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Ensuring Zero Agricultural Land Expansion into High-Carbon Ecosystems

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Highlights

- Relative to agricultural systems, high-carbon ecosystems – such as forests, peatlands, and mangroves – store large amounts of carbon per unit area.
- Agricultural expansion often comes at the expense of high-carbon ecosystems, contributing to climate change.
- Ensuring no further agricultural expansion occurs in high-carbon ecosystems is a substantial climate change mitigation opportunity.
- The estimated costs of managing forests for climate benefits range from US$2 to 393 billion per year, depending on growth scenarios and carbon prices; this is a bargain compared to the leverage these systems have on climate change and its social costs.
- Individuals, indigenous people, policies and institutions, and investments are all agents of change and will need to work together to avoid further land conversion.

4.1 Leveraging High-Carbon Ecosystems

Alignment of global emissions trajectories with the Paris Agreement's climate targets will largely be dictated by phasing down (and out) of fossil fuels in the energy and transport sectors. However, food systems also require transformation to stand a chance at remaining below the 1.5°C threshold (Clark et al., 2020) reinforced by the Glasgow Climate Pact. Food systems currently contribute roughly 35 percent of the total global emissions (Crippa et al., 2021), with over two-thirds of that amount relating to agriculture, including livestock. Farming and changes in land use have expanded agriculture's production area, with expansion typically coming at the expense of high-carbon landscapes such as forests and peatlands, which store disproportionate amounts of carbon per unit area. Losses of the carbon reserves contained in these high-carbon ecosystems are in many cases

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'irrecoverable' (Box 4.1); as such, conserving high-carbon ecosystems has emerged as a critical action for stabilising the climate (Griscom et al., 2017).

Agriculture in general, and specifically globally traded agriculture, drives the conversion of high-carbon ecosystems. Between 2001 and 2015 alone, 85 and 75 million ha of total global forest loss was due to commodity production (27 percent) and shifting cultivation (24 percent) respectively (Curtis et al., 2018). Agriculture's threat to high-carbon landscapes is not only restricted to upland forests. In Southeast Asia, for instance, of all the mangroves lost, nearly 50 percent were lost due to aquaculture and rice expansion (Bryan-Brown et al., 2020). In Latin America, beef is a primary driver of land-use change and loss of high-carbon ecosystems (Zu Ermgassen et al., 2020). The footprints of global supply chains – including beef, soy, cocoa, coffee, and palm oil – stretch deep into high-carbon landscapes (Henders et al., 2015).

Under this background of agricultural expansion for global markets, conservation of high-carbon ecosystems for mitigation can be viewed through three measures: (1) avoiding emissions, for example, through zero-agricultural land expansion, (2) enhancing carbon sequestration and reducing emissions, such as by rewetting and restoring peatlands, and (3) promoting sustainable agriculture management practices over previously converted high-carbon landscapes. The only option to sustainably manage high-carbon landscapes is to avoid conversion, stop deforestation, and, in the case of peatlands, keep them in their natural state. Therefore, in this chapter, we focus on actions to protect high-carbon ecosystems. Steiner et al. (2020) recognise this essential ingredient to the transformation agenda and suggested the agricultural sector must prevent expansion into 250 million ha of tropical forests and 400 million ha of peatlands.

Box 4.1
Irrecoverable Carbon

Forests and wetlands, including mangroves and peatlands, have a typical carbon density far greater than their agricultural counterparts. For example, peatland carbon stocks can exceed 700 tonnes of carbon/ha^{-1} per metre depth of peat, an amount nearly three times that stored in the most carbon-dense tropical rainforest. By contrast, the carbon density of global croplands is an order of magnitude lower for even the most carbon-rich agricultural systems, for example, multi-strata agroforestry. If released, carbon in high-carbon ecosystems cannot be restored by 2050, the deadline for averting the climate crisis. Their sequestration abilities make protecting high-carbon ecosystems from conversion for agriculture a particularly salient near-term climate solution (Goldstein et al., 2020).

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4.2 Mitigation Potential and Economic Costs

Protecting high-carbon ecosystems from agriculture offers significant mitigation potential. Globally, eliminating their conversion could reduce approximately 17 percent of global emissions, or 8.4 billion tonnes of carbon dioxide equivalents per year (Roe et al., 2021). Nearly half of the potential benefits are derived from just three countries – Brazil, Indonesia, and the Democratic Republic of Congo – which represent 41 percent of potential mitigation opportunities. There are 11 agriculture-driven deforestation fronts that will be key deforestation hotspots by 2030 (Pacheco et al., 2021). They extend over dry ecosystems in Latin America and Africa, for example, Cerrado, Chaco, and Eastern African Miombo, as well as forest ecosystems in Choco-Darien, the Amazon, the Atlantic Forests, the Congo Basin, New Guinea, the Greater Mekong, Borneo, Sumatra, and Eastern Australia.

