deforestation differ among the continents, with pasture for cattle dominating in Latin America, fuel wood and cropland co-dominating in Africa, and cropland dominating in Asia. Thus, future decreases in deforestation would imply reduced future land area in food production.

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