



Chapter 13 SDG 13: Climate Action – Impacts on Forests and People

Bas Louman*, Rodney J. Keenan, Daniela Kleinschmit, Stibniati Atmadja, Almeida A. Siteo, Isilda Nhantumbo, Ronnie de Camino Velozo and Jean Pierre Morales

Key Points

- The Paris Agreement is the principal international instrument for achieving SDG 13. Current commitments under the agreement are likely to be insufficient to remain under the 2°C limit. If average global temperature increases exceed 2°C, there will be increased risks to forest area, biodiversity and species composition, and forest ecosystem services. These will most strongly impact poor and marginalised people.
- If mitigation activities are widely adopted, forests and the people depending on them will benefit through lower reductions in forest area and biodiversity and improved functions and services.
- Forest- and land-based climate action has the potential to support the adaptation of society to climate change and contribute to up to 20 per cent of the needed emission reductions to meet the 2°C goal. Despite these opportunities, only 3 per cent of climate finance is used for this purpose.
- Scaling up of such climate actions is necessary but requires stronger linkages between global climate change mitigation goals and local development and adaptation priorities. These can best be achieved through landscape-scale, locally driven, long-term approaches that engage all relevant actors and industry sectors, including agriculture. Community forest management shows promise for combining mitigation objectives with strengthening adaptive capacity.
- Evidence-based policies and regulations, education and market mechanisms that are linked to the economic benefits of forest-based climate actions can support improved decision-making by governments, communities and industries.

* Lead author.

13.1 Introduction: Climate Change, SDG 13 and Forests

SDG 13 is action to combat climate change. The most recent progress report on SDG 13¹ indicates that global temperatures have reached 1.1°C above pre-industrial levels due to increased greenhouse gas concentrations, with increasingly costly extreme weather events and rising sea levels. Urgent action is required to reduce emissions and adapt to climate change, and forests can play an important role. This chapter provides insights into the links between SDG 13, forests and the people who depend on them.

Climate change is a major challenge for societies and environments, and forests have been integral to this challenge. Forests play an important role in the global carbon cycle, and tropical deforestation and forest degradation are significant contributors to global emissions. Forests capture and store carbon dioxide in living biomass and help store carbon in soils. Above and below ground, there are 795–927 Gt of carbon stored in the soils and vegetation of the world's forests, more than half of it (55 per cent) in the tropics (Pan et al. 2011). Biomes differ in how this carbon is distributed between soil and vegetation: in boreal forests, 60 per cent of carbon is in the soils; in tropical forests, only 32 per cent. Loss of these forests has contributed an average of 2.27 Gt to global annual CO₂ emissions between 2001 and 2013 (Zarin et al. 2016). This occurred mainly in tropical forests (Liu et al. 2015).

Combined with afforestation and improved forest management, avoiding deforestation and reducing degradation can mitigate 4–20 per cent of global emission-reduction targets required to meet the +2°C limit of the Paris Agreement (Forsell et al. 2016). Such mitigation actions in the land-use sector are essential to keep global warming below 1.5°C above pre-industrial average global temperatures by the end of this century (IPCC 2018).

In addition, forests can help people and environments become less vulnerable to climate change by providing protection from floods and storms, providing food, materials or alternative income after crop failures and improving water quality and, in some cases, yield for downstream users (Osman-Elasha et al. 2009).

On the other hand, forests can be affected by climate change which will favour the survival and growth of some species, but hamper that of others. Climate change is also expected to reinforce the current threats to forests and their ecosystem services by increasing the frequency and intensity of fires, pests and diseases, extreme events (flooding and storms) and changing precipitation regimes. Achievement of Targets 13.1 and 13.2 will reduce the

¹ <https://sustainabledevelopment.un.org>

negative impacts of climate change and contribute to the resilience of forest ecosystems. Furthermore, forests may be affected positively or negatively by the implementation of measures under SDG 13 involving conversion of land to other forms of land cover or land use.

