Land Use and Forestry — The Toughest Part of Addressing Climate Change?

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I was a forest researcher working in the Federal Government of Canada in 1992 when it was announced that Maurice Strong, Chair of Ontario Hydro, the largest electric utility in North America, had agreed to purchase over 30,000 acres of rainforest in Costa Rica to offset some of the company's environmental damage from its greenhouse gas emissions.[1] Maurice Strong was equally a visionary and an enigma—a Canadian oil and gas executive who became the Secretary General of the Earth Summit in Rio in 1992. However, the media and government immediately ridiculed Strong's deal as a waste of taxpayers' money. Despite Strong's reputation and charisma, he couldn't pull it off, and one of the world's first forestry carbon transactions was dead on arrival.

Integrating land use, forestry and conservation into a comprehensive climate change mitigation and adaptation program has remained a struggle over the past 30 years. There is ongoing scepticism from various commentators about whether structures, such as carbon markets, to provide funding to conserve natural ecosystems, implement sustainable forestry and agriculture and restore degraded land are a legitimate part of the net zero transition being adopted widely by government and business. However, the scale of emissions from deforestation and unsustainable land use, as well as the scale of the opportunity to reverse these emissions, makes it inevitable that we must find solutions. In this short paper, I will argue for redoubling effort to resolve outstanding issues, to integrate land use and forestry into climate policy at the international and national levels, and to create policy frameworks that enable capital to flow into outcomes that benefit the climate, biodiversity, and sustainable development. I will also suggest that there may be new approaches beyond just using carbon offsets to provide financial support for the land use transition.

Land use is an economic frontier phenomenon. There are about 4 billion hectares of forests on earth, and for the vast majority of these forests, they represent substantial ecological value but little or no commercial value—therefore in remote, inaccessible areas, forests remain as wilderness. As forests become increasingly accessible, they are harvested for timber production or used for grazing. In more productive and accessible areas forests are cleared and then converted to agriculture. Agriculture steadily intensifies as profits increase and land value rises. With rising population and increasing food demand, there is a continuously shifting continuum from wilderness to highly valuable intensive agriculture. Over the past 30 years 420 million hectares of forest has been converted, mostly to agriculture.[2]

Some history of land use policy related to climate change

As the international community launched the UNFCCC COP[3] process in 1995, there was an acceptance that forestry and land use had to be integrated into the objective of reducing greenhouse gas emissions. Even over 20 years ago, the Intergovernmental Panel on Climate Change (IPCC) recognized the importance of land-based emission sources and sinks.[4] It was also understood that agricultural emissions related to nitrous oxide and methane had much higher global warming impact per tonne of emissions and that attention was needed on reducing those emissions as urgently as carbon dioxide.[5] We now know that the comprehensive accounting of greenhouse gas emissions from deforestation, land degradation and agriculture represent in the order of 23% of global emissions.[6] All major climate models demonstrate that reaching Paris Agreement climate targets only occurs when emissions from land use are reduced and significant reforestation contributes to removal of existing carbon in the atmosphere.

Recent scientific work has created a relatively simple framework to think about these "Natural Climate Solutions". There are three areas of action needed. The first is to stop converting natural ecosystems to production systems like cropping or grazing land. The second is to restore land which has become degraded by unsustainable land use, often over decades, with much of the restoration needing to occur in developing countries or major agricultural regions. The third is to implement sustainable production systems—climate friendly agriculture and forestry. Comprehensively addressing all three of these opportunities would reduce emissions by billions of tonnes of carbon dioxide equivalent per annum and begin to remove emissions from the atmosphere and back into the biosphere over time.[7] A central challenge is to ensure that production systems utilize land as efficiently as possible so that more can be produced from the existing production land base, rather than needing to increase the area under production.

Prior to the adoption of the Paris Agreement, the Kyoto Protocol included accounting for land use and land use change and incorporated afforestation, reforestation and improved forest management as opportunities for climate mitigation under articles 3.3 and 3.4. But accounting for carbon sinks in natural forests was controversial. The United States would have met its 1997 Kyoto Protocol emission reduction target simply by accounting for the natural carbon sequestration in its forests under Article 3.4. This created conflict with Europe who had taken on a similar emissions reduction target but without using sequestration in its forests as a central part of achieving their goal. When the US withdrew from the Kyoto Protocol early in 2001, it left a legacy of mistrust of the role of forestry and land use in the international policy process.