The conservation of peatlands represents another key mitigation opportunity. Peatland protection and restoration has the potential to mitigate 1.74 billion tonnes of carbon dioxide equivalents per year by 2050, or approximately 10 percent of the potential mitigation related to high-carbon ecosystems (Roe et al., 2021). Seventy-five percent of this mitigation potential is, however, related to the restoration of peatlands, which could mitigate 1.31 billion tonnes of carbon dioxide equivalents per year (Roe et al., 2021). Based on data on the extent of tropical peatland (Gumbricht et al., 2017) and cropland distribution (ESA CCI, 2017), approximately 25 million ha of peat are being used for agriculture in the tropics, with 54 out of 79 tropical countries hosting at least 5,000 ha of agriculture over peatlands. Unlike the predicted fronts of deforestation, agriculture-peatland hotspots are spread throughout the tropics though concentrated in Asia (Figure 4.1). Eighty-three percent of the total area is in just nine countries. Peat in other continents is still remote and under less pressure from population growth; for example, while Latin America hosts the largest fragmented areas of peat in the tropics (Gumbricht et al., 2017), the region only contributed 7 percent to the total area of agriculture-peatlands, though there are other threats to those peatlands. Similarly, Africa's top 10 countries only accounted for 5 percent of the total agriculture-peatland area.

Current agriculture over lowland peatlands globally is 23.9 million ha. The potential expansion area, assuming that in the baseline year of 2015 there was a 2.5 km buffer of agriculture-lowland peat areas, is equal to 45.5 million ha. This would represent a substantial increase in the total area, given not all the surrounding peatlands can host agriculture; some areas are protected, in complex terrain, or are too far from markets. However, a smaller, more targeted effort may be a more realistic short-term goal. Sixty-two percent of this avoidable expansion remains in Asia, 19 percent in Latin America, and 12 percent in Africa. The analysis is based

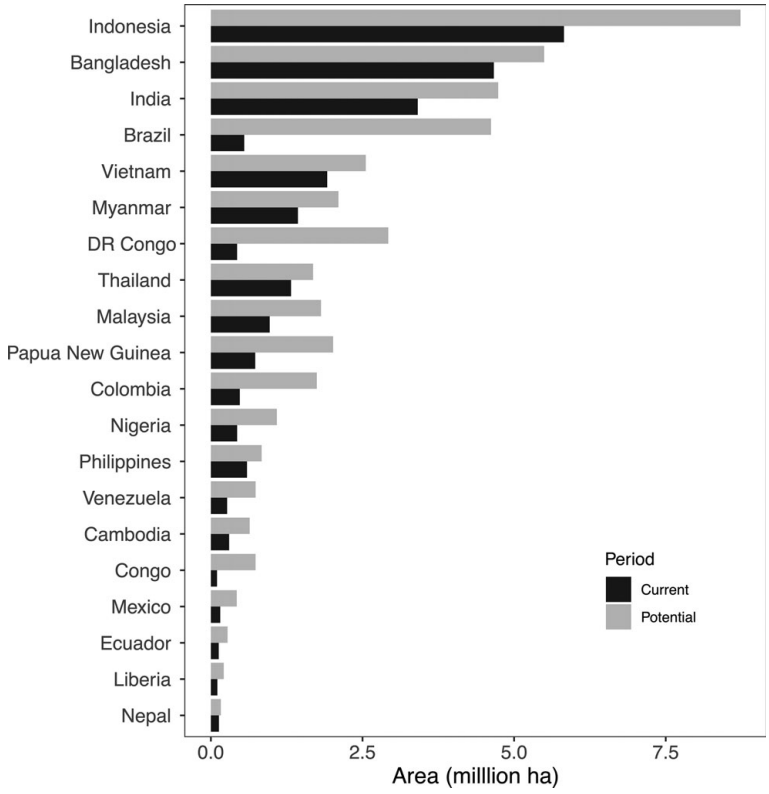

Figure 4.1 Top 20 countries with agricultural activities currently on peatlands and potential expansion into peatlands

on the tropical wetland and peatland map by the Center for International Forestry Research (CIFOR) (Gumbricht et al., 2017) and the distribution of croplands as per the European Space Agency's CCI-2015 land cover map.

