Correspondence: The 2nd World Congress of Agroforestry 2009; “Agroforestry - The Future of Global Land Use”

- Expansion of plantations replacing natural forest has received criticism from the environmental community because of the CO₂ emissions generated.
- Secondary forest, shrubland and Imperata grassland are available for plantation expansion and using these lands poses less environmental damage.
- Time-averaged C-stocks of such plantations in comparison to the primary or secondary forests and shrub that they replaced were analyzed under upland and peatland conditions.
- Method and information on carbon budget associated to land use transitions to agriculture is important in designing the sector’s contribution in green house gas (GHG) emission reduction strategies.

Calculation of Carbon Budget

\[ E = E_a + E_b + E_d \]  

- \( E_a = C_b * 3.67 \)  
- \( E_b = B_p * C \)  
- \( E_d = C_o * 3.37 \)

For mineral upland soil the carbon balance is determined by the difference in plant C-stock between the initial and the subsequent land uses. In most cases conversion of primary and secondary forests with time average C-stocks of about 300 and 152 ha⁻¹, respectively, results in a net negative carbon balance (C debt).

If shrub or Imperata grassland, with respective C-stocks of 15 and 2.1 ha⁻¹ is converted to plantation, it generally results in an increase in the land C stock. Infrastructure, socio economic and tenure constraints for such carbon efficient conversion should be overcome by the responsible institutions.

On mineral soils, greenhouse gas emissions could be reduced either through avoided deforestation and/or establishment of high carbon stock plantation systems on low carbon stock ecosystems such as saline Imperata grassland or shrub land. For peatland, avoided deforestation is the most effective approach of terrestrial C conservation. Once the peat forest is converted, the CO₂ emission escalates and the management systems required by the subsequent land uses determines the emission ratio. The utilization of peat shrub rather than peat forest for plantation systems reduces emissions from plant biomass and peat burning, but can not always turn the land from carbon emitter to carbon sequester.

Estimated annual average CO₂ emission in plant and in mineral soil associated with land use changes into plantation.

Processes entailed in (peat) forest conversion

1. Plant biomass burning
2. Peat burning
3. Peat decomposition
4. C Sequestration

Maintaining shallow water table, e.g. through canal blocking reduces CO₂ emissions from peat decomposition.