Critical Transition 3.
Protecting and Restoring Nature

	Better Futures Additional Investment Requirements 2030 *(USD billions)*	Better Futures Business Opportunity *(USD billions)*	Economic Prize from Hidden Cost Reductions *(USD billions)*	
 Protecting & Restoring Nature	2030	2030	2030	2050
	$45 - 65	**$200**	**$895**	**$1,310**

Expanding human activity at the expense of forests and other natural ecosystems has historically been a precondition for economic development. Today, this must and can change. This critical transition focuses primarily on tropical forests and peatlands because they are both of immense ecosystem value and under immediate threat. But the general message of protecting and restoring ecosystems applies globally. Fixing tropical deforestation requires global as well as local solutions, partly because many of the biggest drivers of deforestation are demand for globally traded commodities including soy, palm oil, cattle, paper and pulp, cocoa, coffee and rubber.

The argument for comprehensive protection and restoration of natural ecosystems is not made lightly. On the face of it, natural ecosystems seem to be converted for legitimate reasons, primarily food production. But modelling done for this report demonstrates that the conventional idea that nature is disappearing because there is a necessary trade-off between it and economic development is incorrect. It is both possible – and necessary – to halt tropical deforestation and protect other natural ecosystems while setting aside hundreds of millions of hectares of land for forest and ecosystem restoration, and to produce affordable, nutritious food for the global population. In other words, the conversion of natural landscapes to produce food is not a necessity, but a result of failures in markets and governance.

Those failures need to be corrected as a matter of urgency. Neither the SDGs nor the Paris Agreement goals can be reached without intact and abundant tropical forests and other ecosystems. Indeed, there is no pathway towards the Paris goals considered by the IPCC that does not assume a near immediate halt in forest conversion and significant forest restoration over the coming decades.[60] This transition is critical to ensuring that the planet can continue to sustain human civilisation.

Goals and benefits

Given the urgency of the climate crisis, the most carbon rich and geographically restricted biomes – mangroves and peatlands – should be protected, fully and immediately. Tropical forest deforestation rates need to be slashed, starting with a radical reduction from 2020 onwards to achieve at least a 75 percent drop by 2025 and a near complete halt by 2030. Forest degradation needs to be cut at similar rates. At the same time, around 300 million hectares of tropical forests need to be restored by 2030. The protection and restoration of savannahs, wetlands and certain other forest types should follow a similar trajectory.[v]

As well as the contributions that forest ecosystem services make to agricultural productivity and food security, achieving these goals offers specific benefits for the environment, health and inclusion.

Environment:

- Reducing annual net greenhouse gas emissions by more than five gigatonnes carbon dioxide equivalent by 2030 and more than eight gigatonnes by 2050,[vi] which is consistent with limiting global heating to 1.5-degrees Celsius and will yield a social benefit of $800 billion a year;
- By protecting and restoring ecosystems the Biodiversity Intactness Index (BII) starts to recover after 2020, a sign of halting and reversal of biodiversity decline. Avoiding the loss of tropical forests is crucial from this respect. In contrast, the world is currently on a path of steady biodiversity decline towards the "sixth extinction", at a speed similar to that of the last 40 years; locking-in natural ecosystems' continued ability to provide critical services like predictable rainfall, watershed management and pollination;
- Gradually removing the otherwise increasing risk that events once considered extremely low probability – such as a full collapse of forest basins like the Amazon – would materialise.[61]

Health:

- Halting climate change, natural ecosystem conversion and biodiversity loss, which is fundamental to human health and wellbeing;
- retaining the pharmaceutic potential of the biodiversity of the natural world, and in particular of tropical forests (already valued at more than $1500 per hectare, a value which is likely to grow);[62] and
- reducing the air pollution health costs of forest and peatland fires as well as the threat that they pose to life and property.

Inclusion:

- Preserving the livelihoods and sociocultural heritage of the hundreds of millions of poor and often vulnerable people living in and off the forests, including indigenous peoples' groups;
- preserving the varied and proven well-being effects of protected natural systems on communities near them;[63]
- helping forest frontier communities prosper and indigenous peoples' groups maintain their way of life, whilst at the same time raising standards of living by establishing and scaling payments for ecosystem services and the sustainable forest frontier business models described below.

Food security:

- The environmental gains from this critical transition are indispensable to secure medium and long-term food security.

[v] The climate and ecosystems services benefits of afforestation and reforestation vary widely by region, including the complexity of potential albedo effects at higher latitudes. As such, all planned restoration efforts should assess these before widespread implementation.

[vi] Note this benefit is derived solely from achieving the associated reductions in deforestation and increases in afforestation and does not include other 'Natural Climate Solutions'. For information on the benefits of other Natural Climate Solutions, see Griscom et al., 2017.[64]

The annual economic gain from this transition is an estimated $895 billion by 2030, and $1.31 trillion by 2050. A reduction in environmental costs of $440 billion a year by 2030 would be the biggest driver of the gain. However, it is important to recognise that this an extremely conservative estimate since we have not quantified tail end risks, for example the risk of significant reductions in rainfall across the breadbaskets of Argentina, Brazil and potentially the mid-west of the United States which could result from Amazon dieback.[65]

Feasibility

Evidence from several regions shows that decoupling development from deforestation is possible. For example, during a period of unprecedented economic and population growth in the temperate zone, temperate forests went from being the primary culprit of global climate change emissions to a relatively insignificant contributor.[66] Temperate deforestation reduced by 85 percent between the periods of 1920-1949 and 1950-1979. In the following 30-year period it came to a complete halt. More recently, studies show that one-third of the planet's total vegetated lands have been re-greening[vii] since 2000.[67] Remarkably, the key actors driving this phenomenon are China and India, the most populous countries: re-greening is part of their economic development. While maintaining high growth, China has contributed 25 percent towards the global afforestation that has taken place since 2000 despite having only seven percent of the world's vegetated land areas. Some 42 percent of this impressive contribution can be explained by extensive programmes to conserve and restore forest in an effort to reduce soil erosion and air pollution and mitigate climate change.[68]

Unfortunately, while providing positive lessons, there are caveats. The halting of deforestation in the temperate zone coincided with a rapid acceleration in deforestation in the tropical zone, driven in part by demand for commodities from countries in the temperate. Moreover, much recent re-greening is not desirable natural forest reforestation: it is made up of monocultural tree plantations and agricultural intensification, not all of it regenerative or sustainable.

Most importantly, these areas have deforested first and then – partly by default, partly by design – allowed their forest to regrow. This development trajectory, known as the forest transition curve, has contributed to the climate crisis faced today, and it certainly cannot be replicated in tropical countries without disastrous climate impacts. The global climate simply cannot afford an interim period in which the carbon from today's tropical forests moves from the earth to storage in the atmosphere before returning.

