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the contribution of forests to climate change mitigation

a synthesis of current research and understanding

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Authors: Wouter van Goor and Martijn Snoep



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1 EXECUTIVE SUMMARY

Although many studies suggest that the global mitigation goals cannot be met without the inclusion of forests, reducing deforestation and forest degradation, reforestation and improved forest management (IFM), they are often overlooked as readily available carbon removal solutions. Forests have great potential to deliver on the climate mitigation goals while at the same time providing important benefits to soils, air, water, biodiversity and development. However, forests and lands only receive 3% of available climate funding.

In this report we discuss the potential role and cost-effectiveness of forest conservation, restoration and management (REDD+) in climate change mitigation; the value and (co-) benefits of forests and REDD+ and; the constraints, risks and safeguards associated with REDD+ implementation and management.

The role of forests in global climate change

For the past 25 years, forest cover in temperate climate countries has been stable or increasing. Since the 1960s however, tropical forests are experiencing severe pressure and deforestation and forest degradation have increased with alarming rates. Between 2000 and 2017 the rate of deforestation doubled and rose to a loss of more than 14 Million hectares in 2017 (about four times the size of the Netherlands; WRI, 2018).

Forest land stores approximately 60% of the total carbon stock contained in terrestrial carbon pools. Around 30% of the current anthropogenic CO₂e emissions are removed by terrestrial ecosystems (mainly forests), the loss of forest causes direct emissions from deforestation and reduces the capacity of global forests to remove these emissions. In total, the current global forests store a greater amount of carbon than the estimated carbon emission potential of the current available fossil fuel reserves.

Studies estimated that the annual emissions from deforestation, forest degradation, forest fires, peat fires and peat decay (collectively grouped under the term 'Forestry

and other Land use' (FOLU) or Land Use, Land-Use Change, and Forestry (LULCF) account for around 10% of the global net carbon emissions (mainly from tropical deforestation). When considering gross emissions (total anthropogenic emissions from deforestation without the deduction of sequestration by forested land elsewhere) however, FOLU is responsible for approximately 30% of the global total carbon emissions.

Estimates of the mitigation potential from afforestation and reforestation (AR) vary, from 0.5–3.6 GtCO₂e/yr (to 2050) up to 2.7–17.9 GtCO₂e/yr (to 2030). The variation in estimates is, among others, related to different assumptions on the amount of land that is available without inducing conflict with other land use. Improved forest management (IFM) offers large mitigation opportunities, many of which can be implemented rapidly without changes in land use or tenure (Griscom, et al., 2017). However, such strategies would also entail severe reductions in annual wood harvest volumes of these forests and plantations. It was estimated that up to 18% of cost-effective mitigation potential through 2030 could be realized with AR and IFM combined (based on Griscom et al., 2017).

Cost-effectiveness of REDD+

The majority of carbon prices around the world do not yet properly reflect societal and environmental costs of climate change and are still too low to reduce emissions fast enough to limit global warming to a safe level. Without the right level of ambition on climate change and well-functioning carbon pricing systems huge costs are expected for future generations.

Avoiding deforestation and forest degradation offers a large, fast, and cost-effective means of reducing emissions. With price estimates varying between US\$10–100 per tCO₂e, studies estimate that up to 80% of the potential estimated mitigation potential for avoided deforestation and forest degradation can be achieved (and up to 50% at or below US\$10/tCO₂e).

Costs for afforestation and reforestation (AR) range between US\$1–100/tCO₂e, while estimates of the cost effectiveness of improved forest management range between US\$10–100/tCO₂e.

The latest IPCC report indicates that delays in reducing GHG emissions means that in future we will become increasingly dependent on 'Negative

Emission Technologies' (NETs) for achieving the climate goals. However, to date, AR is considered the only 'mature' NET technology that already exists at scale, with the potential for storing large amounts of carbon, ignoring the other major, often more cost-effective, categories.

While the potential of forests as a mitigation strategy outside of the tropics are often limited, in developing countries reducing deforestation and forest degradation could offer nearly half the potential of cost-effective emission reductions. Although compliance markets have yet to accept REDD+ offsets, there is a large potential for western countries to significantly contribute to climate change mitigation through investments in REDD+ abroad. Simultaneously these countries can increase their ambition to close the gap between current NDC's / domestic policies and what is needed to deliver on the goals of the Paris Agreement.

REDD+ in the voluntary market

REDD+ credits are the most commonly transacted voluntary offsets over the past decade. Carbon credits of forest projects

are regularly valued higher than other project categories due to the appeal and substantial co-benefits of forest projects. However, due to large supply and low demand current market prices are still often at the bottom of or below the cost for implementation. Additionally, these projects often require substantial up-front investment and cannot exist based on sales from carbon credits alone. Without the prospect of a stable carbon price it is difficult to attract mainstream financing. On the other hand, REDD+ credits do not suffer from conflicting local policies such as renewable feed-in tariffs which are beginning to exclude many other project types from the voluntary carbon market amidst concerns over additionality.

The co-benefits of REDD+

Next to the substantial potential to contribute to climate change mitigation, REDD+ projects have significant positive impacts on biodiversity conservation and restoration, the development of livelihoods of local communities and the preservation and recovery of a broad range of ecosystem services provided by forests. These benefits are very much interlinked and can have an impact well beyond the

boundaries of the forest itself. On the one hand this underlines the high potential impact and significance of REDD+, but also the massive damage that deforestation and forest degradation can cause at multiple levels and scales.

REDD+'s rigorous design and methodologies strive to ensure that the impacts are real, additional and remain intact in the long term. Additionally, REDD+ includes safeguards to ensure that unintended emissions resulting from the project intervention outside the project boundary are avoided and if not avoidable, mitigated and accounted for.

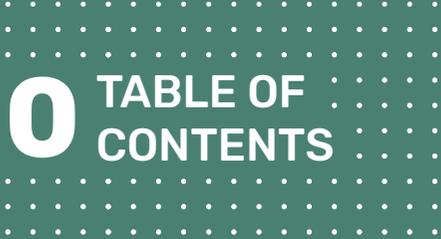
REDD+ Potential and Safeguards for Long-Term Benefits

It is also important to look at the impacts of REDD+ to the local population. Assurances to engage communities and indigenous peoples, to apply free and prior informed consent (FPIC), are mandatory for REDD+ projects and doing 'no-net-harm' to communities is a minimum condition. REDD+ has the potential to be pro-poor and create net positive social benefits, provided that the interests of forest-dependent people

and other stakeholders are carefully considered.

Conclusion

With robust environmental and social standards and safeguards, enshrined in standards, methodologies as well as national and international policies and programs, REDD+ offers a large, fast, and cost-effective means of reducing emissions while at the same time creating substantial net positive social and environmental benefits.



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1 INTRODUCTION

Under the Paris Agreement most countries have agreed to take measures to maintain the global average temperature rise well below 2°, while pursuing efforts to limit the increase to 1.5°. In a new assessment on the impacts of 1.5°C of global warming (IPCC, 2018), IPCC states that limiting global warming to 1.5°C would require rapid, far-reaching and unprecedented changes in all aspects of society. Based on the current country pledges (NDCs), global warming is expected to surpass 1.5°C, even if countries would significantly increase scale and ambition of mitigation after 2030. The 2018 IPCC assessment suggests a remaining carbon budget for <1.5°C (with a 67% probability) about 550 GtCO₂, and of about 750 GtCO₂ (with a 50% probability). To remain within the 750 GtCO₂ budget implies that carbon neutrality should be reached in +/- 35 years, while for a 550 GtCO₂ carbon budget this should be within 25 years.

Studies (Federici et al., 2017; Grassi et al., 2017; Griscom et al., 2017; Rockström et al., 2017; Seymour and Busch, 2016) and the IPCC (AR5 report, 2014) suggest that the global mitigation goals cannot be met without the inclusion of forests, reducing deforestation and forest degradation, reforestation and improved forest management (IFM). They are however sometimes overlooked as effective and attractive carbon removal solutions. To date forests are the only proven means of removing and storing atmospheric CO₂ at a scale that can meaningfully contribute to limiting global warming. Alongside drastic fossil fuel related emissions reductions, forests have great potential to deliver on the climate mitigation goals while at the same time providing important benefits to soils, air, water, biodiversity and development. Forests already remove around 25% of the anthropogenic carbon emissions added to the atmosphere each year (Le Quéré et al., 2018), and could provide an additional 30% of the mitigation needed by 2030 (Griscom et al., 2017). Houghton et al. (2015) argue that tropical forests could offset much of the carbon released from the declining use of fossil fuels, helping to stabilize and then reduce atmospheric CO₂ concentrations, thereby providing a bridge to a low-fossil-fuel future. However, forests and other land use (excluding agriculture) only receive 3% of available climate funding (Buchner et al., 2017).

The REDD+ framework was negotiated under the UN Framework Convention on Climate Change (UNFCCC) over the past decade and was endorsed in the Paris

Agreement. Most of the REDD+ activities have been at individual project level within the voluntary carbon market, through inter-governmental funding and public funding. The Paris Agreement allows for international transfer of mitigation outcomes (Seymour and Busch, 2016), but compliance-driven carbon markets are yet to allow REDD+ offsets.

This report aims to summarize the current understanding of and debate about the role of forests in global climate change dynamics. In the following chapters we discuss the potential role of forest conservation, restoration and management in climate change mitigation (Ch. 2); the cost-effectiveness of REDD+ (Ch. 3); the value of forests (Ch. 4); REDD+ constraints, risks and safeguards (Ch. 5).

We found that the book 'Why Forests, why now?', written by Frances Seymour and Jonah Busch, published by the Center for Global Development in 2016, was a great source of information. For a more detailed overview and further reading about the value of forests and the role of tropical forests in climate change mitigation we recommend you to read this publication.