Due to the sector's exclusion from the EU Emissions Trading Scheme, forestry and land use played almost no role in the Clean Development Mechanism (CDM), which under the Kyoto Protocol was designed to support investment by wealthy countries into emissions reduction projects in developing countries. As a result, there was no impetus to conserve forests, reforest degraded areas or improve agricultural systems to reduce emissions. While the voluntary carbon market that emerged in the 2000s led to the development of some tropical forest conservation and reforestation projects, these were relatively small. With carbon prices for forestry projects only $1-2 per tonne of carbon dioxide equivalent (CO2-e), the underlying economic drivers of deforestation and land degradation continued to intensify with rising demand for agricultural production.

By 2007, the international community realized that the exclusion of forests and land use was a growing problem. All the emissions reductions from investments in renewable energy each year were dwarfed by the emissions coming from deforestation. Even worse, the investment of hundreds of billions of dollars in renewable energy was being overwhelmed by emissions that could be reduced at a fraction of the cost in the land use sector, but which were being ignored. The Bali COP of 2007 coined the concept of Reducing Emissions from Deforestation and Forest Degradation (REDD+) and sought to develop methods to reward countries, mostly tropical developing countries, for reducing deforestation.[8] However, despite the enthusiasm at the time, the implementation of REDD+ has been challenging. Debates over the concept of ”additionality” (would the emission reduction activity have happened without the carbon project) and setting of an emissions baseline (what would the emissions have been if there were no REDD+ payment) and leakage (if you protect a forest in one area does another one just get cleared elsewhere) led to many criticisms and slow implementation. The voluntary markets embraced REDD+ projects, but again, prices were so low that most frontier forests were still economically more valuable being converted to even rough grazing, for example, on the Amazon frontier.

Over the past decade some national and sub-national emissions reduction schemes have successfully integrated forestry and land use, usually as offsets for large emitters. The concept is that as the unit cost of emissions reductions rise, incorporating lower cost emissions reductions, for example, from reforestation and forest conservation, in a market-based instrument allows more rapid overall emissions reductions. Research by the International Emissions Trading Association (IETA) suggests that utilizing international market-based instruments can lead to twice as much emissions reduction for the same quantum of investment.[9] These market-based regimes have been designed to help achieve wider public policy objectives. For example, in California where timber harvesting has been controversial, the carbon market rewards forest conservation and reduced harvest rates.[10] In New Zealand, where forestry land was being systematically converted to dairy farming there are penalties for the emissions associated with converting timber plantations to agriculture, and incentives for reforesting marginal land.[11]

Over the past few years, the lack of attention to land use-based emissions, as well as the potential of better land use to remove carbon dioxide from the atmosphere, has been highlighted by scientists and ENGOs. It has been suggested that a third of cost effective climate mitigation could come from land use over the next decade in support of Paris Agreement targets.[12] Other studies have suggested large-scale reforestation is needed—in the order of hundreds of millions of hectares.[13] The reality today, however, is that regulated and voluntary carbon offset schemes are not yet at the scale required to reduce emissions to meet our climate mitigation ambition.

Efforts to make nature more valuable

So, what could we do better? The two major approaches are regulation and controls on the one hand, and incentives and changing economic price signals on the other. This is generally dubbed sticks and carrots.

Agriculture, ranching, and other forms of land use are always challenging sectors to regulate. Any efforts to change traditional land use or regulate agricultural emissions is politically and often practically difficult as land management practices are hard to monitor effectively. This leads to more use of carrots than sticks. But often the carrots include agricultural subsidies, fuel tax rebates, low interest loans for farm development and other policies that increase, rather than decrease, emissions.

Regulation by governments, or forms of market access regulation like certification schemes, can reduce conversion of natural ecosystems into production systems or make conversion uneconomic. But the criticism from many rural stakeholders is that this represents a restriction of private property rights without fair compensation. If we take Australia as an example, the agricultural land may be worth USD 7,000 per hectare, but land under natural vegetation is only worth about USD 300 per hectare. Similarly, in Southeast Asia, the tropical lowland rainforest that might have undergone a primary logging operation, but which still holds substantial carbon and biodiversity value might be worth USD 400-500 per hectare, which is the net present value of future potential timber revenues. However, if the land is approved for conversion to oil palm, it immediately becomes worth USD 5,000 per hectare. Once producing palm oil it can be worth USD 20,000 per hectare. This is an economic arbitrage that leads to relentless pressure for conversion and the search for ways to circumvent restrictions on development.

A different approach is to try to create commercial value for the carbon stocks, biodiversity and even cultural value of natural ecosystems. If the lowland dipterocarp forest discussed above is holding 600 tonnes of carbon dioxide equivalent in its biomass and soils, as well as a spectacular ecosystem of diverse, inter-dependant species, could this value be made to rival the value of conversion to agriculture? In our example above, at a price of $10 per tonne of carbon dioxide equivalent, it would be more economically rational to conserve the forest rather than to convert it to oil palm plantation. However, the carbon accounting for projects designed to avoid deforestation often includes net-downs for leakage, additionality, physical risk, estimation error, and other factors. This may increase the price needed to meet the option value of conversion to $30 or $40 per tonne-about 8-10 times the current market value for carbon offsets.