In addition, research shows that the benefits humanity derives from forests stem from their quality as well as quantity. Natural forests, which develop with little or no disturbance from humans, store 40 times more carbon than plantation forests.[69] Old growth or primary tropical forest is one of the most complex, rich and beneficial habitats on the planet, providing ecosystem services far higher in quantity and quality than any forest habitat that has been disturbed or engineered by man.[70, viii] To preserve biodiversity, analysis shows there is no substitute for protecting primary tropical forests.[71]

And those forests are still being lost at the rate of several million hectares a year. This means the urgent challenge is to decouple development from deforestation in tropical countries so they follow a new kind of climate-resilient forest transition curve. There are numerous examples of progress, from the remarkable return of forests in Costa Rica, driven by subsidy reforms and payments for ecosystem services, to the decoupling of deforestation from development in the Brazilian Amazon over the period 2006-2014 (which still is the case even if under pressure from recent developments), recent policy progress in Indonesia and Colombia and a pioneering ecological fiscal transfer scheme in India (Box 21).

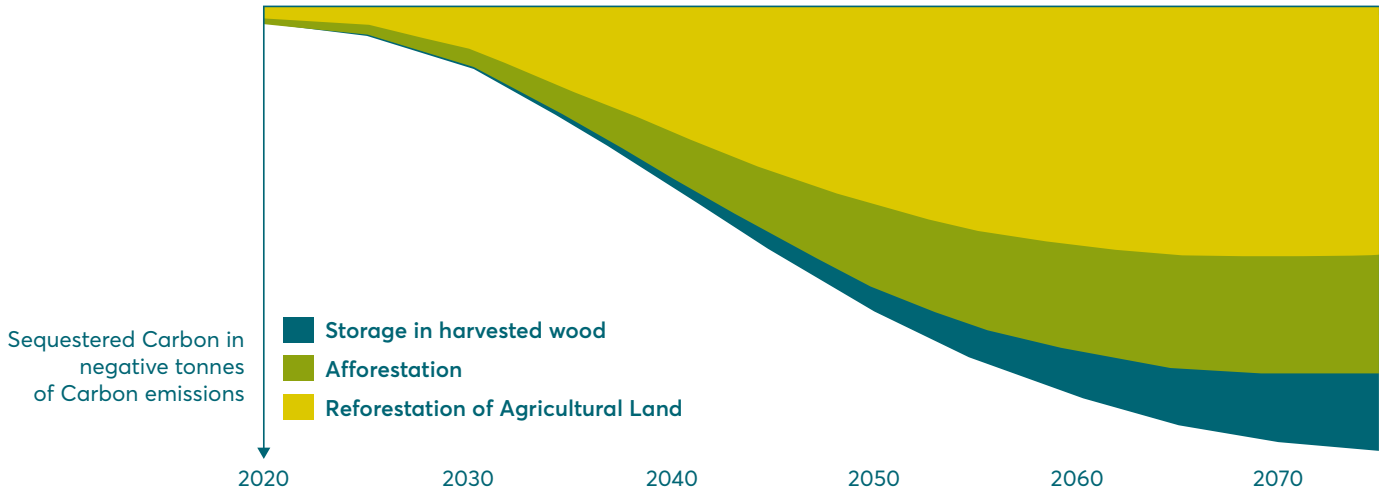
[vii] Increasing leaf area of vegetation.

[viii] Ecosystem services are the benefits that humans freely gain from properly functioning ecosystems, including: food, clean air, oxygen, water filtration, biodiversity, soil fertilisation, protection against extreme weather events and carbon sequestration.

Finally, it is important to emphasise that the carbon sequestration potential of forests builds over time. The gains produced from forests planted today take several decades to reach full fruition. As Exhibit 19 shows, carbon sequestration follows an s-curve that sees a slow start followed by rapid gains, emphasising that the best time to restore forests is now.

EXHIBIT 19

Carbon Sequestration potential of forested land follows an 'S-Curve' – we must plant now to get maximum gains later



Source: IIASA, 2019 (indicative analysis only)

BOX 21

Examples of tropical forest protection and restoration

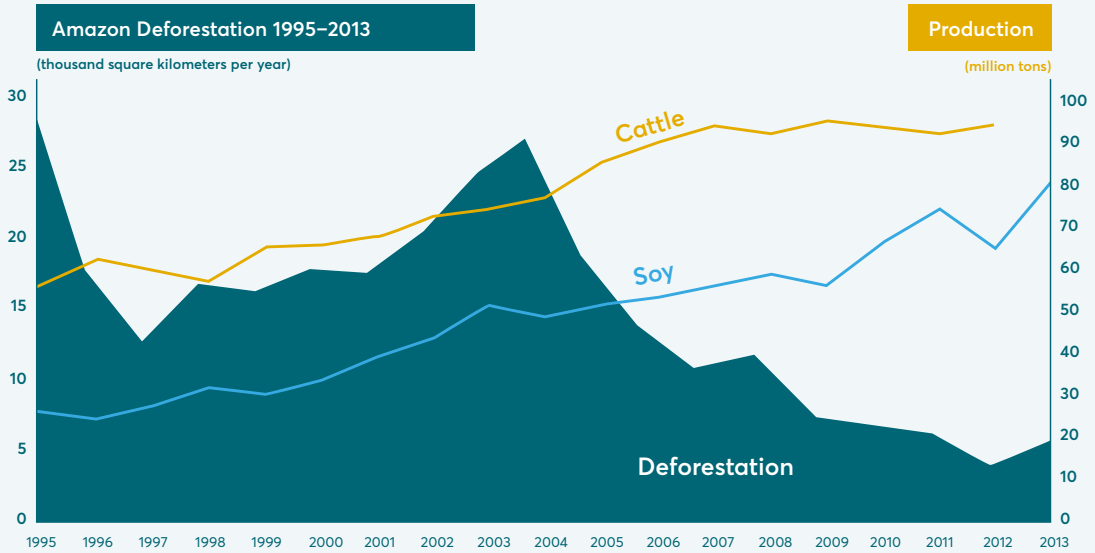
In many countries, effective policies and interventions have led to rapid reductions in deforestation and increases in total forest area. These examples by no means offer perfect answers but all indicate useful lessons that can be adapted to other settings.