¹ Five Reasons the Earth's Climate Depends on Forests. Statement from Scientist Signatories. <http://www.climateandlandusealliance.org/scientists-statement/>

² Available at the CGDEV website: <https://www.cgdev.org/sites/default/files/Seymour-Busch-why-forests-why-now-full-book.PDF>

2 THE ROLE OF FORESTS IN GLOBAL CLIMATE CHANGE



2.1. Deforestation and forest degradation trends

The latest Forest Resource Assessment (2015) from FAO reported that global forest cover has decreased from 4,128 million ha in 1990 to 3,999 million ha in 2015; a net loss of 129 million ha. They found that the annual net loss of forest slowed from 0.18% in 1990 to 0.08% between 2010 and 2015. These figures are however misleading because forest cover in many tropical countries is increasing as a result of the expansion of monoculture plantations. The gross loss of natural forest between 1990 and 2015 is therefore much higher: 203.5 million ha of natural forests disappeared over this period while planted forest area increased with 105 million ha. This indicates that even though newly planted forest compensated part of the forest loss, negative impacts on biodiversity and valuable natural resources are more severe than the net figure of forest loss suggests. While temperate deforestation and

Global Forest Watch (WRI): https://blog.globalforestwatch.org/data/2017-was-the-second-worst-year-on-record-for-tropical-tree-cover-loss?utm_campaign=gfw&utm_source=wriinsights&utm_medium=hyperlink&utm_term=gfw-climatebythenumbers_10_2018

associated land use changes have been the major sources of GHG emissions until 1912, for the past 25 years, forest cover in temperate countries has been stable or increasing (Seymour and Angelsen, 2013). Since the 1960s however, tropical forests are experiencing severe pressure and deforestation and forest degradation have increased with alarming rates. Data from the University of Maryland (Figure 1) shows a gradual increase in deforestation in the past 17 years, with a significant increase in 2016 and 2017. Based on current projections,

Seymour and Busch (2016) state that if no measures are taken, tropical deforestation is projected to rise steadily through the 2020s and 2030s and then accelerate in the 2040s, resulting in the clearing of an area of 2.9 Mkm² by 2050.

Apart from deforestation, forests are subjected to degradation, through unsustainable harvest or land-use practices, fire and other disturbances, leading to substantial reduction of forest biomass, species composition and structure. The global extent of

forest degradation, however, is more difficult to assess. The FRA 2015 (FAO, 2016) provides an estimate of degradation by proxy of partial canopy cover loss. Between 2000 and 2012, the partial canopy cover loss was estimated at 185 million ha (tropical forests accounted for 156 million ha). Furthermore, the FRA 2015, reports 65 million ha of burnt forest in 2010. A study by ITTO (2002) on the other hand, estimated that in 2000 up to 850 million hectares of forest and forest lands were degraded.

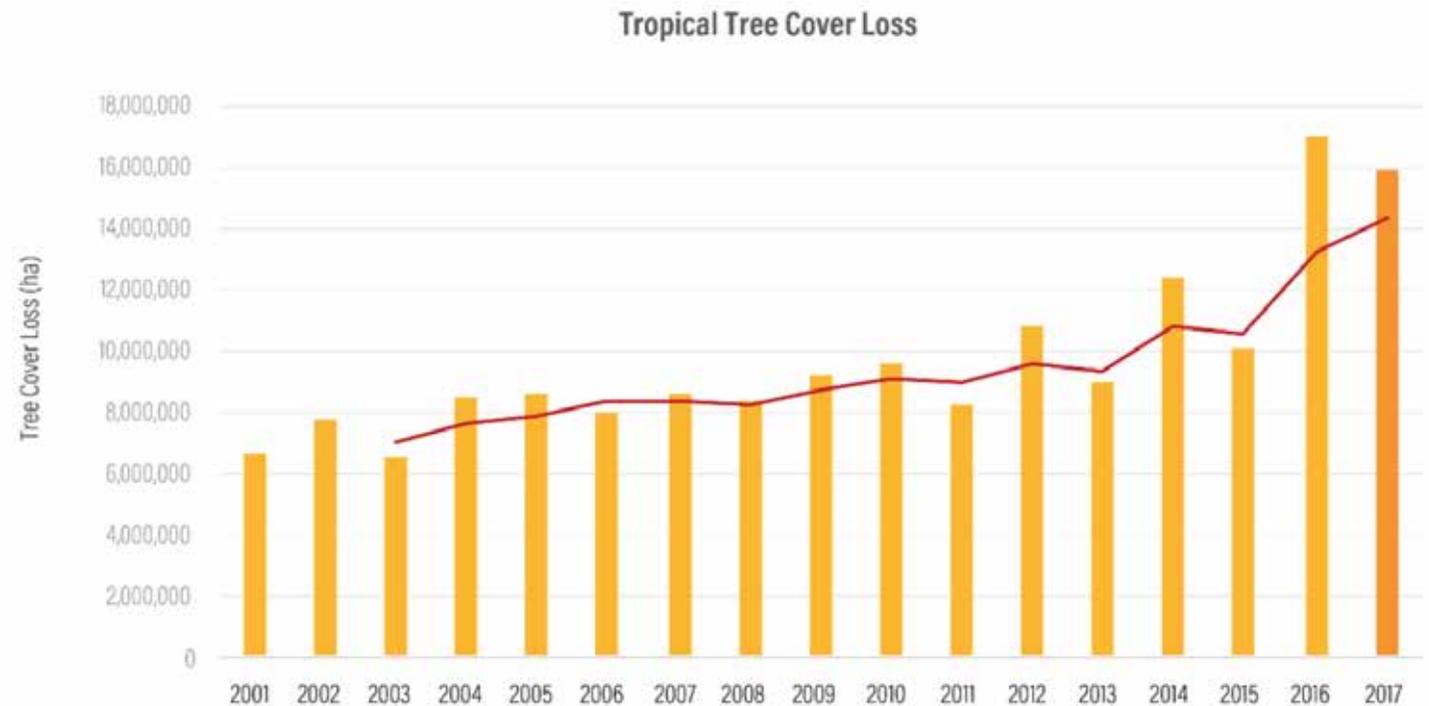


Figure 1. Tropical tree cover loss between 2001 and 2017, according to data from the University of Maryland. Source: Global Forest Watch, WRI.



2.2. Forest carbon storage and emissions

2.2.1 Global forest carbon stocks

Forest land stores approximately 60% of the total carbon stock contained in terrestrial carbon pools (Federici et al., 2017). The FRA 2015 estimated a carbon stock of 1085 GtCO₂e in live forest biomass, while Pan et al., 2011 and the IPCC (2018) assessment reported carbon stocks of 1331 GtCO₂e and 1645 GtCO₂e, respectively. When including organic matter in soils, litter, and deadwood, Pan et al. (2011) and IPCC (2000, in Federici et al., 2017) report an even far greater estimate, 3157 GtCO₂e and 4033 GtCO₂e, respectively. In total, the current global forests store a greater amount of carbon than the estimated carbon emission potential of the current available fossil fuel reserves (2700 GtCO₂e; Heede & Oresskes, 2016; see Figure 2).

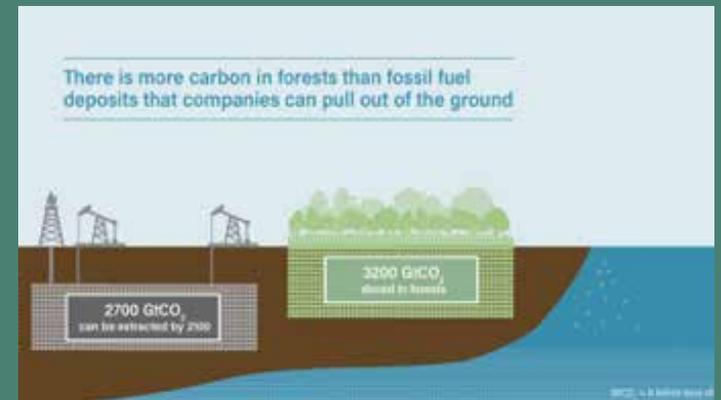


Figure 2. Carbon stored in available fossil fuel reserves and current global forest carbon stocks. Source: <http://www.climateandlandusealliance.org/scientists-statement/>

2.2.2. Forest carbon emissions and sequestration

Temperate and boreal forests are considered carbon sinks with an average estimated sequestration rate of 2.6 GtCO₂e/yr and 1.8 GtCO₂e/yr respectively between 1990 and 2007 (Pan et al., 2011).

Wherein tropical forests however, emissions from deforestation and forest degradation outpace sequestration. Various estimates of annual emissions from global tropical deforestation have been made in recent years, with various

scopes (only deforestation, including forest degradation or including both degradation and peat). A couple of studies have summarized these estimates and made an analysis of their differences (see IPCC, 2014; Seymour and Busch, 2016; Baccini et al., 2017; Griscom et al., 2017). The studies synthesized by IPCC (2014) showed an estimated 8.4 GtCO₂e to 10.3 GtCO₂e per year of gross emissions and an estimated 4.3 GtCO₂e/yr to 6.2 GtCO₂e/yr of gross removals from forest (re) growth, or 4.1 GtCO₂e/yr in net

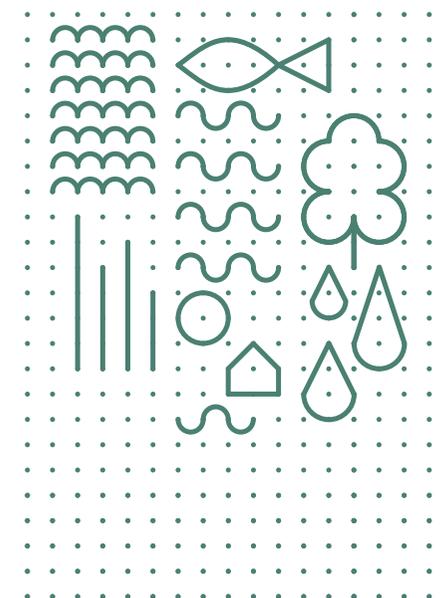
emissions. This amounts to around 8% of the global net carbon emissions. When including emissions from forest fires, peat fires and peat decay (collectively grouped under the term 'Forestry and other Land use' (FOLU) or Land Use, Land-Use Change, and Forestry (LULCF); see IPCC, 2014), the proportion is estimated at 11%. The relative proportion has decreased to 10% in recent years, because of the continuing growth of fossil fuel use (Federici et al., 2017). When considering gross emissions, however, FOLU is responsible for around 30% of the global total GHG emissions.