There have also been efforts to work directly with national or sub-national (e.g. States or Provinces) governments to "pay for performance". The idea is to set a baseline at the country level and pay for actual reductions in emissions.[14] These jurisdictional systems address the additionality and leakage issues but can be impacted by shifting political and policy positions on deforestation, most recently demonstrated by Brazil. Brazil had been making good progress on reducing deforestation at the Amazon frontier, but the Bolsonaro government reversed that progress by encouraging land clearing and not enforcing rules against conversion.

These risks and uncertainties associated with paying for reduced deforestation have led many companies to shift their emphasis towards paying for removing carbon dioxide from the atmosphere.[15] International frameworks around the pathway to Net Zero, like the Science-based Targets Initiative (SBTi) emphasise the use of removal-based offsets to address hard-to-abate residual emissions instead of offsets from avoided emission activities, like REDD+. Removals activities include reforestation or extending the rotation age of commercial forestry. There is a logic and simplicity of communication associated with paying to remove carbon dioxide from the atmosphere to compensate for emissions, as opposed to paying to prevent emissions from deforestation or forest degradation. Some scientists and NGOs have argued against a sole focus on "removals" because this leaves the conservation of carbon stocks in frontier forests and other threatened ecosystems under the relentless pressure for conversion discussed above.[16] These natural forests are considered irreplaceable once converted because of their rich biodiversity and substantial carbon stocks.[17]

It is clear from this discussion that large scale change in land use, including conservation of remaining natural systems, restoring degraded land, and implementing climate friendly agriculture and forestry, is complex and difficult. But as noted at the outset it is also important. The current situation of ineffective regulation of land use change, and insufficient economic price signals for conservation and restoration of ecosystems will not result in the large-scale land use transition needed, and rather will make slow, marginal changes in some locations. There isn't enough government to government grant funding or philanthropic funding to create a sufficiently pervasive change in land use economics.

Are Markets an answer?

The atmosphere can't tell the difference between a tonne of carbon dioxide from deforestation and a tonne of carbon dioxide emitted from steelmaking. In many emissions reduction measures like feed-in tariffs, the implied price of carbon dioxide emission is $100 per tonne or more. Spending $100 per tonne of emissions reductions from hard to abate sectors, when this investment could lead to 5-10 tonnes of emissions reductions or removals in land use seems like a misallocation of capital. While the argument that driving down fossil fuel-based emissions should be a priority is reasonable, possibly there also needs to be a price at which rigorously implemented land use-based credits, with net downs for the physical risk, leakage etc, can be used as offsets. It might also be worth considering a scheme where the price of carbon emissions reductions are augmented by the additional biodiversity conservation value and cultural or community social co-benefits.

Most emission reduction strategies follow a pathway where initially there are no regrets actions that can be implemented at no cost. Then there are emissions reductions that have little cost relative to the economic benefits—say pricing up to USD 20 per tonne. Then there is a point at which further emissions reductions escalate rapidly in price. Some studies suggest that the marginal cost of the last 10% to 20% of emissions reductions could be hundreds of dollars per tonne in some countries.[18]

While there has been criticism of the voluntary carbon markets, one of the biggest problems has been too much supply of offsets relative to demand.[19] There needs to be some restriction of supply from old projects associated with the Kyoto Protocol CDM and Joint Implementation (JI) mechanism that sell for one dollar per tonne or even less.[20] New market approaches that remove the cheap industrial or renewable energy credits and create grades of carbon such as nature-based units, or deforestation reduction units, which can be accredited under the existing or new voluntary methodologies may lead to prices that will support more rigorous verification, perpetuation of outcomes and risk management protocols. At $3 or $4 per tonne, it is unlikely that carbon offsets will be rigorous, permanent or properly tracked over time. You get what you pay for.

Maybe offsets and voluntary markets are not the final solution? Should companies directly sponsor nature on their balance sheets, taking property rights to the carbon and biodiversity benefits created by conservation, restoration and high sustainability management regimes? These could be created as unique non-fungible tokens (NFTs) that act like conservation easements but with low transaction costs and distributed ledgers to track ownership and link to dynamic carbon or biodiversity accounts over time. These instruments might integrate with company balance sheets to ensure both positive and negative change in carbon or the integrity of ecosystems are captured as increases and decreases in asset value.