Brazil. Facing some of the most extreme deforestation threats on the planet, Brazil has also pioneered some of the most innovative and effective counter-measures. The introduction of an advanced satellite monitoring system (DETER), coupled with robust enforcement on the ground, has been given much of the credit for drastic reductions in deforestation in the Amazon after 2005.[72] (In converse, lagging enforcement and contrary political messages have been given much of the blame for the recent upsurge in deforestation.) Supported by public-private cooperation and civil society engagement, the Soy Moratorium has since 2006 helped to reduce soya's share of recent Amazonian deforestation from 20 percent to less than one percent.[73] Through a combination of increasing law enforcement, expanding protected areas, recognising indigenous territories and increasing agricultural productivity, by 2012 Brazil had reduced large-scale deforestation by over 75 percent relative to the 1996 to 2005 average.[74] This reduction, accompanied by continued rises in GDP, amounted to decoupling development from deforestation (Exhibit 20).

Tragically, recent policy developments are reversing progress, and data seems to indicate that deforestation is increasing steeply. This case thus demonstrates both the importance of political will to progress on sustainable land use and the risks of its absence.[75]

EXHIBIT 20

Deforestation in the Brazilian Amazon 1995-2013



Source: Seymour, F. & Busch, J., 'Why Forests? Why Now?,' Centre for Global Development, 2016

BOX 21 - Continued

Colombia. Colombia has made an ambitious commitment to protect the 50 percent of its national land mass covered by forests. Since 2017, its government has put in place a cross-departmental strategy to combat deforestation and promote sustainable forest management. Although deforestation rose in the power vacuum that followed the peace agreement of 2016, the strategy is already showing progress: actual deforestation rates were down by ten percent from 2017 to 2018, owing to stringent government enforcement and the provision of alternative livelihoods for rural people.[76] International cooperation has also been a factor: the German, UK and Norwegian governments have together committed between $300 million and $400 million to Colombia if the country delivers quantifiable and pre-agreed results in reducing deforestation.

Costa Rica. Costa Rica is the first tropical country to have stopped and subsequently reversed deforestation: more than half of its land is now covered by forest, compared to one-quarter in 1983. Costa Rica has achieved this through a long-term vision of economic growth and development, innovative and progressive policies – particularly to eliminate cattle subsidies and introduce payments for ecosystem services – and consistent international support. On payments for ecosystem services, the government used a novel approach of deploying revenues from taxes on fuel and water to pay farmers and landowners to maintain the provision of ecosystem services on their land, such as carbon sequestration and protection of watersheds. Payments were significant: as much as $125 per hectare a year for the restoration of land with high levels of biodiversity and native species.[77] As large tracts of land were restored and preserved, the socio-economic benefits spread well beyond ecosystem services. Attracted primarily by its natural beauty and biodiversity, more than three million visitors a year travel to Costa Rica. The tourism sector is growing by more than six percent a year and foreign exchange from tourism alone makes up more than six percent of GDP.[78]

India. Since 2005, India has included the forestry sector in fiscal transfers through grants and a tax devolution scheme undertaken by the Finance Commission (FC), providing grants for conserving forest cover. Since 2010, FC grants have included a performance-based instrument through which the release of funds for the final three years was linked to completion of forest management plans by the state forest departments. Since 2015, the FC included forest cover in the tax devolution formula that compensates states for the opportunity cost of maintaining forests and providing ecosystem services. Estimates indicate that $7 billion to $12 billion will be transferred to states in the 2015 to 2020 period on the basis of their forest management performance, making this one of the largest ecological fiscal transfer systems in the world. States that increase forest cover are likely to gain tax revenues of $174 to $303 per hectare a year, whereas states that reduce forest cover before 2020 will stand to lose the same amount.[79]

Indonesia. Over the past decade, the Indonesian government has trialed and implemented a range of policies and initiatives to tackle the extraordinary pressures on its natural ecosystems. In 2010, it declared a complete moratorium on further concessions for conversion of primary forest. It has since then gradually expanded the reform agenda, which has included a national moratorium on peat drainage since 2016. Although challenges remain, the impact of specific policies demonstrates progress: in the year following the peat moratorium, primary forest loss in protected peat areas fell by 88 percent to the lowest level since official records began.[80] This downturn in forest and peat loss and related emissions made Indonesia eligible for results-based payment under the REDD+ Letter of Intent signed with Norway in 2010.

Although they are firmly in the driver's seat, tropical forest countries have not been alone in making progress on this transition. Under the United Nations Framework Convention on Climate Change, a comprehensive arrangement for north-south cooperation on reducing tropical deforestation has been negotiated. This is best known by the acronym REDD+ (Reducing Deforestation and Forest Degradation in Developing Countries, Box 26). In an early test of this arrangement, the Norwegian government in 2008 pledged $1 billion to Brazil by 2015 if Brazil reduced Amazon deforestation below an agreed reference level. Brazil overdelivered by a factor of ten, and Norway fulfilled its obligation. (This being a results-based partnership, payments have been reduced in recent years due to significant increases in deforestation. In 2019 Norway's announced that payments would be halted after unilateral Brazilian government changes to the structure of the fund.) More broadly, Germany, Norway and the United Kingdom promised at the Paris summit in 2015 to contribute $5 billion in tropical forest finance by 2020, a pledge they are on course to fulfilling. Significant steps forward have been made on forest monitoring, including increasingly robust national systems established in several countries, along with global satellite monitoring tools such as Global Forest Watch (Box 22) and international trade and supply chain transparency initiatives such as Transparent Supply Chains for Sustainable Economies (TRASE) (Box 23).

BOX 22

Global Forest Watch

Global Forest Watch (GFW) is an online platform that provides data and tools for monitoring forests. By harnessing cutting-edge technologies (satellite imagery, big data, machine learning) and free access, GFW allows anyone anywhere to obtain near-real-time information about where and how forests are changing around the world. Launched in 2014, GFW is being used by governments to enforce forest protection, companies to pursue deforestation-free supply chains, civil society to hold governments and companies accountable, indigenous communities to protect their homeland, researchers to better understand drivers and hotspots of deforestation, and the media to ring the alarm bell where needed.

BOX 23

Transparent Supply Chains for Sustainable Economies (TRASE)

Transparent Supply Chains for Sustainable Economies (TRASE) maps in unprecedented detail the complex and often opaque links in global supply chains between consumer countries, trading companies and the places where agricultural products are farmed. TRASE can show how commodity exports are linked to agricultural conditions – including specific environmental and social risks – in the production locations, allowing companies, governments and others to understand risks and identify opportunities for more sustainable production. TRASE is a partnership between the Stockholm Environment Institute and Global Canopy and brings together academia, NGOs, governments and corporates.

Left: A member of the Embera village of Chigorodó, Indigenous Reserves of Yaberaradó and Polines [Pueblo Embera de Chigorodó. Resguardos Indígenas de Yaberaradó y Polines] in Uraba, Colombia, holding a native plant, that has special significance to him.

