Uncertainty and REDD

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Uncertainty and REDD: an Ethical Approach to this Nagging Problem

By Rock Ethics Institute on January 27, 2009 6:31 PM| 1 Comment

Editor's Preface: The following post is the first of several that will appear in ClimateEthics.org focused on deforestation, climate change, and ethics. Because of the large contribution to climate change from deforestation activities, the Bali Road Map adopted at COP-13 in Bali Indonesia by the parties to the United Nations Framework Convention on Climate Change (UNFCCC) made deforestation an important element in the international community's strategy to reduce climate change's threat. It is widely believed that deforestation programs will be an important element in a new regime under the UNFCCC that will replace the Kyoto Protocol. Yet deforestation programs raise a host of ethical issues that ClimateEthics.org will explore in the months ahead.

I. Introduction

There is much about forest carbon that we don't know and perhaps will never know. Yet carbon markets require that reductions in greenhouse gas (GHG) emissions be precisely known. When you buy a pound of coffee you want to know you are getting a pound of coffee. Similarly, when you buy a tonne of CO2 emissions reductions from a forestry project, you want to know you are buying a tonne. Without this certainty, confidence in the market will falter and fraud could run rampant.

II. Sequestration uncertainty

Accurate measures of forest carbon fluxes are difficult. This difficulty exists at all scales.

At the largest scale, the total amount of carbon on the planet is estimated at 66,041,986 gigatonnes (Horel and Geisler 1997). Of this massive amount, roughly 66,000,000 gigatonnes of carbon are stored in the planet's sediments (land and sea), deposits from ancient volcanic eruptions. This reservoir represents "old carbon" and is largely insignificant on human time scales. The carbon in question for climate change is the "new carbon" found in the atmosphere, land, and ocean. Estimates of those stores vary. The difference between just two standard climate change texts shows the magnitude of uncertainty at the global level (Table 1).

Table 1: Carbon reservoir estimates (Gt)

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Reservoir	Houghton (2004)	Horel and Geisler (1997)
Deep ocean	39,000 (2004)	39,123
Soil and detritus	2,000(2004)	1,500
Atmosphere	760(2004)	756
Land biota	500(2004)	610

Of concern here are the land biota estimates where these scholars differ by 110 Gt of carbon. To put this in human terms, if were to we take today's price of CO2 on the European market of $12 a tonne, the differing estimates above equal $403,700,000,000 worth of carbon credits. (One tonne of carbon equals 3.67 tonnes of CO2 by molecular weight.) Soil and detritus estimates are even more uncertain. Accurately determining the amount of carbon in these stores will be fundamental to the validity of activities falling under the proposed reduced emissions from deforestation and forest degradation in developing countries (REDD) mechanism being considered by the parties of the United Nations Framework Convention on Climate Change.
For carbon markets generally, the global flux of carbon is also important. The global net atmosphere-land flux is estimated to be -1.4 ± 0.7 Gt annually (CBD 2003: 49). The economic value of this flux, again at today's price, is anywhere between $2.5-$7.7 billion. This wide range is due in large part to the fact that the total global carbon budget is not known. According to the Woods Hole Research Center (2008), the average annual emissions of carbon during the 1990s was roughly 8.5 Gt (6.3 ± 0.4 Gt from fossil fuels and 2.2 ± 0.8 Gt from land use change). This total is greater than the annual accumulation of carbon in the in the atmosphere (3.2 ± 0.2 Gt) and uptake by the oceans (2.4 ± 0.7 Gt). An unaccounted 2.9 Gt of carbon per year represents a "missing sink." Recent studies indicate that the missing sink may be located in northern mid-latitude terrestrial ecosystems, but exactly where, within which country at what rate is unknown – you can't buy or sell what you do not know exists.

For the United States, the sink capacity is estimate at 0.2-1.3 Gt per year (Schulze et al. 2000). This sink could be worth between $700 million and $4.8 billion today on the European market. For Europe, the sink capacity could be worth between $700 million and $1.5 billion. Attractive amounts indeed, but the precise value cannot be determined. Part of the problem arises from researchers using different methods measuring different fluxes at different temporal and spatial scales (Schulze et al. 2000). Beyond the methodology, much of the problem arises from our inability to measure gases at such a grand scale; we don't have the capacity to do so with the precision necessary to engage in buying and selling of forest carbon.