The carbon emissions from the projected tropical deforestation (2.9 Mkm², see §2.1) from 2016–2050 would be 169 GtCO₂e of carbon dioxide (Seymour and Busch, 2016).

2.3 Potential of REDD+

2.3.1 Reducing deforestation and forest degradation mitigation potential

As the previous paragraph suggests, the potential contribution to global climate change mitigation by avoiding deforestation and forest degradation is estimated to be 10%. Seymour and Busch (2016), however, argue that the total mitigation potential should be considered much higher, as they depict



in Figure 3 below. Around 30% of the current anthropogenic CO₂ emissions are removed by terrestrial ecosystems (mainly forests), the loss of forest does not only cause direct emissions from deforestation, but also reduces the capacity of global forests to remove these emissions. Seymour and Busch (2016) also argue that the 24–30% mitigation potential of forest could be over- or underestimated. On the one hand it will be a challenge to completely stop all deforestation. On the other hand, this mitigation potential from forests does not yet include the additional carbon sequestration potential from afforestation, reforestation (AR) and IFM (see §2.3.2).

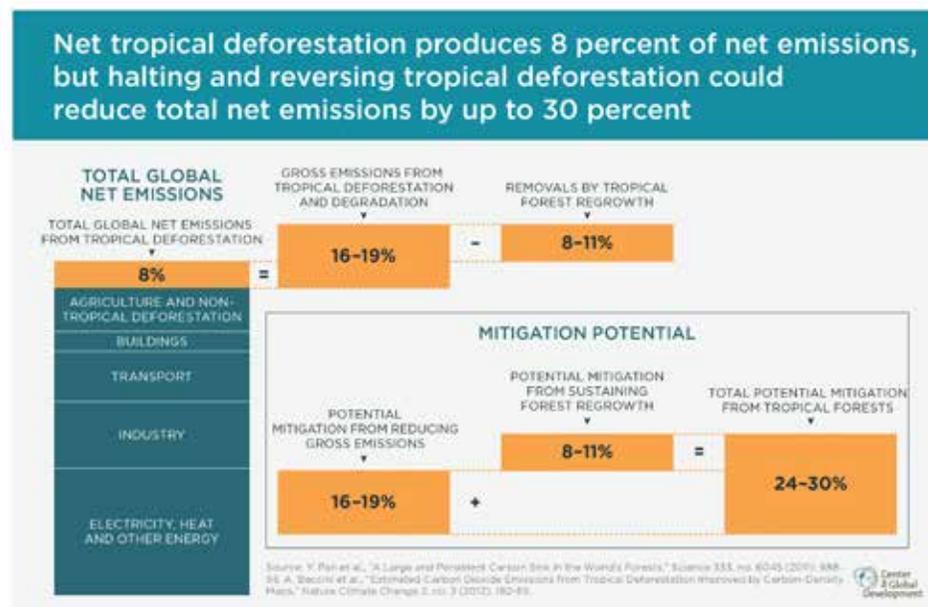


Figure 3. Mitigation potential from reducing gross tropical deforestation and sustaining forest regrowth. Source: Why forests, why now? by Seymour and Busch, 2016.



2.3.2. Afforestation and Reforestation removal potential

Houghton et al. (2015) estimated around 500 Mha of deforested land in the tropics is available for reforestation, which could sequester 3.7 GtCO₂e yr⁻¹ for decades (however declining in productivity from 2065). IPCC (2018) reports that other estimates in literature vary between 1–7 GtCO₂e/yr up to 2050. Based on a systematic literature review, Fuss et al. (2018), narrowed this down to 0.5–3.6 GtCO₂e/yr, based on a number of constraints. Up to 2100 the estimates vary between 1–12 GtCO₂e/yr. A 2030 range estimate by Griscom et al. (2017), 2.7–17.9 GtCO₂e/yr for reforestation, suggests a possible larger potential. On the other hand, NASEM (2018) advises not to go beyond an upper boundary of 10 GtCO₂e/yr for deployment of AR until research has proven that such vast amounts of land are available without incurring major risks of leakage and permanence due to conflict with other land use.

2.3.3. Improved forest management removal potential

Improved forest management (IFM) offers large mitigation opportunities, many of which could be implemented rapidly without changes in land use or tenure (Griscom, et al., 2017). Some IFM activities (such as reduced impact logging) will not conflict with wood yield, but others (like extending harvesting cycles) will reduce yields. Erb et al. (2018), state that restoring global used forests (including plantations) to 90% of their potential biomass would amount to a total potential between 216–389 GtCO₂e. However, they also submit that such strategies

would entail severe reductions in annual wood harvest volumes. Griscom et al., 2017 estimates a potential between 1.3–9.6 GtCO₂e/yr. Putz et al. (2008), on the other hand estimate the global mitigation potential of improved timber harvesting in tropical forests around 0.6 GtCO₂e/yr.

2.3.4. Uncertainty and limitations

The IPCC (2018) states that REDD+ raises concerns of cross-biome leakage and encroachment by agriculture on other ecosystems. By reducing rates of deforestation, the land available for agriculture and grazing will be constrained. This is further discussed in Chapter 6. On the other hand, REDD+ may be associated with significant co-benefits if implemented so as to restore natural ecosystems (see Ch.5).

A challenge for REDD+ implementation is to properly measure and monitor the actual carbon emissions mitigation (REDD) and removals (AR and IFM) by forests. However, data quality and -availability and forest monitoring technologies have made tremendous improvements in the past decades, enabling proper accounting and monitoring of REDD+ efforts (Seymour and Busch, 2016). Furthermore, bilateral and multilateral REDD+ funding through the FCPF and UN-REDD programs, have enabled many developing countries with forests to establish a national REDD+ strategies, baseline forest reference levels as well as a national monitoring and reporting systems. This illustrates that standardized accounting and monitoring of forest carbon stocks and comparability is in fact a very strong component of REDD+.

When comparing the potential of avoided deforestation with reforestation, Seymour and Busch (2016) illustrate in the figure below (Figure 4) that it takes many years for a re-growing forest to accumulate the same amount of carbon that was there originally. This strongly underlines the urgency to maintain the existing forests and shows that AR won't be enough to slow climate change.

The carbon released immediately from deforestation can take a century to re-establish through forest growth

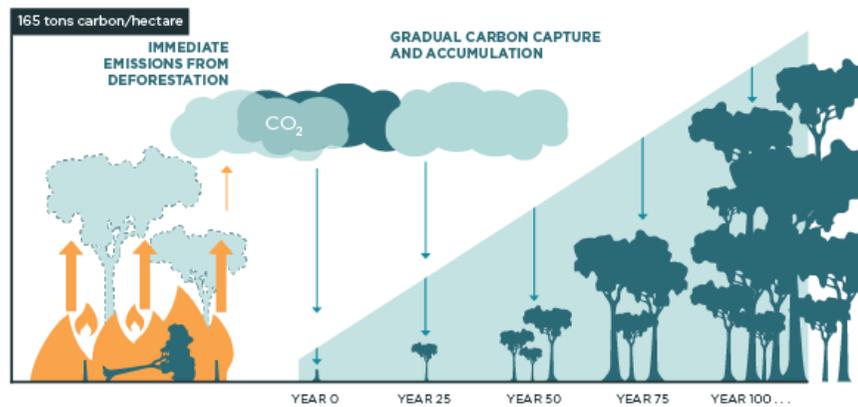


Figure 4. The carbon released immediately from deforestation can take a century to re-establish through forest regrowth. Source: Why forests, why now? by Seymour and Busch, 2016.

Regarding the global differences in effectiveness of AR, Fuss et al. (2018) argue that the albedo effect largely constrains afforestation as a mitigation strategy to the tropics. In general, afforestation in boreal zones is considered to have a warming effect (under more cloud-free skies) that is larger than the cooling effect of reducing GHGs, and the opposite effects in the tropics (Ellison et al., 2017). In temperate zones, the effects are considered to be highly variable. Other studies (Montenegro et al., 2009), have found net regional and global cooling impacts from afforestation at higher latitudes, which indicates that net warming or cooling is not only dependent on albedo change, but rather by a combined impact including amongst others evapo-transpiration.



3 COST-EFFECTIVENESS OF REDD+

Halting climate change requires reducing emissions across many sectors. The extent to which forests can contribute does not only depend on its mitigation potential (\$2.3), but is also largely determined by the cost-effectiveness of REDD+.



3.1. The price of carbon

Carbon pricing mechanisms try to capture the external costs of carbon emissions (i.e. the costs to society, such as damage due to extreme weather, sea-level rise, health care costs, etc.) and tie these costs to their sources. Currently there are 46 national and 25 subnational jurisdictions that have set a price on carbon (either through taxes or cap and trade programs) covering approximately 11 GtCO₂e, representing 19.8% of global GHG emissions. More initiatives are in development aiming to price carbon (Hamrick and Gallant, 2017b), but studies argue that the majority of carbon prices around the world do not yet properly reflect societal and environmental costs and are still too low to reduce emissions fast enough to limit global warming to safe levels (IPCC, 2018; OECD, 2018; Essl et al., 2018). Essl et al. (2018) found that lower bound carbon price estimates (<US\$35/tCO₂e) are often based on

conservative assumptions of risks and impacts of climate change and the underlying models often apply a high discount rate, attenuating the effects of long-term costs.