The successes and failures over the past three decades show that progress on this transition is possible. It requires strong government action, supported by civil society and business. However, many tropical forest countries continue to struggle. More than 12 million hectares of tropical forest – an area almost the size of England – was lost in 2018.[81] Equally concerning, continuing high rates of forest degradation are causing forest fragmentation and increasing the fragility of ecosystems across the tropics. Of the fewer than two billion hectares of tropical forest cover standing today, under a quarter remains intact, meaning more than three-quarters is fragmented or degraded.[82] Despite many reasons for optimism, the barriers to progress should not be underestimated. They are extremely complex and wide-ranging. The following are the most important.

First, many governments lack the capacity or the political will to establish and then enforce clear regulatory frameworks for forests and other natural ecosystems. As noted above, political will is the essential ingredient. With that, all other barriers can over time be surmounted. Without it, little will be accomplished even if money is spent.

Second, there has been marginal respect for the traditional territories of forest-dwelling communities and even less legal recognition. But they are demonstrably effective in protecting forests (Box 24). Ignoring their rights impedes progress on this transition.

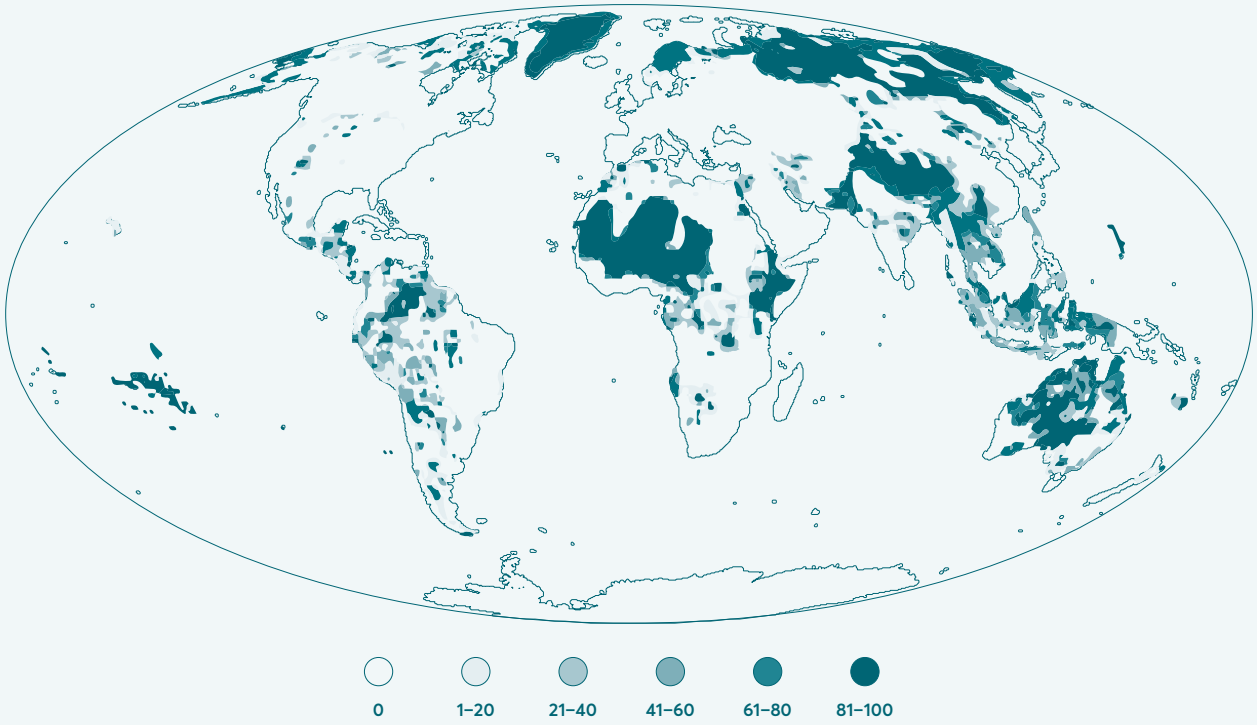
BOX 24

Stewardship of indigenous peoples

The potential contribution of indigenous peoples' groups to the future of the planet's natural lands is inestimable. Some 40 percent of remaining ecologically intact landscapes are under the tenure or management of indigenous peoples.[83] These areas store more than 200 gigatonnes of carbon and coincide with areas that protect as much as 80 percent of the world's biodiversity.[84] The 370 million indigenous peoples,[85] inhabiting 3.8 billion hectares of land, are essential partners and practitioners in the stewardship of the most vital but vulnerable remaining natural resources, and have an essential role in the design and implementation of upcoming and urgent global agreements.[ix]

EXHIBIT 21

Global land area managed and/or controlled by Indigenous Peoples



Note: Darker colour indicates a higher percentage of land area under Indigenous management.
Source: Garnett et al. 2018. 'A spatial overview of the global importance of Indigenous lands for Conservation'. Nature Sustainability.

Beyond the question of scale, nobody has proved themselves better at managing wild places and protected areas than their indigenous inhabitants. Between 2000 and 2012, average annual deforestation rates inside tenure-secure indigenous lands were two to three times lower than in similar forests without secure tenure in Bolivia, Brazil and Colombia (Exhibit 22).[86]

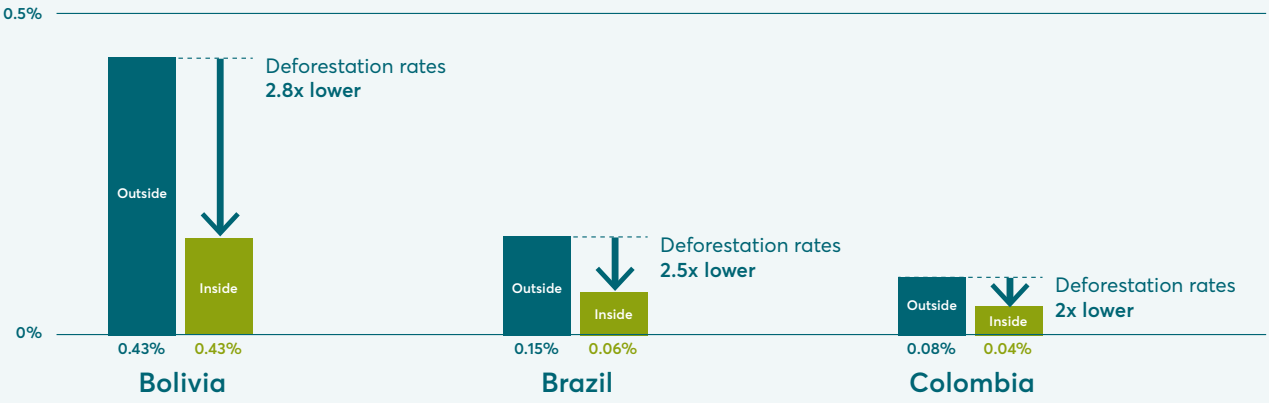
[ix] Such as the upcoming post-2020 global biodiversity framework.