Whereas the carbon benefits of ensuring zero agricultural expansion in high-carbon ecosystems are increasingly clear, the costs of doing so are much more uncertain. Several studies estimate the costs of reducing deforestation, with the results dependent on the location, growth scenarios, and carbon prices. A recent estimate suggests that managing global forest for carbon benefits – including deforestation, reforestation, and management – would cost between US$2 billion and US$393 billion per year (Austin et al., 2020). The cost of avoiding global peatland conversion is not available, with most economic research on peatlands focused on restoration and in countries in temperate latitudes, with Indonesia being the exception. Regardless, even higher-end estimates for avoiding deforestation can be viewed as a bargain. The conversion of high-carbon ecosystems has significant leverage on the global carbon budget and the costs of protection

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represent a relatively small percentage of the global economy or US$98 trillion in 2021. Furthermore, arresting agricultural expansion would have countless co-benefits, ranging from maintaining hydrology and biodiversity to reducing risks of zoonotic disease spillover, all of which have economic benefits.

4.3 Enabling Transformation

Several opportunities exist to transform food systems in ways that conserve high-carbon ecosystems. Suggested measures include actions that affect individuals and their behaviour, policies and institutions, investments and finance, and research. Rather than these factors working in isolation, change will be brought about by a mix of economic incentives, governance, capacity building, and the intensification of production, with the importance of any individual factor dependent on the local context. Here we discuss each of these actions through the *agents of change* lens presented in Chapter 1.

Individuals and Behaviour Change: High-carbon land conversion is a result of millions, if not billions, of individuals' decisions throughout food systems. Individuals send market signals on acceptable economic and environmental costs, and, by extension, the production practices for agricultural commodities. This includes whether growing crops on land that previously supported high-carbon ecosystems is considered acceptable. It stands that consumer choice can be a powerful mechanism for transformation. However, in practice, consumer choice towards deforestation-free consumption or other efforts to limit commodity impact have had minimal effects on the overall land-use trends. Certified shade-grown coffee, for example, is often lauded as a promising case study but the relative amount of area dedicated to shade- versus sun-grown coffee is decreasing. The market share of sustainable commodity production is simply too small to affect rapid change in producer behaviour.

Individual producers also have an important role in transformation regarding the conversion of high-carbon ecosystems. Throughout the tropics, indigenous people manage high-carbon ecosystems. Evidence suggests that, across the tropics, deforestation rates are lower in indigenous lands than non-protected areas, while in Africa, deforestation rates are also lower than in protected areas (Sze et al., 2021). These results suggest that creating programmes that support indigenous individuals and local communities' stewardship of high-carbon ecosystems will be an important transformational action.

Policies and Institutions: Transformative actions on land use for climate mitigation goals are multi-scale. These include the Nationally Determined Contribution (NDCs), which are international mitigation and adaptation commitments under the United Nations Framework Convention on Climate Change

(UNFCCC) that lay out the blueprints for national climate action. These plans will increasingly dictate activities as governments and investors align funding with these commitments. Unfortunately, analysis of the first NDCs indicates that only an estimated 30 percent of the countries that are home to significant tropical forest cover include forest protection and/or restoration, often without explicit targets (NYDF Assessment Partners, 2019). NDCs, however, are non-binding commitments, and as such have produced limited results for high-carbon ecosystems (Box 4.2). The inclusion of high-carbon ecosystems in NDCs is, therefore, a necessary action but is insufficient to drive change alone.

Alignment of policies across climate, conservation, and development is needed to balance competing interests and create the right incentives for conservation and land use. For example, in many countries, agriculture and forestry industries receive government subsidies such as tax exemptions or capital financing. These

Box 4.2
Lofty Promises and Empty Targets: The Case of the New York Declaration on Forests

The New York Declaration on Forests (NYDF) emerged from the sidelines of the 2014 United Nations Secretary General's Climate Summit. More than 200 governments, companies, civil society, and indigenous organisations signed up to voluntary, non-binding promises to halve tropical deforestation by 2020 and stop it entirely by 2030. That first promise has not been met. Between 2014 and 2020, tropical forest loss increased and was only encumbered by the global financial crisis brought about by the COVID-19 pandemic in 2020. The lack of action has been in part linked to a lack of finance; it was estimated that in 2019 only 5 percent of the funds necessary to tackle forest and climate issues had been mobilised, just US$175 million instead of US$24.5 billion. An assessment of 32 countries with the greatest forest mitigation potential found that only 10 had set forest protection targets in their first NDC (NYDF Assessment Partners, 2019). Forest protection is not occurring anywhere near the scale necessary. The progress, or lack thereof, highlights that agenda-setting commitments, while necessary, are often not sufficient to influence land-use decisions. Incentivising systems need to be put in place to change actions on the ground. At the 26th United Nations Climate Change Conference (COP26) in Glasgow, a new Declaration on Forests and Land Use was made, again to end deforestation and land degradation by 2030. People and institutions that take on this challenge would do well to consider the fate of previous commitments such as the NYDF and explore ways to solve the problems that stymied their progress, to build on previous efforts. Time will tell if the lessons learned from the NYDF will aid in deforestation targets being met.