A robust, predictable and rising carbon price is needed to properly stimulate emission reductions and investment in low carbon solutions, such as REDD+. Additionally, most current carbon pricing schemes do not include sectors related to land use (such as the food-, cosmetics- and textiles industries) and thus provide no incentive to avoid or reduce emissions in these production chains. Without effective carbon pricing associated with appropriate ambition and (ideally) inclusion of all material sectors, huge costs are expected for future generations. UNEP (2016) estimated that annual costs of adaptation to climate change could range from US\$140 billion to US\$300 billion by 2030 and from US\$280 billion to US\$500 billion by 2050. In their 2018 report they indicate that these costs

could be substantially higher, as the current estimates do not yet consider biodiversity and ecosystem services (UNEP, 2018a).

Through global cooperation and the establishment of an international carbon market, countries and businesses that have the responsibility to reduce their emissions, gain the flexibility to purchase emission reductions for unavoidable emissions, wherever it is most cost-effective, allowing for an increase in ambition (World Bank, 2016).

3.2. Cost-effectiveness of reducing deforestation and forest degradation

The overall shared view from previous studies is that REDD offers a large, fast, and cost-effective means of reducing emissions (IPCC, 2014; Calvin et al., 2017; Federici et al., 2017; Griscom et al., 2017; Busch and Engelman, 2017; Seymour and Busch, 2016; UNEP, 2017; UNEP, 2018b). Seymour and Busch

(2016), found that (in the <2°C scenario) tropical countries can apply REDD at 25% of the cost of reducing emissions from industrial sources in the EU or US (see Figure 5). While REDD has less potential in non-tropical countries, they can significantly contribute to climate change mitigation through REDD abroad, at relatively low costs. Through commodity value chains these countries also have an important role to play in conserving forests and reducing deforestation tropical countries. In combined effort, industrial nations together with countries with tropical forests could achieve their targets with an estimated cost reduction of 28-30%. Without reducing costs, they estimate that global temperature increase could be kept between 0.15°C-0.82°C lower, or GHG emissions could start decreasing 2-5 years faster.

⁴ https://carbonpricingdashboard.worldbank.org/map_data



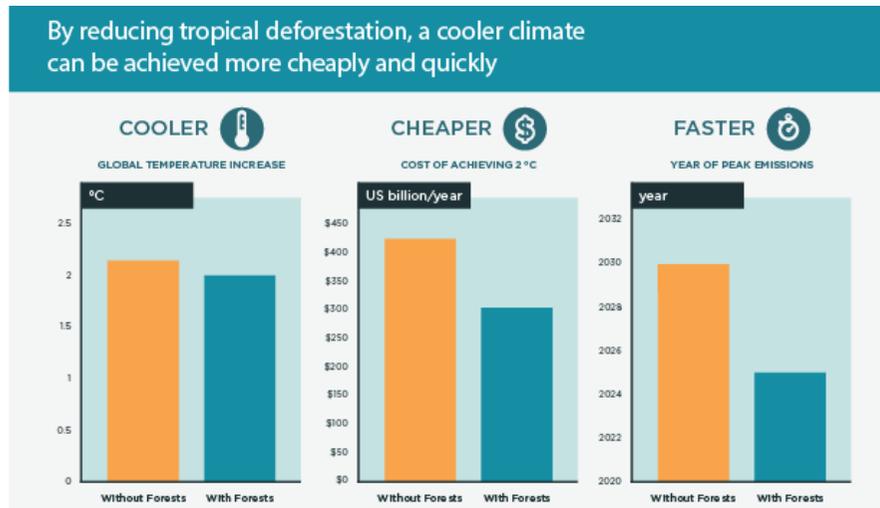


Figure 5. By reducing tropical deforestation, a cooler climate can be achieved more cheaply and quickly.
Source: Why forests, why now? by Seymour and Busch, 2016

Previous studies have assessed the cost-effective potential of REDD through the analysis of government expenditures, site-specific case studies, integrated assessment models, or partial equilibrium models (Busch and Engelman, 2017). The results are often presented in the form of marginal abatement cost (MAC) curves. MAC curves illustrate how many emission reductions can be achieved at a particular cost at a particular place and time (Kesicki and Strachan 2011 in Busch and Engelman, 2017). They can help prioritize the most cost-effective actions across or within sectors. Busch and Engelman (2017) plotted the different MAC curves for tropical deforestation

from previous studies and included their own (Figure 6). Their study shows that at a price of US\$20/tCO_{2e}, between 0.8–4.4 GtCO_{2e}/yr could be avoided till 2020 (depending on which MAC curve is applied). Emissions from tropical deforestation could be reduced by about 25% if governments in tropical countries were hypothetically able to set carbon price or taxes at US\$20/tCO_{2e} (Seymour and Busch, 2016). Based on their own MAC curve, a carbon price of US\$20/tCO_{2e} across tropical countries would avoid 41 GtCO_{2e} (1.2 GtCO_{2e}/yr) from 2016–2050. At a price of US\$50/tCO_{2e} this would be nearly half of tropical emissions from deforestation, 77 GtCO_{2e} (2.3 GtCO_{2e}/yr).

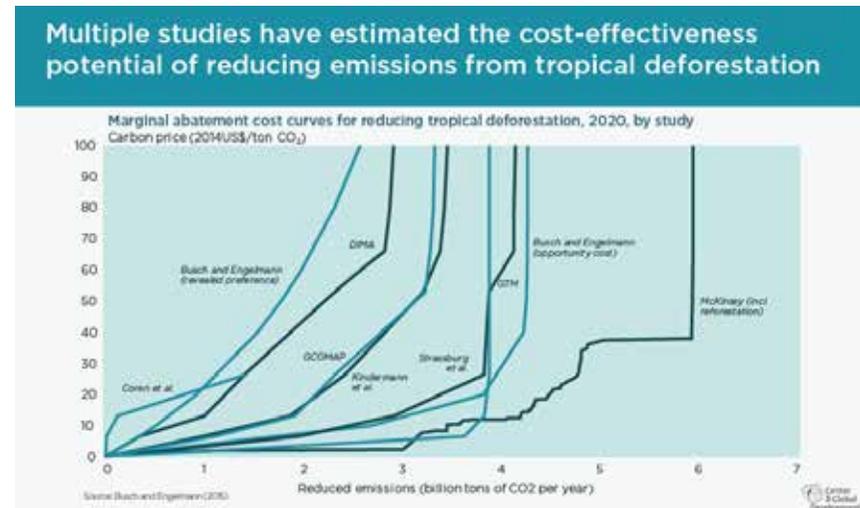


Figure 6. An overview of multiple estimates of cost-effective potential of reducing emissions from tropical deforestation, 2020. Source: Why forests, why now? by Seymour and Busch, 2016

The above depicted MAC curves mainly represent opportunity costs, i.e. the value of the alternative land use (agriculture, livestock). This opportunity cost represents the theoretical minimum amount that a landholder would have to be paid to refrain voluntarily from deforesting. The MAC curves do not fully take into account direct costs of implementation (Luttrell et al., 2018), law enforcement or incentive payments (Seymour and Busch, 2016). Furthermore, as the meta-analysis of 32 case studies by Phan et al. (2014) demonstrates there are significant differences in opportunity costs between different alternative land use categories. While palm oil plantations were observed

having a mean unit cost of US\$125/tCO_{2e}, the mean cost for logging was US\$77/tCO_{2e}. Also, between countries significant differences can be expected. Griscom et al. (2017) calculated that about 80%, or 2.9 GtCO_{2e}/yr of the estimated mitigation potential for avoided forest conversion, can be achieved at around US\$100/tCO_{2e} (based on social cost of carbon at US\$100/tCO_{2e}, estimated to be US\$82–260/tCO_{2e} in 2030 to meet the 1.5–2 °C climate target), and about 50%, or 1.8 GtCO_{2e}/yr at around US\$10/tCO_{2e} (considered consistent with the current cost of emission reduction efforts underway and current prices on existing carbon markets).

3.3. Cost-effectiveness of afforestation/reforestation

As the IPCC (2018) special report on 1.5 degree warming indicates, AR is considered a cost-effective carbon removal strategy. All analyzed 1.5°C-consistent pathways use afforestation or BECCS (bioenergy with carbon capture and storage) to a certain extent. A couple of studies have summarized the potential and associated costs for carbon removal through AR (Minx, et al., 2018; Fuss et al., 2018; NASEM, 2018). The below table (Table 1) presents an overview of these figures. Costs for AR range between US\$1-100/tCO_{2e} (between US\$5-50/

tCO_{2e} reported by IPCC (2018), based on Fuss et al., 2018). The wide range reported represents different assumptions and modeling approaches, and variable prices or incentives for implementing activities (NASEM, 2018). The low end of the range assumes marginal agricultural land available and landowners who would be willing to participate in mitigation.

At the high end, 10's of millions of hectares would be incentivized to convert from crop or grass production to forest. In these areas, competition with other land use (food production) could be high which, over time, could cause issues with permanence and leakage.