BOX 24 - Continued

EXHIBIT 22

Deforestation in tenure-secure Indigenous Lands

Average Annual Rates, 2000 - 2012



Source: "Protecting Indigenous Land Rights Makes Good Economic Sense," World Resources Institute, October 7, 2016

As forest cover declines, securing the rights to land of indigenous peoples and local communities, and recognising them as forest stewards, is essential to mitigating the climate crisis. In the context of growing pressures from outside groups seeking to farm, log, mine, and drill for oil and gas on Indigenous and community lands and the threats these pressures pose to traditional norms, institutions, and knowledge, it is more important than ever to secure customary rights and strengthen traditional institutions. These efforts must be tailored to local circumstances. While Indigenous territories in the Amazon, community forests in Mesoamerica, and forest user groups in Nepal have all maintained healthy forests, each one's characteristics reflects its own unique context. Integrated approaches are needed – focusing not only on tenure security, but also on complementary regulatory frameworks and financial, technical, and legal assistance to support local forest management systems and advance sustainable livelihood alternatives.

Third, many governments have opaque processes and criteria for providing forest conversion concessions, price them well below their real value and enforce conditions on the concessions lightly if at all.

Fourth, dependence on wood for energy is a key driver of deforestation and land degradation. In sub-Saharan Africa, in the absence of alternative energy sources, 90 percent of the population relies on firewood and charcoal as a primary source of domestic energy.[87] Population growth and urbanisation are causing energy demand to rise, increasing pressure on forests as a source of wood fuel. In Tanzania, it has been estimated that every one percent rise in urbanisation has increased charcoal consumption by 14 percent.[88]

Fifth, there is generally no monetary return for keeping forest standing, even if the benefit to society is overwhelming. In the absence of regulatory frameworks or pricing of externalities, simple economics make it more valuable for an enterprise to convert a hectare of tropical forest to agricultural activities than to leave it standing. This is true for smallholders as well as large companies.

Sixth, consumers have so far not been willing to pay more for sustainable "deforestation-free" food. Major multinationals have struggled to develop reliable deforestation-free supply chains, partly because buy-in to that concept from companies around the world has been far from universal, and there has thus not yet been momentum for a race to the top.

Seventh, governments in many developed countries have created mandates that have added unintentionally to deforestation pressures, notably in the case of bioenergy (Box 25).

Finally, although estimates suggest that trade in illegal forest products adds up to as much as $100 billion a year,[89] national and international law enforcement agencies have generally not treated this as a priority crime. The commons have, in large parts of the world, been more or less free access, with predictable results.

BOX 25

Bioenergy

Bioenergy remains a contentious issue in climate change mitigation debates. Hailed by many as a significant opportunity to rapidly decarbonise our economy (in particular, transport), it also has considerable life cycle analysis weaknesses.

The key points to understand in bioenergy discussions, are that:

- Biomass is a poor converter of sunshine and land to energy. The energy output from a hectare of productive, well-watered land covered with solar methods is typically 30 to more than 100 times higher than the same hectare covered with energy crops.[90] On most global land, if 100 hectares of land were to become available from agriculture, devoting one hectare to solar and 99 hectares to reforestation rather than using that land for bioenergy would typically produce at least the same quantity of energy and more than 100-times the greenhouse gas reductions per year for decades.[91] Costs of bioenergy that divert the productive capacity of land are proportionally high relative to the energy and climate mitigation effect that is being produced.
- Bioenergy comes in different forms and is produced in many different ways – ranging from foraged wood for open cookstoves, through to advanced third generation biofuels (using algae, for example). For the purposes of this report, the essential questions include; (i) whether bioenergy production competes with land for food production or natural ecosystems; and (ii) whether it is a cost-effective climate mitigation approach.
- Land is a fixed and limited resource. A hectare of arable land always has an associated opportunity cost not merely financially but also in carbon terms. In scenarios that do not reduce agricultural land, bioenergy will compete directly or indirectly with carbon storage in existing natural ecosystems. In scenarios that reduce agricultural land, land could alternatively be used for bioenergy or forest regeneration. The carbon savings from the alternative uses can therefore be compared per hectare per year, and absent extremely high yields of energy crops, forest regeneration would sequester more carbon per year for decades. Regeneration is also likely to be cheaper financially. Even if high energy crop yields could be achieved, the net savings compared to regeneration would thus be much lower than the apparent gross savings. Whenever fossil energy can be replaced in other ways, therefore, using available land to restore forest provides added greenhouse gas reductions.
- The potential justification for biofuels is greater for hard to abate sectors – in particular long-haul air travel. For these sources, biofuels could help reducing use of fossil fuel and keep more oil in the ground. Even for these sources, however, the challenge cannot justify deploying biofuels solutions that sacrifice large quantities of either existing or potential carbon storage, and policies will need to come with robust sustainability schemes and incentives to moderate travel demand. It is therefore crucial to put sufficient resources into energy options, potentially including biofuel options, that do not come in competition with land for nature and food security.

BOX 25 - Continued

- While the science is clear about the comparative carbon benefits from using a hectare of land to regenerate forest versus produce bioenergy, the economic mechanisms to ensure optimal allocation of land still need to be put in place whether for forest protection or bioenergy. Hence, the argument presented in this report for a strong, determined push to formalise and enforce forest and other natural ecosystem protection and restoration, and to develop high-quality REDD+- and national payments for ecosystem-markets, both internationally and domestically, to drive appropriate land allocation and create alternative rural incomes and livelihoods.

This report recommends that while more advanced forms of bioenergy, including from waste, can likely play a modest though potentially important role in decarbonisation over the next 30 years, the focus of bioenergy efforts must be on forms of bioenergy that do not, or only minimally, increase pressure on land. For both environmental and economic cost effectiveness reasons, at no point should bioenergy be allowed to drive deforestation or other conversion of natural ecosystems, or to get in the way of degraded land restoration.[x] Existing bioenergy mandates, targets and incentives for crop based-biofuels should be phased out as is, and new policies introduced which better account for potential risks including adverse effect and risks of conversion of natural ecosystems and high carbon stock, including through land diversion. Inefficient sectors (low yielding or carbon-saving crops, feedstocks associated to deforestation) should be phased out of these policies, and incentives redirected towards more advanced bioenergy – including waste-based –or other renewable technology research and development, or tropical forest protection and regeneration.

