**Tropical forest management for climate change mitigation, sustainable development, and biodiversity conservation: Is this dreamland?**

Ken MacDicken
Center for International Forestry Research (CIFOR)
Jakarta, Indonesia

The decision to include afforestation and reforestation as the only land use change and forestry mitigation actions for the first commitment period of the Kyoto Protocol limits opportunities to achieve mitigation and sustainable development to a relatively small subset of total possibilities. When biodiversity conservation is included as part of this complex combination of goals, it becomes important to clearly define relative priorities – and to understand the costs of each combination of goals. Center for International Forestry Research (CIFOR) is concerned with all three of these components of LULUCF projects: carbon stocks, livelihoods and biodiversity.

Drivers of change in tropical forest carbon stocks:
- Land use change is key – fluxes almost irrelevant
- Complex ecologies, high carbon turnover rates
- El Niño-induced fire regimes expanding
- High levels of poverty, high rates of population increase
- Dysfunctional institutions (rules, regulations, organizations)
- Degradation and inappropriate deforestation increasing due to the above

Conflicting objectives (with many interactions):
- Net carbon sequestration increased
    - *Low cost options sought
    - *Long-term storage desired
- Biodiversity conserved
    - *Often increases costs
    - *May reduce livelihood options
- Sustainable development enhanced
    - *Land use flexibility sought
    - *Stable income desired

It is key to remain aware of the interactions between carbon sequestration and the other two objectives. Opportunities for biodiversity conservation are limited until forest conservation is included in the Kyoto Protocol's

mechanisms. In terms of livelihoods, there are potential conflicts between museum taxonomists and local people, particularly in the tropics where people live on forested lands and depend on forests for parts of their incomes. There are also relationships between carbon stocks and biodiversity within biomes but these may or may not hold true across biomes.

Looking at some of these relationships for Sumatra, we see the relationship between a vegetation biodiversity index and carbon stocks (see Figure 1) and between sustainable local employment and carbon stocks (se Figure 2).

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There are also three-way interactions between carbon stocks, sustainable local employment and biodiversity. Forest management for carbon purposes can be attractive to landowners. In addition, as the density of natural forested areas is increased, local people also gain benefits, especially from non-timber forest products from those areas, such as ratan from Indonesia. As for the third element, biodiversity, the density of primates increases with a rise in forested land.

Sustainable development is defined by the host country and can thus be defined in many different ways. It is ineffective as a criteria by which to exclude a project. It is generally assumed to include benefits to local people, but it is incredibly complex and difficult to achieve in most parts of the tropics, partly due to institutional problems.

Internal tensions between the three major objectives often exist in particular projects. Take, for example, the Profafor plantation forestry project in Ecuador. Eucalyptus, a non-native species, as well as native species, were planted. From a biodiversity standpoint, planting a non-native species is not desirable. However, from the standpoint of increasing carbon storage as well as the standpoint of profitability for the local people and the landowner, the non-native eucalyptus is far more productive and thus more desirable than the native species (see Figure 3). This illustrates some of the tensions that can arise between competing objectives. There are always both costs and benefits, as well as major tradeoffs in these projects.

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How to help deal with conflicting objectives:

- recognize and quantify tradeoffs
- reduce expectations that we can achieve all objectives in each project
- focus on no-regrets solutions for now
- work towards realistic win-win solution
    - *e.g., exotic plantations with natural forest corridors
    - *benefit sharing with active involvement of local communities

The best outcomes will result from working with stakeholders to find optimal solutions that work for local stakeholders as well as for investors and for the formal government processes.