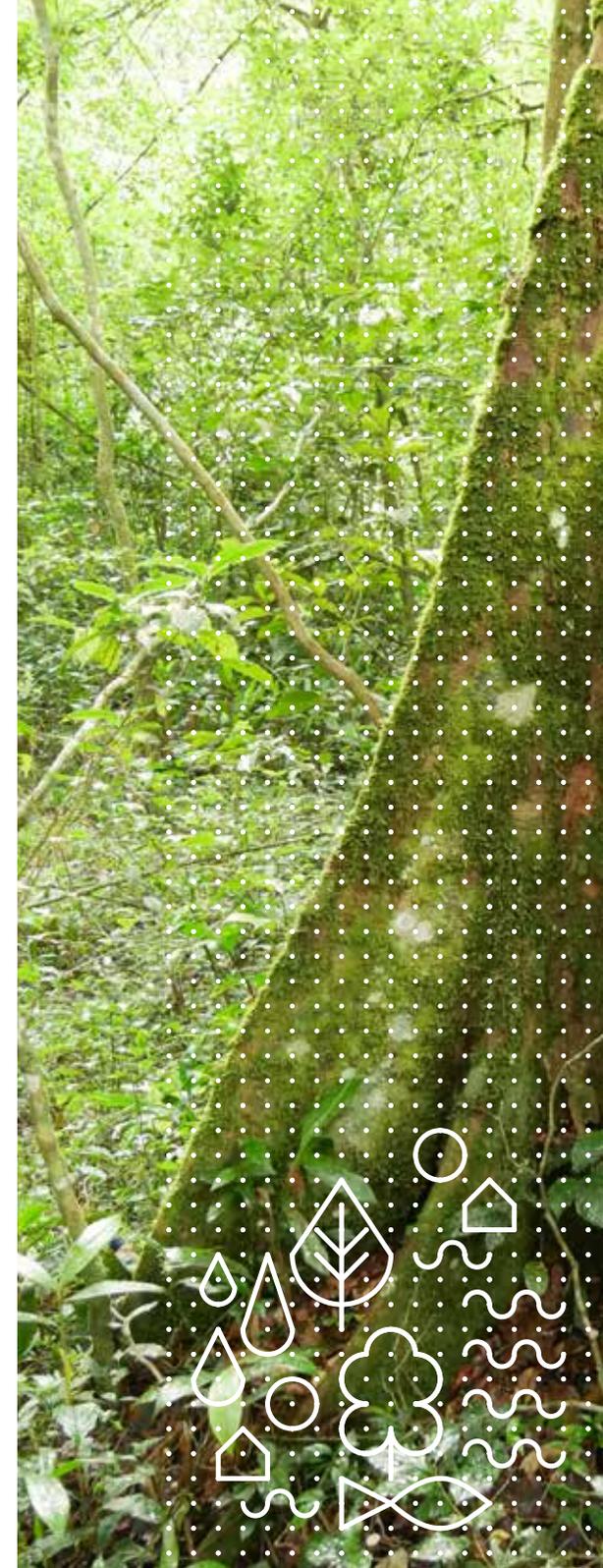
3.4. Cost-effectiveness of improved forest management

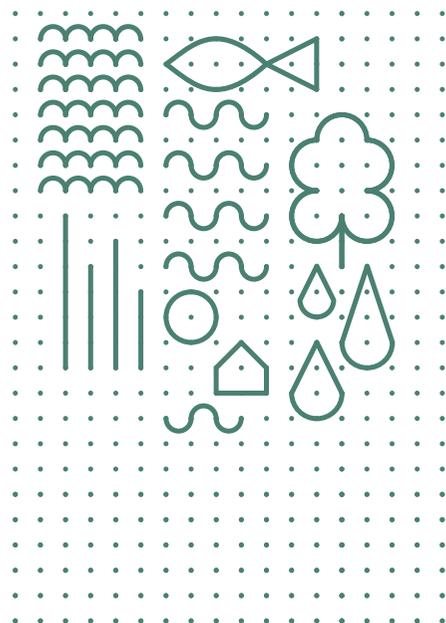
Apart from Griscom et al. (2017) we found no estimates of the cost-effectiveness of improved forest management as a carbon mitigation strategy. Table 1, above, provides an overview of costs with their estimated potential. They estimate a mitigation potential up to 2030 of 0.4 GtCO_{2e}/yr at a price of US\$10/tCO_{2e} (+/- 20% of its total potential). At a price of US\$100/tCO_{2e} the mitigation potential is 1.3 GtCO_{2e}/yr (+/-60% of the total potential). The Statement from Scientist Signatories submit that reforestation and improving forest management together have large potential to remove CO₂ from the atmosphere and could provide up to 18% of cost-effective mitigation opportunity through 2030 (based on Griscom et al., 2017).

Table 1. Summary of AR and IFM costs and potential extracted from Minx, et al., 2018 and Griscom et al., 2017

Scope	Potential (flux)			Potential (cumulative)		Costs US\$/tCO _{2e}	Source
	2030	2050	2100	2050	2100		
Afforestation & Reforestation					80-100	20-100	Caldecott et al. 2013
			2-5		100	1-100	NRC, 2015
		1.5-3				20-100	Friends of the Earth, 2011; McLaren, 2012
		0.5-3.6				5-50	Minx et al., 2018; Fuss et al., 2018
			4-12.1			18-30	Smith et al., 2016
	3.0					<100	Griscom et al., 2017
				671		Vaughan and Lenton, 2011	
IFM	0.4					10	Griscom et al., 2017
	1.3					<100	

Five Reasons the Earth's Climate Depends on Forests. Statement from Scientist Signatories. <http://www.climateandlandusealliance.org/scientists-statement/>





3.5. REDD+ cost-effectiveness compared to other climate mitigation solutions

As extensively discussed in previous paragraphs, REDD, AR as well as IFM show a considerable potential to effectively mitigate climate change, predominantly at low costs per ton CO₂e. In the below figure (Figure 7), Seymour and Busch (2016) show that reducing deforestation could offer nearly half the potential low-cost emission reductions in developing countries.. For developing countries outside of China this potential is even higher (+/- 67%).

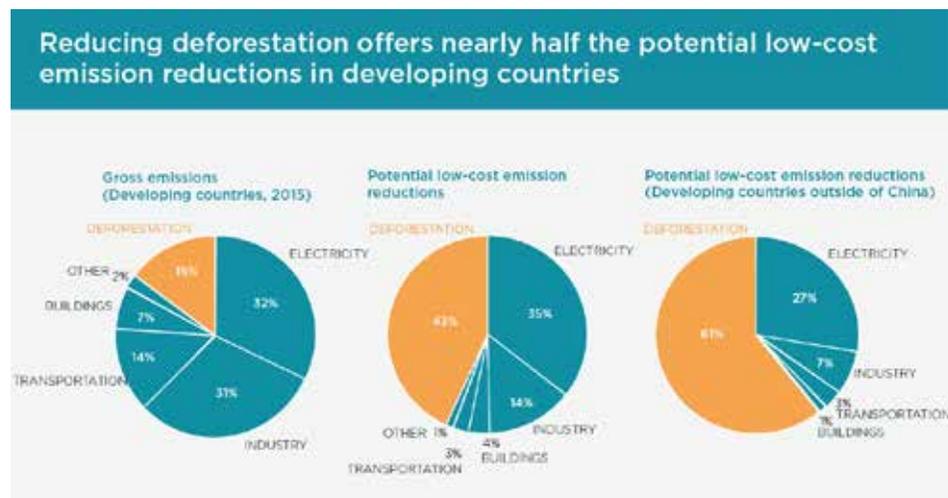
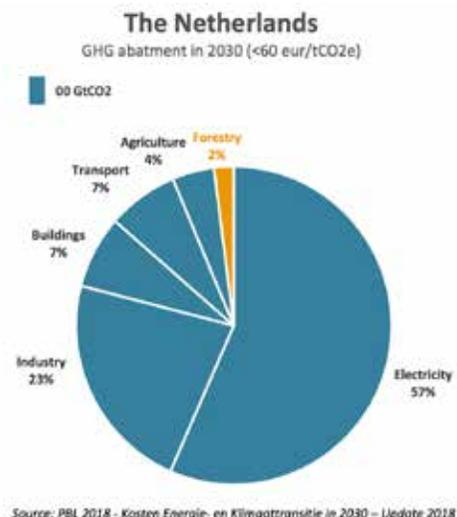


Figure 7. Reducing deforestation offers nearly half the potential low-cost emission reductions in developing countries. Source: Why forests, why now? by Seymour and Busch, 2016

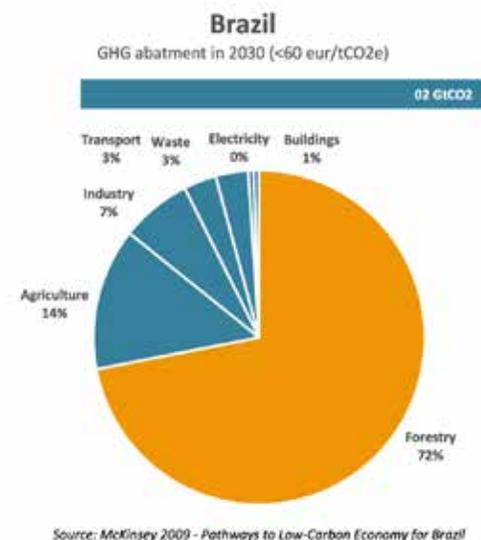
The mitigation potential of different 'low cost' strategies vary greatly. In contrast with the general picture outlined by Seymour and Busch (2017) for tropical countries, the domestic potential of forests as a mitigation strategy outside of the tropics are often limited. To illustrate this, we plotted the potential of low costs (\leq €60) mitigation strategies of the Netherlands, extracted from the report Plan Bureau voor de Leefomgeving (Koelemeijer et al., 2018), and those of Brazil, based on McKinsey (2009) data, in the figure below (Figure 8).

While more than 70% (2009 estimate) of Brazil's low-cost mitigation potential lies with forests (predominantly avoiding deforestation), the Dutch forests have a very small mitigation potential, albeit at a low price (\leq €10).