Humans are connected to forests via complex socio-ecological systems (Figure 13.1). In Section 13.2, we analyse how actions and measures under SDG 13 (see list of targets in Table 13.1) may influence interactions between forests and people.² We use documented case studies that illustrate climate actions and their impacts on forests and people at local and regional levels, focusing on two major international initiatives that link forests to climate change: forest and landscape restoration (FLR) and REDD+.³ In Section 13.3

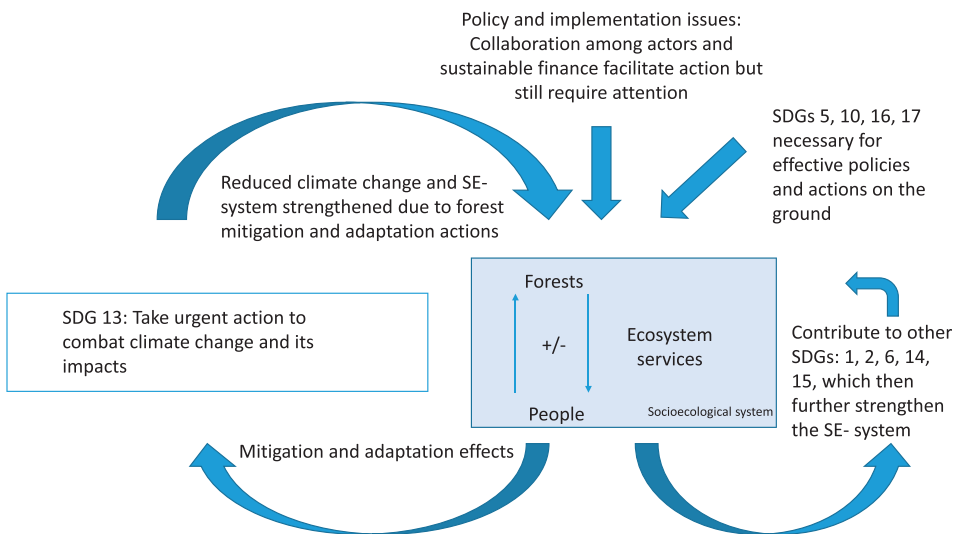


Figure 13.1 Framework of the relationship between forest-based socio-ecological (SE) systems and SDG 13. Forest-based SE systems (landscapes) have the potential to generate a virtuous cycle for the implementation of SDG 13: if climate actions consider forests in their policies, measures and actions, the mitigation and adaptation potential of forests will be enhanced and will better contribute to SDG 13 targets and the Paris Agreement’s main goal of reducing the carbon concentration in the atmosphere. The latter will slow down climate change and allow forests to adapt better to new conditions. Achievement of SDGs 5, 10, 16 and 17 will reinforce the positive effects of SDG 13 on forests, while we expect that the achievement of positive effects of SDG 13 on forests will support the achievement of SDGs 1, 2, 6, 14 and 15 (Reed et al. 2015), which in turn may have positive effects on SDG 13 and forests. Greater collaboration and sustainable finance are still major challenges for SDG 13 implementation.

² The effects of climate on forests have been amply analysed elsewhere (e.g. Swamy et al. 2018).

³ Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

Table 13.1 SDG 13: Take action to combat climate change⁴

Target	Action
13.1	Strengthen resilience and adaptive capacity
13.2	Integrate climate change measures into national policies, strategies and planning
13.3	Improve education, awareness-raising and human and institutional capacity
13.A	Fully operationalise the Green Climate Fund through its capitalisation (USD 100 billion/year)
13.B	Support least developed countries, small island developing States, including focusing on women, youth and local and marginalised communities

Source: Adapted from <https://sustainabledevelopment.un.org/sdg13>
⁴ Acknowledging that the United Nations Framework Convention on Climate Change (UNFCCC) is the primary international, intergovernmental forum for negotiating the global response to climate change.

we discuss how major policy and implementation issues related to these initiatives influence the impact that SDG 13 may have on forests and people, and [Section 13.4](#) presents a set of conclusions.