There are signs that carbon prices are rising[21], and a range of policy processes have been launched to strengthen the credibility, transparency and integrity of carbon offsets from land use.[22] Innovation is occurring in mechanisms to create cooperative structures for accrediting carbon projects by small landholders[23], monitoring technology, buffering or insurance of credits to reflect physical risk, and distributed finance systems that can reduce transaction costs and maintain effective tracking of the ownership of these offsets or tokens.[24]

Systems to monitor and reward climate friendly land use are central to achieving a net zero outcome under the Paris Agreement. While there is still resistance to the concept of offsets, the alternative of a largely business as usual emissions profile for land use is worse as an outcome. The conceptual understanding of how to address land use emissions, remote sensing advances and ability to monitor performance, along with the new financial technologies emerging to make carbon finance accessible to even the smallest family farmers, all make many of the criticisms less convincing. Markets are complex, subject to gaming and unintended consequences, but with appropriate periodic reviews a continuous improvement approach can be implemented. We have come a long way since Maurice Strong tried to protect Costa Rican rainforests, and the challenge now is to get conservation, restoration and sustainable land use to the scale needed to meet the Paris Agreement targets.

[1] https://www.forbes.com/forbes/1998/0112/6101046a.html?sh=71217124087c
[2] www.fao.org/state-of-forests/en
[3] United Nations Framework Convention on Climate Change Conference of the Parties.
[4] https://www.ipcc.ch/site/assets/uploads/2018/03/srl-en-1.pdf
[5] van Amstel, A.R., Swart, R.J. Methane and nitrous oxide emissions: an introduction. *Fertilizer Research* **37,** 213–225 (1994). https://doi.org/10.1007/BF00748940
[6] IPCC, 2019: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, et al, (eds.)].
[7] Griscom et al. 2017. Natural Climate Solutions. Proceedings of the National Academy of Science. See https://www.pnas.org/content/114/44/11645
[8] For more information on REDD+ see: https://redd.unfccc.int/
[9] IETA. 2019. The economic potential of Article 6 of the Paris Agreement and Implementation Challenges. See: https://ieta.org/resources/International_WG/Article6/CLPC_A6%20report_no%20crops.pdf
[10] For information on the California forest carbon offset protocol see: https://ww2.arb.ca.gov/sites/default/files/classic/cc/capandtrade/offsets/overview.pdf
[11] For more information on the original rules incorporating forestry into the NZ ETS in 2008 see: https://environment.govt.nz/assets/Publications/Files/Emissions-trading-bulletin-no3.pdf
[12] https://www.nature.org/en-us/what-we-do/our-insights/perspectives/natural-climate-solutions/
[13] See for example Bastin et al. 2019. The global tree restoration potential. https://www.nature.org/en-us/what-we-do/our-insights/perspectives/natural-climate-solutions/
[14] Frances Seymour of WRI argues the case for a jurisdictional approach to REDD+ crediting here: https://www.wri.org/insights/insider-4-reasons-why-jurisdictional-approach-redd-crediting-superior-project-based
[15] For an explanation of the rationale for removal credits vs avoided emissions credits see: https://carbonremoved.com/blog/carbon-removal-and-carbon-credits/
[16] See for example this perspective from Derik Broekhoff of the Stockholm Environment Institute: https://www.sei.org/perspectives/should-carbon-offsets-only-include-removing-co2-from-the-atmosphere/
[17] See Smith, C. C., et al. (2021). Old-growth forest loss and secondary forest recovery across Amazonian countries. Environmental Research Letters, 16(8). https://doi.org/10.1088/1748-9326/ac1701 and Goldstein, A., et al. (2020). Protecting irrecoverable carbon in Earth's ecosystems. *Nature Climate Change*, *10*(4), 287–295. https://doi.org/10.1038/s41558-020-0738-8
[18] See IETA paper referred to above.
[19] See interview with Verra CEO David Antonioli on current market oversupply here: https://www.spglobal.com/platts/en/market-insights/latest-news/coal/021221-interview-carbon-offsets-demand-to-grow-despite-covid-setback-verra-ceo
[20] Warnecke et al. 2019. Robust eligibility criteria essential for new global scheme to offset aviation emissions. Nature Climate Change. https://www.nature.com/articles/s41558-019-0415-y
[21] See for example the recently released state of forest carbon finance report from Ecosystem Marketplace: https://www.ecosystemmarketplace.com/articles/new-report-finance-for-forest-carbon-doubled-since-2016-but-still-far-from-meeting-its-potential-as-a-natural-climate-solution/
[22] See for example the Task Force on Scaling Voluntary Carbon Markets: https://www.iif.com/tsvcm and the voluntary carbon market integrity initiative: https://vcmintegrity.org/
[23] See for example www.green-trees.com or www.ncx.com
[24] See for example Air Carbon which is an exchange for various grades of securitized carbon offsets. https://www.aircarbon.co/