Although compliance markets have yet to accept REDD+ offsets, there is a large potential for countries, such as the Netherlands, to significantly contribute to climate change mitigation through investments in REDD+ abroad.



Source: PBL 2018 - Kosten Energie- en Klimaattransitie in 2030 - Update 2018



Source: McKinsey 2009 - Pathways to Low-Carbon Economy for Brazil

Figure 8. Low cost potential mitigation strategies in the Netherlands (left) and Brazil (right). Based on PBL, 2018 and McKinsey, 2009.

Current integrated assessment models indicate that delays in mitigation means that in future we will become increasingly dependent on negative emission technologies (NETs) for achieving the climate goals (IPCC, 2018). However, none of the NDCs contain plans to develop negative emissions and many of the NET solutions are still in the 'research and development phase', where large scale application has yet to be demonstrated.

AR, however, is considered a mature 'technology' (Nemet et al., 2018). It already exists at scale, and the potential for storing large amounts of carbon has been generally recognized (IPCC, 2018). Fuss et al. (2018) and Minx et al. (2018) provide comprehensive comparisons between costs for AR and other NETs such as bio-energy with carbon capture storage (BECCS) and

direct air capture with carbon capture and storage DACCS. They found that all the selected studies they reviewed indicate the low cost of implementing AR compared to that of other NETs. Realizing such large potentials is thought to come at higher land and water footprints than BECCS though (IPCC, 2018). Figure 9, below, indicates that AR is at the low end of estimated costs per tCO₂e, while its potential ranges between 0.5 and 3.6 GtCO₂e/yr. The cost of implementing BECCS - which, next to AR, is mostly included as viable carbon dioxide removal technology within IAMs- generally is much higher (US\$100-200/tCO₂e). An indicator of the cost-effectiveness of forest restoration was presented by De Groot et al. (2013), who calculated ecosystem restoration costs base on 94 restoration case studies (Figure 10).

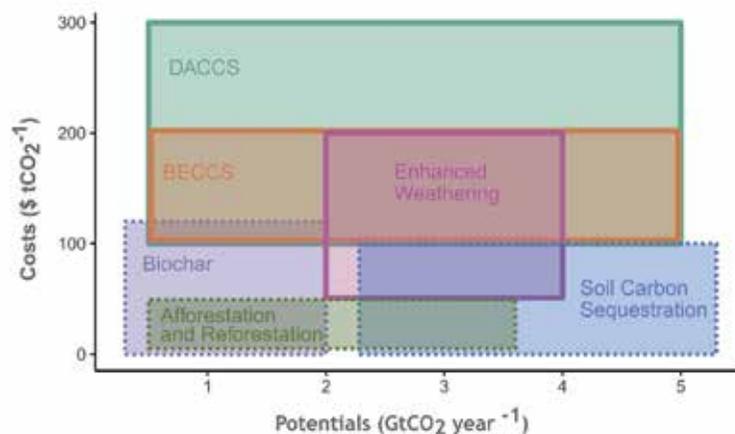


Figure 9. Estimated costs and 2050 potentials of different negative emission technologies. Source: IPCC (2018), based on Fuss, et al. (2018).

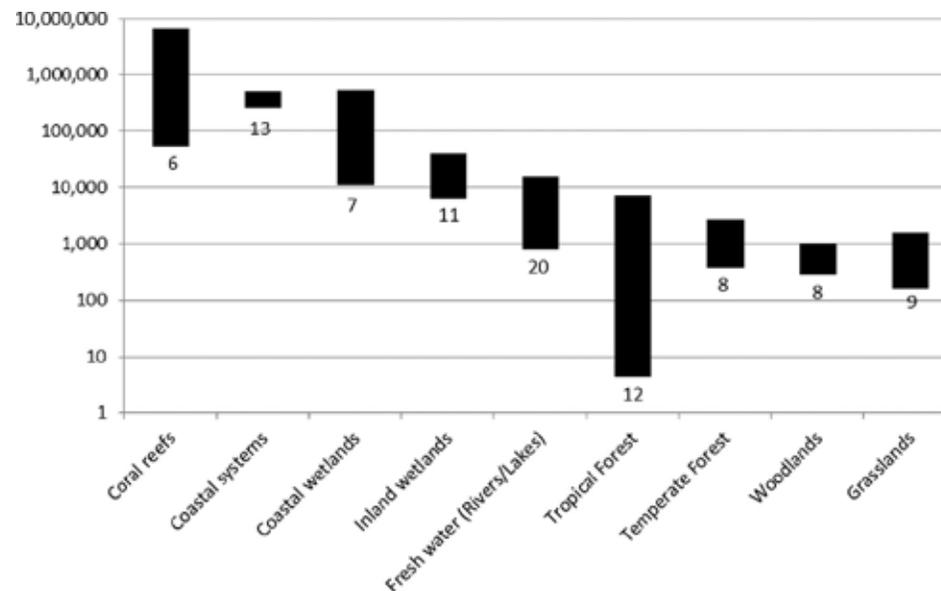


Figure 10. Range of ecosystem restoration costs (log cost in 2007 US\$/ha) of 9 major biomes. Numbers below the bars represent the number of cases studies evaluated. Source: de Groot et al. (2013).

They found that costs for tropical forest restoration can be lower than 10US\$/ha, but also as high as 9,000 US\$/ha. The high variation is influenced by i.a. the level of degradation, local infrastructure availability, type and scale of restoration, population pressure and density, the legal framework, existing land use and tenure arrangements, land value, labor costs and method of measurement (Sewel et al., 2016). Nonetheless, their analyses confirm general understanding that restoration of forest can be achieved at relative low cost. Based on Total Economic Value (TEV) estimates of monetary values

of 22 ecosystem services, de Groot et al. (2013) also present estimates of cost-effectiveness of restoration for the different biomes. They show that in terms of cost-benefit ratio, grassland and woodland restoration seem the most effective. However, coastal- (including mangroves) and inland wetlands and tropical forests offer the most value for restoration investment in absolute terms. High returns however do not guarantee substantial cost recovery (Sewel et al., 2016), as returns may be public and/or non-monetary and may vary in time.

3.6. REDD+ in the voluntary carbon market

While many national and regional-level governments around the world are incorporating forest carbon emission reductions into their carbon offset programs, REDD+ credits are currently predominantly transacted in the voluntary market.

REDD credits are the most commonly transacted voluntary offset over the past decade (Hamrick and Gallant, 2017a). Between 2005 and 2017, carbon credits equivalent to 95.3 MtCO₂e have been issued within the forestry and land use project category (Hamrick and Gallant, 2018). In 2016, REDD+ projects constituted the highest volume of transacted offsets (10.6 MtCO₂e; Hamrick and Gallant, 2017b), followed by wind offsets (8.2 MtCO₂e; Hamrick and Gallant, 2017a). REDD projects sold at an average price between US\$4.2/tCO₂e (avoided unplanned) and US\$4.6/tCO₂e (avoided planned) in 2016, while tree planting offsets sold at an average price of US\$7.5/tCO₂e and improved forest management project offsets sold at an average price of US\$9.5/tCO₂e (Hamrick and Gallant, 2017b). Due to the relatively large supply and low demand it is a challenge for forest carbon projects to sell their credits. Carbon credits of forest projects are

Figure 8. Voluntary Forest Carbon Offsets: Market Transacted Volume and Average Price by Project Type, 2016



Notes: Based on 219 transactions representing 14.1 MtCO₂e in 2016. Figure includes voluntary market data only.

Figure 11. Voluntary Forest Carbon Offsets: Market Transacted Volume and Average Price by Project Type, 2016. Source: Fertile Ground: State of Forest Carbon Finance 2017, by Hamrick and Gallant, 2017.

generally sold at a much higher price than other project categories (e.g. the average price for the renewables project category was US\$1.4/tCO₂e), due to the appeal and substantial co-benefits of forest projects. However, as Ickowitz et al. (2017) pointed out, when comparing opportunity costs to the voluntary market prices for REDD+, the majority of the REDD+ mitigation potential opportunity costs are estimated much higher than the average price for forest and

land-use offsets (in 2016 overall US\$5.2, while for REDD between US\$4.2-4.6). Current prices are often at the bottom of or below the cost for implementation. Additionally, these projects require substantial up-front investment (project design, labour, certification, etc.). Thus currently, most forest carbon projects cannot exist based on sales from carbon credits alone.



4 THE (CO-) BENEFITS OF REDD+

Next to the substantial potential to contribute to climate change mitigation, REDD+ has a significant impact on biodiversity conservation and restoration, livelihoods and the preservation and recovery of a broad range of ecosystem services provided by forests. Ecosystem services are those ecological characteristics, functions or processes that directly or indirectly contribute to human well-being. These ecosystem services and their value vary considerably in terms of extent of impact and who benefits (Mullan, 2014, see Figure 12 below). While carbon sequestration and biodiversity preservation can generally be considered as public services with an impact on regional to global scale, provisioning services such as food and other forest products generally have an impact on local livelihoods scale.

The following paragraphs describe some of the main benefits provided by forests, with an emphasis on tropical forests. These benefits are very much interlinked and can have an impact well beyond the boundaries of the forest itself. For example, recent research showed that stream flowing from tropical forests are more efficient in cleaning pollutants than less biodiverse streams (Cardinale, 2011). It shows simultaneously the enormous positive impact and significance of REDD+, and the massive damage that deforestation and forest degradation can cause on multiple levels and scales.