13.2 Targets and Their Possible Impacts

13.2.1 Strengthen Resilience and Adaptive Capacity to Climate-Related Hazards and Natural Disasters – Target 13.1

This target focuses on reducing the potential impacts of climate change. This can be done through national and local disaster risk-reduction strategies or building resilience to more chronic, longer-term stresses due to climate change. Forests may play an important role. Well-managed forests can reduce flood or landslide risks and provide valuable safety nets for local people in times of stress, providing supplemental food sources when crops or pastures fail due to droughts, fires or pests or are impacted by extreme weather events. This role of forests has been recognised in reducing the impacts of disasters such as tsunamis, storms and typhoons. For example, in Southeast Asia, mangroves reduce future climate risks while also providing food, habitat for aquatic biodiversity and carbon storage (Murdiyarto et al. 2015).

Such hazards may occur more frequently or increase in intensity due to climate change (Dale et al. 2001) and will affect both forests and people,

reducing the capacity of forests to provide benefits and mitigate climate change.

This is aggravated by unsustainable land use: human interference may exacerbate forest fires, for example, in boreal (Flannigan et al. 2009) or tropical regions (Nepstad et al. 2008), or they may increase forest fragmentation (Laurence and Williamson 2001). This vicious circle can only be interrupted through deliberate actions, such as those oriented at sustainable use, conservation and restoration of forests.

Many international and national initiatives related to forests are focused on their contribution to current biodiversity conservation objectives or forest-based climate mitigation. These initiatives can have positive impacts on both forests and people. For example, REDD+ activities often have little positive impact on the well-being of forest-dependent communities because they do not add to these communities' resilience to outside changes (Akamani and Hall 2015, Duchelle et al. 2018). If such mitigation strategies addressed local access to forests and forest resources, improving such access could contribute to the adaptive capacity of forest-dependent communities (Turnhout et al. 2017).

In other cases, mitigation may reduce the adaptive capacities of the forest or of local people. Planting large areas of fast-growing trees in degraded forest areas, for example, will increase local carbon stocks, but may decrease water availability and increase the risk of droughts. Forest-based mitigation and adaptation investments need to be carefully planned to address impacts on water resources (van Dijk and Keenan 2007).

The experiences with forest-based climate actions so far have shown that: (1) the impacts of forest-based mitigation and adaptation activities on people's climate resilience depends on their level of social organisation and their level of participation in these activities, and (2) investment in forest-based climate change action is still limited.

In summary, reaching Target 13.1 will have positive impacts on forests and people if the role of forests in climate-hazard reduction can be properly valued and is recognised. Additionally, sufficient evidence of these values should be provided in order to reduce the risk perceptions that investors have of investments in sustainable land use, while social organisation and participation of local people needs to be strengthened to ensure that the most vulnerable people can also benefit from these investments.

13.2.2 Integrate Climate Change Measures into National Policies, Strategies and Planning – Target 13.2

Forest-based adaptation and mitigation have been incorporated into global climate agreements since the United Nations Framework Convention on Climate Change (UNFCCC) was ratified in 1992. The following mechanisms and programmes are included in the framework:

- **Article 3.3 and 3.4 of the Kyoto Protocol.** This provides for Annex 1 parties to use forest-based activities (afforestation, reforestation and avoided deforestation) to meet their emission-reduction commitments.
- **Clean Development Mechanism (CDM).** Under the Kyoto Protocol, reforestation and afforestation are eligible activities.⁵ Less than 1 per cent of CDM projects are in forestry due to stringent requirements for forest carbon monitoring, additionality, permanence and leakage avoidance and limitations on the scale of projects.
- **Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks (REDD+).** REDD+ is recognised in the Paris Agreement as a climate change mitigation action. International funding mechanisms such as the Forest Carbon Partnership Facility (FCPF), the Forest Investment Program and the UN-REDD Programme were established to help countries prepare for and implement REDD+. The Green Climate Fund has made investments in developing countries to support forest-based activities. The Biocarbon Fund is one of the mechanisms for incentivising action through payment for results.
- **Nationally Appropriate Mitigation Actions (NAMAs).** A set of voluntary policies and actions that contribute to achieving a country's mitigation commitments, which differ by country. Some examples of NAMAs (plantations in Chile, livestock and coffee in Costa Rica) indicate their potential to contribute to forest and tree cover. Developing a NAMA, however, takes time, because it combines technical and policy aspects, involves many stakeholders and is country-driven, with limited resources.
- **Paris Agreement.** This Agreement sets a comprehensive long-term temperature goal for all parties, potential for increased ambition, and mechanisms for regular review of nationally determined contributions. Implementation of this Agreement is essential to achieving SDG 13.