Bioenergy plus carbon capture and storage (BECCS) could be a different story, because it actually removes the greenhouse gases from the atmosphere. It has therefore been used in a large number of scenarios of mitigation efforts needed to limit global warming to 1.5-2.0 degrees Celsius. On the condition of high energy yields, low losses of biomass between harvest and use and high carbon capture rates, BECCS could generate more carbon savings per hectare than reforestation and could continue to generate savings longer.

The Better Futures scenario of this report does not require the use of BECCS because it is based on a low-energy demand (LED) scenario.[92] However, if the necessary energy efficiency gains (or decarbonisation of the energy system) to stay on a 1.5-degrees pathway by 2040 are not realised, extraordinary measures will potentially have to be taken. In such a case, if and where these conditions for preferring BECCS to reforestation could be achieved, BECCS might be advisable deployed as a 'back-up' option to generate negative emissions. However, these specific conditions must be fulfilled, and even then BECCS would be more expensive than reforestation and come at a cost to biodiversity.

Fortunately, the BECCS choice does not have to be made now. Assuming land can be freed from agriculture, reforesting this land first could be cheaper and provide more benefits. If BECCS is ultimately deemed necessary and efficient, some of these forests could then be harvested and used for that purpose, and the areas be converted to fast growing biomass plantations.

Although this 'back-up' BECCs option keeps the world on a 1.5 degrees pathway, it does so at the expense of biodiversity. In the Better Futures scenario, a recovery of the biodiversity intactness index (see technical annex for description of this concept) is achieved due to protection and restoration of forests and other natural ecosystems. Switching to a BECCs solution would see a reversal of that gain from 2040, and this would continue to trend downwards through to 2100. BECCS, then, may at some point be a necessary last resort to avoid climate catastrophe, but it would involve significant trade-offs and every effort should be made to minimise its deployment. It is, moreover, an unproven technology at any meaningful scale, with poorly understood risks, and as of today, very expensive. If, by 2040, the need for extraordinary climate change mitigation measures becomes clear – far from an unlikely scenario – a thorough and timely analysis of BECCS versus other potential approaches in terms of effectiveness and efficiency must be completed. In the meantime, massive efforts should be directed at other potential solutions (e.g. direct air capture) with better environmental footprints.

[x] The 2019 IPCC Climate Change and Land report highlights that food security may be threatened if land-based bioenergy displaces crops and livestock, with associated risks to terrestrial ecosystems and water scarcity. It also estimates that if the global area dedicated to bioenergy production is less – under some circumstances far less – than 100 million hecates, there will be low to moderate risks to food security, land degradation and desertification.[93]

Priority actions

Success in this transition depends fundamentally on successes in other transitions, notably reducing pressure on land through changing diets, increasing agricultural yields and making more efficient use of land through regenerative farming. However, this will not automatically translate into protection and restoration of forests and other natural ecosystems. Success in this transition will require direct interventions, including measures to overcome the barriers described above.

The essential tools to protect and restore forests and other natural ecosystems are under the control of governments, both national and often subnational. So the jurisdictional approach – a series of different incentives and interventions as described below, targeted simultaneously towards the jurisdictional level – is generally accepted to have the greatest chance of success.[94] The UN climate change convention has recognised this in its REDD+ framework (see Box 26).

To achieve a transition to protecting forests at speed and scale, the global community needs to work on five priorities:

Establish and enforce protection and restoration of forests and other natural ecosystems

Forests and other natural ecosystems are public goods. Government action is needed to protect them. This means putting in place national spatial planning capacity to deploy land to its most socially effective use, and not selling or handing out publicly owned forests. It means developing appropriate forms of protection, including regulations and strict sustainable use regimes, and passing moratoria on converting forest to agricultural land. And it means strictly enforcing these measures.

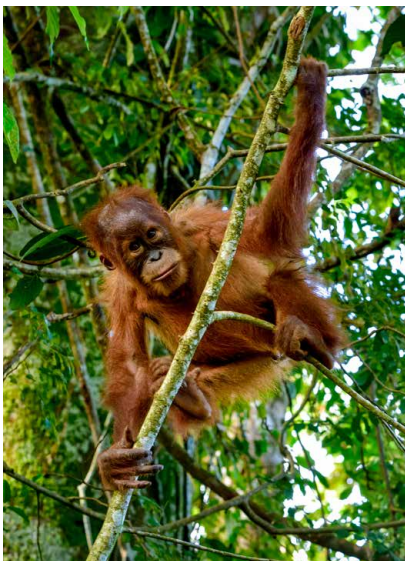
One proven form of forest protection that could be rapidly scaled – and has potentially outsized potential – is granting indigenous peoples' groups legal title to their traditional lands, and the means to defend them. Traditional protected area networks are also crucial, as is setting aside and policing areas for natural forest and ecosystem restoration, in particular the edges of forests. For all categories of protection, it is essential that regulations and enforcement protect both the ecosystem and the full variety of biodiversity thriving there. For example, the decimation of large mammal populations in parts of the world must be halted because of their intrinsic value and because the functioning of ecosystems depends on their continued presence (see also the recommendation in this report to establish a Global Alliance Against Environmental Crime).

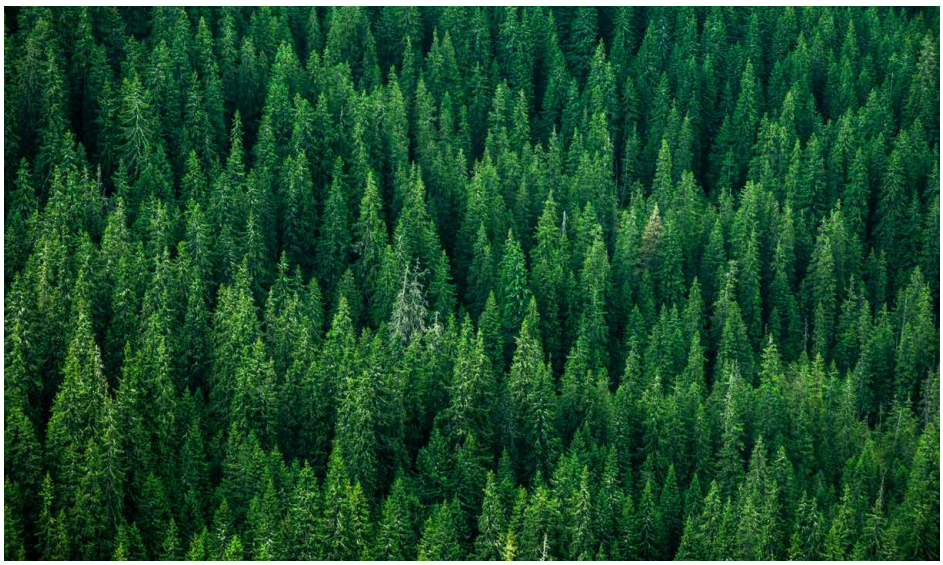
Supplementing regulations and enforcement, public finance needs to be redesigned to avoid perverse incentives for forest and ecosystem conversion. This involves reforming agricultural subsidies (see Box 21 on the impact of removing cattle subsidies in reversing Costa Rica's loss of forests), public procurement, tax regimes and transfer mechanisms. Where practical, public finance should be designed to promote forest protection. For example, governments – as well as multilateral development banks and private financiers – could tie low-interest credit to protection of forests, as Brazil has done. International development assistance for agriculture can also be linked to assistance for forest protection and restoration. And support for productivity gains should also be linked with efforts to protect natural ecosystems from further conversion to agriculture.