4.1. Forests, agriculture and livelihoods

Forest protection or restoration has to be balanced with food production, income generation and development. Competition for land with food production and other land uses is noted by IPCC (2018) as the major constraint for REDD+ as a climate change mitigation strategy. Developing countries are challenged to improve the standard of living while at the same time conserving the remaining forests and other natural resources. Research shows that healthy forests also make substantial contributions to agricultural production and multiple income streams for local livelihoods (Seymour and Busch, 2016). Forests are a source of clean water for irrigation. Rainforests pull water from the ground and release water vapor through the leaves of the trees, generating atmospheric rivers of moisture that water crops thousands of kilometers away from where they stand (Ellison, 2018; Wolosin and Harris, 2018). Although estimates of scale and location of transcontinental impacts of tropical deforestation vary, changes in rainfall driven by tropical deforestation together with warmer temperatures could pose a substantial risk to agriculture around the world (Lawrence and Vandecar, 2015). The flora and fauna of

forests also play an important role in agriculture pollination of crops and pest control.

The forestry sector accounts for an estimated total of 45.15 million jobs and an income of more than of US\$580 billion per year (FAO, 2018). Estimates (FAO, 2014, Agrawal et al., 2013) further suggest that around 40 to 60 million people are involved informally in the forest sector. While varying significantly between locations, FAO (2014) estimated that globally, on average, edible plant-based non-wood forest products provide 16.5 kcal per person per day. As one of the most affordable and reliable energy sources, wood fuel is used by an estimated 2.4 billion people worldwide (FAO, 2017, FAO, 2018). Especially in rural communities in developing countries, forests provide a valuable additional source of food (and nutritional diversity), fuel and income. Forest foods account for nearly 30% of the income of households, living in and around forests, derived from forest products, second only to wood fuels (Seymour and Busch, 2016). For these households, forests and trees are an important safety net. Women are also strongly involved in forest work such as the collection of food, fuelwood, medicine and other non-wood forest products. Of the 850 million people engaged in (informal, unpaid) collection of fuelwood or

production of charcoal, about 80% are women (FAO, 2014). Deforestation and forest degradation can lead to substantial socio-economic losses, especially at the local and rural community level, where people are more directly reliant on forests for their livelihoods, health and physical safety, as well as by the poor, who have fewer opportunities to substitute for the ecosystem benefits with alternatives (Mullan, 2014). Forests also play an important role in human health. As described above, forests can directly influence health through improvements in nutrition but also in availability and quality of drinking water. Many medicines, traditional as well as pharmaceutical, originate from forests. The World Health Organization (Robinson and Zhang, 2011) estimated

that 70–95% of people living in developing countries rely on traditional medicines for their primary health care needs. Also, incidences of diseases, such as malaria are thought to be linked with deforestation (Seymour and Busch, 2016), although the relationships are not yet fully understood (Mullan, 2014). Forests also impact local air quality but could also indirectly impact air quality on a wider scale (e.g. by preventing soil erosion; Mullan, 2014) Air pollution from forest fires associated with land clearing is considered a major cause of deaths and illnesses (Seymour and Busch, 2016). Mullan (2014, page 21) provides an overview of studies on health cost and benefits estimates associated with forest and/or deforestation. These studies show that costs of deforestation and

benefits of conservation and restoration to human health can be substantial. For instance, a study by Glover and Jessup (2006) estimated total national costs of respiratory illness associated with forest fires to be US\$295 million in Indonesia alone.

4.2 Forests and biodiversity

The conservation and restoration of biodiversity is an important co-benefit of REDD+. Forests are the habitat of around 80% of terrestrial biodiversity (Federici et al., 2017; WWF, 2018). Biodiversity is also the key element of the forest's many ecosystem services. Forests (or plantations) with low biodiversity generally provide fewer eco-

system services compared to diverse native forests.

In April 2018, The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) published four regional assessments of biodiversity and ecosystem services covering the Americas, Asia and the Pacific, Africa, as well as Europe and Central Asia. They found that not only deforestation and land-use change, but also human-induced climate change is increasingly driving biodiversity loss, further worsening the impact of habitat degradation. Under a 'business as usual' scenario, climate change will be the fastest growing driver negatively impacting biodiversity by 2050 in the Americas, becoming comparable to the pressures imposed by land use



change (IPBES, 2018). They expect an associated loss of 40% of the region's original biodiversity by 2050. They also estimated that by 2100, climate change could result in the loss of more than 50% of African birds and mammals, a 20–30% decline in the productivity of Africa's lakes and significant losses of African plant species. In the Asia-Pacific, they anticipate a +/- 45% loss of habitats and species by 2050 under business as usual, while in Europe and Central Asia, across species, projected losses vary between 10% and 55% depending on climate scenario and taxonomic group considered. Deforestation and forest degradation are the greatest drivers of species extinctions (Strassbourg et al., 2012), through loss, degradation and fragmentation of habitats. It was estimated that in 70% of the forest masses of the world, a forest edge can be found within a mean distance of less than 1 km (Haddad et al., 2015). Strassbourg et al. (2012) found that business as usual deforestation is likely to result in large numbers of species extinctions, but that an adequately funded REDD program could substantially reduce these losses (see Figure 13, below).

Also, AR and IFM can have significant positive impacts on biodiversity, depending on the baseline landuse

and if implemented correctly. However, when priority is given to monoculture plantations, at the expense of natural forest, this can result in significant losses of biodiversity. Ecosystems that are not prioritized for their carbon value, could still have high biodiversity values and should not be neglected. This is especially true for low-carbon biodiversity hotspots. (Bayrak, 2016) As also noted by IPCC (2018) and underlined in UNFCCC COP decision 1/CP.16, forest restoration and conservation is highly compatible with biodiversity and should be used to incentivize the protection and conservation of natural forests and their ecosystem services and promote and support transparent and effective forest governance (CBD, 2011). By attracting revenues from carbon sequestration, REDD+ has the potential to protect other services for which no market or other funding of this scale exists (Stickler, 2009).

4.3.2. Forests and soils

Related to the above described processes, forests play an important role in soil condition and the nutrient cycle. Upland, on slopes, forests and trees slow the water flow and shield the soil from hard and heavy rains, thereby preventing erosion and sedimentation and increasing infiltration by soils (Brandon, 2014). Erosion can have detrimental

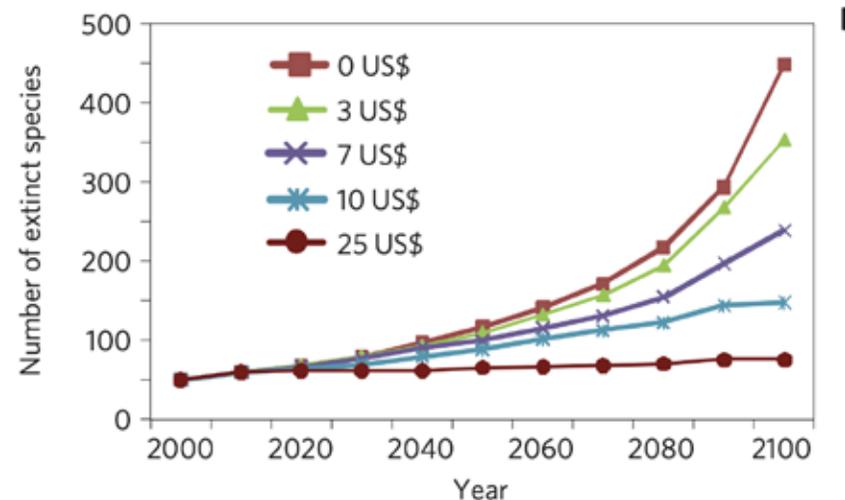
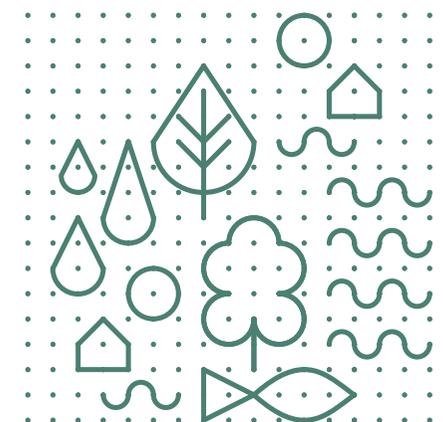


Figure 13. Binary estimate of extinctions from deforestation related to carbon price. Species correspond to forest-dependent mammals and amphibians restricted to the study area. Source: Impacts of incentives to reduce emissions from deforestation on global species extinctions by Strassbourg et al., 2012.

effects not only locally by removing topsoil and washing out nutrients, but also downstream in valleys. Here sedimentation can i.a. cause landslides, impair water for drinking and other uses, change the quality and structure of streams and rivers and cause flooding (Brandon, 2014). Not only do forests mitigate the risk of landslides, they also mitigate the impact of landslides when they do occur. The roots of the anchor the soil and act as brakes (Seymour and Busch, 2016). Lowland and downslope forests play an important role in capturing sediment and reusing nutrients washed from higher ground and holding decompos-

ing plant material in place (Seymour and Busch, 2016). Forest vegetation, leaf litter, microbes and soils jointly remove or biochemically transform contaminants such as pesticides (Brandon, 2014).



4.4 REDD+ and Sustainable Development Goals

Forests contribute to a wide array of sustainable development goals, well beyond SDG 15, 'life on land'. The array of ecosystem services that forests provide, contribute to achieving multiple goals and targets across the 2030 Agenda (FAO, 2018). As described in §4.3, among others, forest play an important role in the livelihoods of people living in and around forests, forest landscapes affect crop production food security. Deforestation and forest degradation as well as the underlying drivers (such as weak governance, demand for (fuel)wood, scarcity of land, etc.) are also strongly related to many sustainable development goals. For instance, deforestation can have serious consequences for water quality and availability, health and sanitation. Strategies to achieve the SDGs should thus consider interlinkages with REDD+ and other initiatives to protect, restore and sustainably manage forests (FAO, 2018).