policies can promote expansion into sensitive ecosystems. Where subsidies support intensifying agricultural production, they may help relieve the pressure for expansion into new lands, essentially 'land sparing'. The effectiveness of intensification and land sparing for forests and other high-carbon landscapes for conservation is uncertain. Getting the incentives right and realignment of subsidies will be fundamental to shifting land use away from vulnerable ecosystems.

Governments have additional levers, besides subsidies, at their disposal. These include designating high-carbon areas as protected areas and restricting certain land-use activities that degrade through draining or burning. Protected-area designation only works when supported by sufficient monitoring and legal mechanisms for enforcement. The creation of protected areas may also increase the vulnerability of the small-scale producers and indigenous people that use high-carbon ecosystems by restricting access to productivity resources. As such, there is the need to account for equity in solution design and development.

Finance: Finance is one of the most significant constraints to conserving high-carbon ecosystems. The lack of finance limits everything from developing programming for alternative livelihoods and developing accurate accounting data, to limiting monitoring and enforcement abilities. New sources of funding must be made available for countries to appropriately manage these resources. Cooperation between governments, the private sector, and development organisations can help develop many of the structures necessary to stimulate new finance. This could include using benefits from cap-and-trade programmes or fuel taxes to support payments for ecosystem services, as occurs in Costa Rica (Table 4.1). Public institutions, such as the Green Climate Fund, and the private sector must consider the impacts of actions and funding on carbon reserves in their investment decisions and development plans. Protection may be best integrated as an explicit goal in investments and private-sector actions. Like recent changes with fossil fuels, government and pension funds should divest from companies that fail to act to protect high-carbon landscapes.

Research and Innovation: Scientific institutions will need to support government, private sector, and individual actions, to ensure zero-expansion of agriculture into high-carbon ecosystems. This will include addressing fundamental questions such as cost-effective approaches to monitoring forest loss or carbon budgets, which have previously received significant attention. Less well-studied questions, for example, those on the effectiveness of various incentives and instruments for conservation or the impacts on indigenous rights will also need scientifically addressing. The answers to these and other questions can help decision-makers pivot towards expansion-free agriculture and make best-fit investments. Research institutions such as CGIAR – formerly the Consultative Group for International Agricultural Research – and universities have a vital role

Table 4.1. *A selection of financial mechanisms to support sustainable management of high-carbon ecosystems*

Financial mechanism	Description	Peatland example	Forest example
Voluntary carbon markets	Markets for buying and selling emission reduction credits, or offsets.	Netherlands 'De Lytse Deelen'	Kasigau Corridor, Kenya
REDD+	Incentive framework for protecting, managing, and restoring forests in developing countries.	Indonesia's REDD+ National Strategy	Central African Forest Initiative
Debt-for-nature swaps	Transaction where a developing country's debt is cancelled or reduced in exchange for investment in conservation.	Seychelles coastal wetland and mangrove restoration	US Tropical Conservation Forest Act
Green bonds	Financial instrument created to raise money to support environmental projects.	Green 'Sukuk' Indonesia	Conservation funds Green Bond
Voluntary certification programmes	Programmes used to incentivise producers to use socially and/or envioronmentally sound production practice.	UK Peatland Code	Forest Stewardship Council

given their work on methodological innovations and deep multidisciplinary investigations. Over the past decade, however, this topic has received little attention from the CGIAR research community due to competing priorities and the siloing of research. Future climate-change research would be well placed to specifically emphasise the expansion of agriculture and conversion of high-carbon ecosystems in its agenda.

4.4 Way Forward

Ensuring zero agricultural expansion into high-carbon landscapes is a building block for transforming our food systems and meeting climate goals. The risk of inaction is clearer than ever before, yet conversion continues at alarming rates. The ways food systems touch this issue mean that every individual and most food system-linked institutions can be agents of change. To ensure no agricultural expansion into 250 million ha of forest and 400 million ha of peatlands will require a potent, fast-acting blend of policies, incentives, and behaviour change.

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