Extend payments for ecosystem services

To halt deforestation and other ecosystem conversion, large-scale payments for ecosystem services will be essential, between and within countries.

Tropical forests are located mainly in developing countries and emerging economies. Yet some of the benefits they provide, including carbon storage and biodiversity conservation, are enjoyed by all countries. The costs of protecting them should therefore be shared. The REDD+ cost-sharing scheme, which essentially provides payments for





ecosystem services to tropical forest countries from developed countries, and potentially from emerging economies, has been established by the UN climate change convention (Box 26). This report recommends scaling finance for this scheme to boost progress on this transition, starting with around $2 billion a year in 2021 and rising rapidly to reach $50 billion potentially in 2030, depending on results.

Governments would need to create and regulate markets for such markets to reach the scale required at the necessary speed. The regulations would include both determining which environmental, social and financial standards should apply, and which private sector entities should pay for which mandatory amounts of emissions reductions. The private sector could play a critical initial role by helping markets emerge through voluntary near-term purchasing commitments (see Box 18).

At the national level in tropical forest countries, payment for ecosystem services to farmers and communities on the forest frontier will be essential to ensure the effectiveness and political viability of measures to protect and restore the forest. In other words, farmers and communities need to see a value from keeping the forests standing. Optimal conservation benefits for a given payment, combined with mechanisms to promote sustainable rural livelihoods, should thus be key when designing payment for ecosystem services systems.

Incentives for countries with high forest cover and low deforestation present a particular challenge. Since they already have low deforestation, it is hard for them to reduce it by much. Moreover, they will sometimes be the exception to the rule that there is enough non-forested arable land to reach agricultural targets. One way to encourage such countries to maintain their high forest cover would be through higher prices per tonne of emissions reductions. Another would be to allow a reference level for deforestation/greenhouse gas emissions slightly above historical levels. Given the acute need to preserve intact ecosystems, this is a challenge that should be taken very seriously both at the international level, through REDD+, and at the national level to ensure sufficient incentives for particularly forest rich jurisdictions.

BOX 26

Reducing emissions from deforestation and degradation (REDD+)

Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD+) is a mechanism defined by the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC). It is designed to offer incentives to reduce emissions from deforestation and forest degradation while fostering conservation, sustainable management and enhancement of forest carbon stocks.

The relevant UNFCCC decisions on REDD+ set the main framework for payments for performance in the shape of verified emissions reductions from tropical forests. This includes provisions for measurement and reporting systems, guidelines for setting reference levels, and safeguards to ensure environmental integrity (the protection of natural ecosystems and biodiversity) and social integrity (the protection of the rights of indigenous peoples and local communities).

Going forward the REDD+ mechanisms could play a central role in achieving net zero emissions in the global economy both by driving down emissions and incentivsing additional removals of greenhouse gas emissions through forest restoration. The mechanisms could form the basis of long-term predictable arrangements for such payments, and potentially be extended to other ecosystems.

Payments would be made directly in proportion with results. For example, the target of $50 billion for tropical forests and peatlands by 2030, which this report recommends, would be based on reaching the goal of close to zero gross deforestation, accompanied by significant restoration. If the results are less impressive, the payments would be lower. Incentives should – in accordance with UNFCCC decisions – be targeted at the national or, in an interim period, sub-national jurisdictional level, and robust measures to ensure the environmental integrity of results would be essential for success.

However, while the UN convention on climate change has determined the basic framework for REDD+, its decisions are not specific enough in themselves to ensure the integrity of results and transactions. The Architecture for REDD+ Transactions (ART) and the Emergent Forest Finance Accelerator (EFFA) are designed to operationalise this framework and to catalyze financing and results at scale. Together, these initiatives have the potential to install confidence in both buyers and sellers of tropical forests emission reductions that REDD+ is now becoming a reality, and that being part of its transactions will lead to real and credible emissions reductions.

ART is a global voluntary initiative to promote the environmental and social integrity, and ambition, of high-quality carbon emission reductions from tropical forest countries. ART is overseen by an impartial global board. It includes a rigorous standard to quantify emissions reductions from REDD+ at a jurisdictional and national scale, and a comprehensive technical process to register, verify and issue high-quality, serialised credits transparently.

EFFA is a non-profit organisation that serves as an intermediary for transactions of ART credits. It provides a simple, standardised and credible method for private and public buyers to access ART credits, while providing forest countries with a guaranteed source of demand for their forest services and streamlined access to a wide range of financing sources. To catalyze both supply and demand, EFFA is designed to be able also to deploy public donor funds to provide purchase commitments through a guaranteed minimum price.

Extend deforestation-free supply chains globally

The deforestation-free supply chains movement has already stacked up some inspiring achievements on important commodities such as soy and palm oil. For example, the Brazilian state of Mato Grosso, which accounts for 85 percent of Brazilian Amazon soy production, saw dramatic reductions in forest conversion following the implementation of the Amazon soy moratorium in 2006.[95] Soy producers can choose to move to other areas without such restrictions, however, and demonstrably have. This is known as "leakage", and can be handled only by comprehensive global approaches.

Thus, achieving universal acceptance of the zero-deforestation principle and extending it to all relevant commodities will give an enormous boost to this transition, as will zero tolerance for environmental crime, land grabs, exploitation and human rights abuse in supply chains. Businesses could establish such principles throughout their supply chains and require all their suppliers to do the same. They could also educate their customers and investors on the value of forests (including their direct and indirect monetary value to production and supply chains, as well as their intrinsic importance). Financial institutions could require the companies they invest in to adhere to the same principles, rewarding high performers and disinvesting from repeat offenders. Governments could encourage the adoption of such principles by participating in public-private collaborations to promote their dissemination and implementation, such as the Tropical Forest Alliance. They could also provide free or affordable access to relevant public goods, such as the data from satellite monitoring services used for monitoring by Global Forest Watch (Box 22), as well as funding for such platforms. Civil society monitoring and campaigns can help to keep all actors accountable.[96]

Use new technology tools and networks to drive transparency and accountability

Tools and networks are needed to clarify the biophysical and legal state of the forests: what happens to them, who is responsible and who finances those responsible?