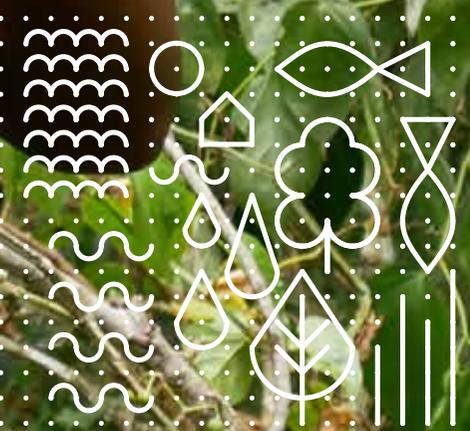
Figure 14, created by the New York Declaration on Forests Global Platform, provides a comprehensive overview of (some of) the relations between forests and the 17 SDGs.



Figure 14. Linking forests and Sustainable Development Goals. Source: New York Declaration on Forests Global Platform. <https://nydfglobalplatform.org/forests-and-sustainable-development-goals/>

5 REDD+ POTENTIAL AND SAFEGUARDS FOR LONG-TERM BENEFITS

Design requirements, standards and guidance have been developed to assure the effectiveness, inclusivity and credibility of REDD+. REDD+ projects and policies based on those rules and safeguards make sure that climate and other impacts are real and remain intact for the long term. This section presents the main criteria for safeguarding and enhancing those impacts.



5.1. Additionality

Additionality is about how real the carbon impact is, whether it is additional to what can normally be expected without a climate-based intervention and finance. By supporting projects that have demonstrated additionality, the investor has a guarantee that funding is spent on activities that make a real difference for the climate; e.g. protecting forests that are under a real threat of deforestation or forest degradation. In addition, certification standards are demanding a conservative approach to carbon accounting, ensuring that the real carbon impact is most likely larger than the claimed impact. This is to provide confidence to investors for their performance-based payments. In many cases the additionality of conserving forests is evident. Many of the tropical forests worldwide are under high pressure of deforestation and forest degradation.

5.2. Permanence

Permanence is about the continuation of the REDD+ impact on the long term, i.e. carbon remains stored in the trees and the soil for the long-term. Projects enhance permanence by carefully assessing, minimizing and mitigating risks. Certification standards have developed solutions for compensating any unanticipated carbon losses from carbon projects, e.g. the Verified Carbon Standard achieves this through a pooled buffer that is maintained by all projects certified under the same standard. If any of the projects has a carbon loss, it will be compensated for by the carbon credits that are placed in the pooled buffer. These backstopping mechanisms add to the credibility of forestry projects.

REDD+ interventions become more robust and reliable by observing the safeguards specifically developed for REDD+. UN members have agreed on the Cancun safeguards for REDD+ in 2010 (Decision 1/CP.16, Appendix I, par. 2), to limit risks and maximise social and environmental benefits while implementing REDD+ in developing countries. The safeguards are applicable to governance, rights and traditional knowledge of indigenous people, participation by stakeholders, conservation of natural forest and biodiversity, permanence and leakage. Parties are required under the Warsaw Framework to provide a summary of information on how safeguards are addressed and respected, before results-based payments can be received. See Braña Varela, 2014. Positive impact to stakeholders, including forest-dependent communities, and involving them in all stages of design and implementation, goes hand in hand with ensuring permanent carbon storage.

5.3. Leakage

Leakage looks at the effect of emissions elsewhere as a result of a REDD+ intervention. The GHG emissions take place outside the project boundary or the area of intervention, as an unintended result of a project or intervention. This can be unintentionally caused by shifting activities or through market effects, when the prices of goods are influenced by REDD+ interventions. Market leakage is usually not significant for project-based interventions and is more related to national policies that have an impact at a larger scale.

REDD+ activities prevent leakage by identifying and assessing the root causes of deforestation and forest





degradation and how they can be best targeted without creating leakage effects. E.g. agents of deforestation switch to a more sustainable and profitable type of land-use or alternative economic activities, which not only avoids displacement of emissions but also contributes to improved livelihoods. The best and most satisfying way to address leakage is national, subnational or jurisdictional carbon accounting, which has been strongly promoted and developed in developing countries.

Although concerns about leakage should be taken seriously, it should be considered within the broader perspective of effectively and efficiently reducing GHG's, looking at how significant leakage is in actual practice, rather than based on theoretical assumptions. Oosterzee et al. (2012) note that it has been difficult to demonstrate whether leakage is actually taking place through concrete REDD+ activities. There are even indications that REDD+ activities contribute to stronger protection of other forests, outside the project boundary, due to a discouraging effect against illegal activities.

5.4. Governance

A key priority for most REDD+ interventions is to focus on good governance. In regions where governance and law enforcement is strong or being enhanced, REDD+ activities are more effective, especially on the long term. Good governance implies transparency, effective decision-making, sufficient capacities and integrity. By observing the Cancun safeguards for national level REDD+ and by working with design standards such

as the Climate Community and Biodiversity standards for project level REDD+, governance can be effectively part of protecting and enhancing forest carbon stocks.

5.5. Stakeholder Participation

REDD+ projects and policies that are based on an inclusive approach and focus on participation of stakeholders throughout the REDD+ process, give legitimacy to the outcome of REDD+, build strong support and therefore contribute to the permanence of protected forests.

REDD+ has the potential to create positive social impacts and avoid negative social impacts by including forest-dependent people and indigenous groups in design and implementation. In tropical areas forests are often very important for the livelihoods of the local population, especially marginalized groups. Forests are often acting as safety nets. Given the dependence of certain groups on forests, it is essential to include them in the decision-making process and the design, development and implementation of project activities and national REDD+.

Most REDD+ projects work with the key principle of Free Prior and informed Consent (FPIC) to legitimize REDD+ design and implementation. It requires to inform stakeholders on positive and negative impacts of REDD+, enables them to vote for or against REDD+ implementation if they have formal or customary land rights, and to be involved in every step of REDD+ implementation. REDD+ projects developed on the basis of FPIC are therefore more effective.

5.6. Land Tenure and Carbon Rights

Clear ownership and use rights are essential for the long-term success of REDD+ and the permanence of emission reductions and GHG removals. The actors responsible for reducing emissions and slowing deforestation need to have the long-term rights to do so. It means they can be rewarded for performance and held responsible for failure. This requires a clear and valid definition of carbon rights and land rights by national governments in the areas where REDD+ is carried out. Without clear rights there can be competing claims and conflicts, taking away the incentive to implement REDD+ (Loft, 2017). That is why certification standards require projects to demonstrate that rights are respected and overlapping claims and conflicts over use rights are appropriately addressed.

Land tenure rights in developing countries are often customary and traditional rights, without being

formalized. REDD+ offers a huge potential to formalize rights and give local communities more certainty on land ownership, which can be beneficial to local people in many ways, e.g. by having access to credit facilities because their land can be considered as collateral. REDD+ has also a strong potential in helping local or indigenous communities to face the main threats to their land and forests. These main threats are from strong economic forces that have an interest in deforestation for commercial agriculture, mining, public infrastructure and migratory settlements. This is where REDD+ can help to protect the interests of indigenous groups. As has been shown in Brazil in the period 2004 – 2012, REDD+ has the potential to reduce deforestation by preventing threats from other economic sectors. REDD+ on the other hand can be achieved by indigenous groups. It has been shown that forests managed by indigenous people usually suffer less from deforestation and are better protected. (Savedoff, 2018)

5.7. Benefit Sharing and Livelihoods

As this section has demonstrated, REDD+ can act as an opportunity for poor communities to improve livelihoods by improving governance and land and use rights. REDD+ interventions also have the potential to improve local livelihoods by addressing the drivers of deforestation. This is a win-win for climate mitigation as well as local livelihoods. Deforestation caused by smallholders can be reduced by providing better economic alternatives to timber harvesting or to conversion of forest to agricultural land. These interventions are made possible by climate finance based on performance and measured by the amount of GHG emissions avoided or sequestered. In addition, REDD+ is an opportunity to also provide more benefits derived from carbon finance, including improving community infrastructure, education and the health sector.



6 CONCLUSION



As the effects of climate change become more and more visible and tangible throughout the world, the global consensus for the need to act now is ever increasing. But in order to maintain the global average temperature rise below 'acceptable' limits, far-reaching and unprecedented changes in all aspects of society are required. There are many climate solutions available that can contribute to changing the tide. This paper has demonstrated that forests can play a significant role in combating climate change. Forest conservation, afforestation/reforestation, restoration and improved management of existing forests have a large potential for the reduction of carbon emissions as well as the removal of carbon dioxide from the atmosphere. Although compliance markets have yet to accept REDD+ offsets, there is a large potential for industrialized countries, without (tropical) forest, to significantly contribute to climate change mitigation through investments in REDD+ abroad. Moreover, REDD+ has a significant positive impact on biodiversity conservation and restoration, livelihoods and the preservation and recovery of a broad range of ecosystem services provided by forests. These benefits are very much interlinked and can have an impact well beyond the boundaries of the forest itself. On the one hand this underlines the high potential impact and significance of REDD+, but also the massive damage that deforestation and forest degradation can cause on multiple levels and scales. By attracting revenues from carbon sequestration, REDD+ contributes to the conservation and enhancement of forest ecosystem services for which no market or other funding of this scale yet exists. In turn, these forest ecosystem services contribute to achieving multiple Sustainable Development Goals and targets across the 2030

Agenda. Design requirements, standards and guidance have been developed to ensure that climate and other impacts of REDD+ projects are real, additional and remain intact for the long term. Additionally, REDD+ includes safeguards to ensure that unintended leakage is accounted for and local communities and indigenous peoples are engaged and included. Thus, REDD+ offers a large, fast, and cost-effective means of reducing emissions while at the same time creating substantial net positive social and environmental benefits.

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