Difficulties also arise at the biome and ecosystem scales. Net ecosystem storage of carbon must include not only live trees, but soils, litter, and dead wood as well. Disturbance and degradation due to desertification, fire, logging, and development must also be included. Adding these layers of complexity are shedding new light on old myths. Generations of forest ecology students have been taught that old forests are not carbon sinks, but are carbon neutral or sources of CO2. In a recent study in appearing in the journal Nature, Luyssaert et al. (2008) show that old forests continue to sequester carbon and represent at least 10% global net ecosystem productivity. The carbon in these older forests is stored throughout the forest, not only in live trees. In fact, old forests are comprised of more carbon by the sheer mass than younger forests. They found that forests as old as 800 years usually had a positive net carbon balance. They add that much of this carbon would move back into the atmosphere if these old ecosystems were disturbed. This is important to keep in mind with REDD.

There are uncertainties at the plant level as well. Plants live within an ecological niche to which they have adapted and evolved. Their ecological niche is often determined by temperature, elevation, nutrients, precipitation, and increasingly human patterns of disturbance including habitat loss and the introduction of non-native invasive species. These factors vary by biome and ecosystem type. Estimates of carbon sequestration, therefore, must accommodate the varying conditions at the biome level that influence CO2 uptake. Difficulties with these estimates become clear when we consider how plants grow.

All forests are comprised of plants. We often forget that the very plants we are putting faith in to mitigate climate change are not that different than our house plants. How many of us fully understood why an amaryllis thrives, or dies, in our care, but survives in your mother's house?

Plants thrive through photosynthesis and respiration. Plants have developed tiny solar engines on their leaves called chloroplasts that use solar energy to combine CO2 with water to make sugar. This is photosynthesis. Plants then use the sugar to take up nutrients from the soil and make cellulose to add to their mass. This is how plants grow (see equation below).

6CO2 + 6H2O + solar energy <=> C6H12O6 (glucose) + 6O2

Photosynthesis only works when the sun is out; at night plants respire and the process works in reverse releasing CO2 back in to the atmosphere through respiration. The net carbon sequestered remains as cellulose in plant tissues.

The photosynthetic process is not in question here. We know how plants grow. Where uncertainty arises is in monitoring both sides of the equation. Estimates or averages could be used for the amounts of CO2, H2O and solar energy, for example, on the photosynthesis side, but a precise measurement cannot be certain because the amounts available to any given plant varies day to

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day, year to year, and now with climate change, season to season.

The same is true for respiration. A tree can use its glucose to draw up nutrients for plant growth, but that process will be determined by the amount of available nutrients in the soil and presence of mycorrhizal fungi on the roots of plants that fix nutrients. There are many limiting factors for plant growth, water availability and nutrients being the most important. Outside a laboratory setting, these factors make it difficult to precisely calculate CO2 fluxes and stores. The most accurate methodology is to measure the basal area growth of each tree in a forest; the costs involved, however, would be prohibitive. Dr. Nadkarni of The Evergreen State College, a specialist in forest canopy research, estimates that there are 400,246,300,201 trees on earth, or roughly 61 trees per capita (National Public Radio 2008). Even if every person on the planet were given the task to monitor their 61 trees it still would be an estimate. The only truly precise way to measure carbon in forests is to rip out all the cellulose in a forest, reduce it to carbon in a laboratory, and weigh it.

Worse yet for REDD, we don't even have accurate rates of deforestation. In recent analysis of forest data appearing in the Proceedings of the National Academy of Sciences, Grainger (2008: 818) concludes that "while the planet has been monitored by remote-sensing satellites since 1972, estimates of the annual deforestation rate are still inaccurate, and appearance of each new estimate generates [additional] debate."
With the science of forest carbon and the rate of deforestation being uncertain, how do we proceed? We can turn to ethics.