The platforms for such transparency are probably best provided by independent civil society institutions, such as the Woods Hole Research Centre or the World Resources Institute through its initiative Global Forest Watch (Box 22). Civil society should work with businesses to encourage them to offer full transparency in their supply chains and make data available on open platforms. Financial institutions should demand transparency across the food and land use value chains of companies they finance, analysing the relationship between sustainability factors and creditworthiness and rewarding high performers with improved interest rates.

Governments should lead by example and maintain full transparency on national land use planning and enforcement, including explicitly pricing in and articulating environmental costs and external factors in all land use decisions. Higher standards on transparency and accountability depend on sanctions for failing to meet them. This report therefore recommends establishing a Global Alliance Against Environmental Crime (Box 27).

BOX 27

Global Alliance on Environmental Crime

The International Criminal Police Organization (INTERPOL) and the United Nations Environment Programme (UNEP) estimate that natural resources worth between $90 billion and $260 billion annually are being stolen. Environmental crime is growing at two to three times the rate of the global economy.[97] Tackling this scourge requires coordinated political, economic and social efforts. Relevant international institutions like Interpol, UNEP and the United nations Office on Drugs and Crime could work closely with national law enforcement agencies through a Global Alliance on Environmental Crime to rapidly scale up the ability to crack down on this category of crime. Increased funding would be needed, both directly for the work of the relevant agencies and indirectly to strengthen the infrastructure needed to leverage modern technology (satellites, tracking, supply chain transparency) in this battle. Funding such an effort at scale would be an extremely cost-effective investment for ODA donors and philanthropies, for example.

Develop and scale forest frontier business models

Satellite-based analysis of deforestation reveals where and how humans are destroying the last remaining tropical forest. The main action takes place at the forest frontier, a 600 million hectare belt of land made up of three categories of land use: relatively intact natural forest, active agricultural land and degraded areas.[98] For each key land use category, a corresponding group of business models exist which are able to provide the socio-economic incentives to keep forest standing and encourage rapid restoration (Box 28).

Regenerative forest frontier businesses need to be rapidly scaled, with target compound annual growth rates of around 20 percent over the next decade. To become established, they will need innovative forms of finance including long-term, patient capital, blended-finance instruments and performance-linked payments. There are many examples to learn from. For instance, a consortium of 20 banks recently announced a $2.1 billion sustainability-linked loan to the commodity trader COFCO.[99] The banks agreed a lower rate on interest repayments, provided COFCO is able to meet a series of pre-agreed sustainability targets, including the production of fully traceable Brazilian soybeans on degraded (rather than forested) land.

BOX 28

Introducing regenerative business models

Primary forests are mostly disappearing from the outside in. Each year, millions of hectares of tropical forest edge are lost to make way for other land uses: commodity production, shifting agriculture, urbanisation. Investing immediately and decisively at this vulnerable boundary – the forest frontier – offers an opportunity to protect the vast quantities of carbon locked in the forests behind it and to try to limit global warming to 1.5 degrees Celsius.

Regenerative business models integrate the needs of society with the integrity of nature. They ensure that the natural sources of value on which society depends are renewed, rather than depleted, allowing the model to be sustainable. In tropical forests, regenerative models derive social, economic and environmental value from the protection, restoration or sustainable management of forests. In doing so, they provide tangible incentives to keep forests standing or to regrow them.

Importantly, most of these business models depend upon the regulatory and financial incentives recommended in this report being in place in order to be commercially viable at scale.

The three main categories of regenerative business model are:

- **Creating value from standing forest.** Models in this category depend on harnessing the variety, value and productivity of naturally occurring forest products and environmental services. They do not include timber plantations or other forms of man-made plantation forests. When implemented, high-value, low-intensity value chains are created: products and services produced by intact forests deliver high market value per unit and can be generated or harvested with minimal impact on the ecosystem. Examples of business models within this category include forest protection efforts to be compensated through payments for ecosystem services (the REDD+ market alone could potentially be worth $50 billion in the next two decades),[100] wild forest production (honey, nuts, pharmaceutical products) and ecotourism.

- **Sustainable agricultural production-protection.** These models involve increasing the productivity and reducing the environmental impact of agriculture in forest landscapes. Improved practices (particularly sustainable intensification) are combined with land use planning, robust local governance and incentive and reward mechanisms for forest protection. The result is increased productivity per hectare, the protection of forest with the highest conservation value and sometimes the restoration of degraded land. Examples of business models within this category include the sustainable production of commodities such as palm oil and cocoa, and the production of crops such as coffee using "climate-smart", shade-grown techniques.

- **Creating value from forest regrowth.** These models focus on restoring degraded land to a state as close as possible to natural forest. They use diverse regrowth mixes that increase above- and below-ground biodiversity and biomass. They do not include monocultural plantations. By mimicking natural ecosystems and using species suited to specific environmental conditions, forest regrowth models can stimulate environmental and economic productivity. Examples of business models within this category include replanting native natural forest for compliance or voluntary purposes (such as compulsory or voluntary corporate social responsibility commitments). A modified version of the latter involves tailoring regrowth to maximise its productivity, using a broad mix of native seeds but focusing on species from which a commercial revenue can be derived, such as sugar palm or rubber. Such near-natural "forests with a cash flow" have yet to be planted on a large scale but may expand rapidly because of the revenue streams and rich ecosystem services they could deliver.

Transition costs

The global costs of this transition break down into the costs of forest protection and its enforcement and the costs of ecosystem restoration. There are good models of host countries and donors sharing the costs of protection and enforcement. For example, in the Brazilian ARPA programme various donors, including international development aid agencies, help Brazil to cover the costs of administering new protected areas.

The cost of restoring an ecosystem depends on circumstances and geographic location. High costs can be a barrier to rapid, widespread restoration, which is why finding ways to produce a reasonable return from restoring forests would be potentially transformational. Current public and private spending on research and development (R&D) could be redirected to R&D for new forest frontier models. Regenerative forest businesses will also be eligible for official development aid, given their large positive knock-on effects on rural livelihoods, economies and resilience.

Scaling up REDD+ to $20-50 billion a year – which could be funded largely by regulating high-emitting companies to purchase environmentally robust emissions reductions from tropical forest countries – will be an essential source of capital targeted mainly at reducing deforestation.[xi]

[xi] The social value of reduced greenhouse gas emissions from forests alone would – given eight gigatonnes of carbon dioxide equivalent mitigation and an assumed social value of emissions reductions of $100 per tonne of carbon dioxide – be worth $800 million a year. In other words, 16 times the cost of the REDD+ scale up if the full potential of tropical forests is realised.

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