III. Ethics
Ethical principles can guide our actions in the face of uncertainty. A set of ethical principles are now widely established and accepted (Brown et al. 2006), including the Precautionary Principle and the No Regrets Principle.

The Precautionary Principle can guide action as follows (Glantz 2003: 168):

- When in doubt, error on the side of caution;
- Act to prevent harm;
- Arrive at decisions democratically;
- Burden of proof resides with the actors of environmental harm;
- Examine the full range of alternatives, including not acting; and
- Do not let uncertainty delay action.

The last two are most pertinent here. Even though we don't know and may not be able to know the exact tonnage of carbon stores and fluxes, we do know that if we fail to protect our forests and engage in reforestation climate change will be enhanced. Not acting to protect and enhance our forests will fail to stem a major source of GHG emissions; over 17% of global emissions since 1970 have come from the forestry sector (IPCC 2007: SPM.3). The level of risk associated with not acting is unacceptable, further propelling us into an era of dangerous climate change. Failure to act is risky behavior, and ethical systems are designed in large part to curtail risky behavior. Article 3 of the Convention already commits the parties to the precautionary principle. Ignoring what we have committed ourselves to is unethical. Since its first assessment report in 1990, the IPCC has also recommended not using uncertainty to delay action (Brown et al. 2006).
As with climate change science in general, we know more than enough about forest carbon stores and fluxes to start acting now. It would be worse to delay action any further as ecological thresholds in forested areas, from which we may not be able to return, are being passed daily.

So where do we begin? I suggest we follow the No Regrets Principle and do our forestry work for known reasons. We know forests:

- Sequester carbon;
- Comprise diverse plant organisms;
- Are critical habitat for other organisms;
- Provide ecosystem services (hydrology, soil conservation) including the oxygen we all breath;
- Have significant ancillary socio-economic benefits;
- Impart and support cultural and spiritual meaning; and
- We know delay means diminishing the options of future generations to sustain themselves.

These are more than enough reasons to protect and enhance forest even in the face of high uncertainty.

IV. Implications for REDD

The problem with using forests as a mechanism for climate change mitigation is not uncertainty; we know enough about forests and their abilities to regulate climate. The problem arises when a complex bio-physical system like forests is forced into a contrived market. Markets requirements are exotic to forests, and perhaps invasive as well. Some of these difficulties with the market approach are already evident with the forestry projects under the Clean Development Mechanism (CDM). Of the 1,152 registered CDM projects, only one is for reforestation or afforestation, and it has to date generated no certified emissions reductions (UNEP 2008). The main reasons given why CDM afforestation and reforestation projects have "failed" are the difficulties in proving additionality and high transaction costs, especially for small-scale projects (Karsenty 2008: 445). But more fundamentally, both of these difficulties arise because of the tremendous accounting acrobatics needed to prove ownership of the emissions reductions and to quantify those reductions. These difficulties will not go away under a market-based REDD mechanism.

V. Conclusion

I will be monitoring the negotiations over the next year leading up to COP 15 in Copenhagen with particular attention given to the fund schemes being proposed. A fund scheme may be preferable to a market-based scheme. The establishment of a fund, where high-polluting countries in the North make payments for REDD projects in the South, could tap in to an existing agenda to protect forests for reasons that precede climate change, namely for biodiversity and socio-political reasons. The need to precisely quantify carbon stores and fluxes for a market could be omitted with such an approach. The alternatives being proposed for a market-based REDD mechanism may be ineffective and inequitable, and require accounting precision that is currently riddled with uncertainties that won't disappear anytime soon.

By:
Jon Rosales, Ph.D.
Environmental Studies
St. Lawrence University
Canton, NY 13617
jrosales@stlawu.edu
(315) 229-5852

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John Burton | January 30, 2009 2:32 PM | Reply

In his ONE WORLD book, Prof Peter Singer discusses at length the moral. ethical, and justice aspects of nation's duties in response to global warming.
Has this been discussed by Climate Ethics?
John Burton

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