Two other international initiatives also relate forests to climate action. These aim to support the Aichi Targets of the Convention on Biological Diversity (CBD) and the UNFCCC:

- **The Bonn Challenge.** The Bonn Challenge was launched in 2011 to restore 150 million ha of land by 2020. It has led to many pledges for FLR.
- **New York Declaration on Forests (NYDF).** Made in 2015, it expands the goals of the Bonn Challenge to 350 million ha by 2030, in line with Agenda 2030. As of September 2018, 56 countries or jurisdictions have

⁵ www.cdmpipeline.org/cdm-projects-type.htm

committed to restore more than 160 million ha of forest, potentially sequestering 15.66 Gt of CO₂ by 2030.⁶

There has also been a range of bilateral investments to reduce deforestation emissions and expand forest cover, most notably by the Norwegian government in Brazil and Indonesia and more recently by the UK and German governments in a number of countries.

Of all these initiatives, REDD+ and FLR have received substantial support from governments and the private sector, and they can work in tandem to contribute to maintaining forest cover and sustaining restored forests and landscapes.

REDD+ addresses deforestation, degradation, conservation, management and restoration of carbon stocks in forests in developing countries. Countries interested in REDD+ need to go through a readiness phase, which includes strengthening policy frameworks, institutions and human resources. This is followed by implementation and results-based payments phases. However, pledged funding for REDD+ stays well behind the projected needs to reduce deforestation (Turnhout et al. 2017). A lack of human and institutional capacity among developing countries to access and use funds efficiently is limiting investment. This can be seen in the early experiences of implementing REDD+ (see Box 13.1). This has also hampered access to and equitable distribution of financial resources at local scales, particularly for small and medium-sized forest enterprises and communities (Myers et al. 2018). A further limitation is the top-down nature of global climate programmes. Global objectives (to reduce emissions from deforestation) need to be better translated to align with the needs and interests of local actors to be successfully achieved at a local scale (Sanders et al. 2017), and need to demonstrate clear benefits for local, poor people.

Box 13.1 REDD+ Progress and Issues: Challenges to Achieving Long-Term Positive Impacts

REDD+ discussions and initiatives have been successful in putting the spotlight on deforestation; early REDD+ initiatives have achieved institutional changes in the forest sector and have started intersectoral coordination, bringing representatives of the government, environmental organisations, commercial (forest and agricultural) productive organisations, civil society organisations and communities to the same table (Brockhaus et al. 2017). Important issues such as land tenure, regulations and transparency are at least partially addressed (Sunderlin

⁶ www.bonnchallenge.org

Box 13.1 (cont.)

et al. 2014), and more detailed information – not all limited to REDD+ – continuously becomes available on the forests, even from lesser-known carbon pools in some of the remotest places on Earth (Webb et al. 2017).

Different authors question whether the approach taken (i.e. REDD+ related initiatives) will produce the long-term results needed for the forest–society interactions to become sustainable and climate proof (Lund et al. 2016). One of the criticisms is that current policies and measures (PAMs) are oriented towards strengthening existing relations and practices rather than promoting transformational change that allows for reducing or eliminating the underlying causes of deforestation and forest degradation. Indeed, addressing these underlying causes is one of the major challenges encountered by REDD+ practitioners, as is the unwillingness of relevant sectors to collaborate in solving these issues (Angelsen et al. 2017) and the emphasis on technical approaches rather than seeking political approaches to resolve problems of recognition and justice (Myers et al. 2018).

At the same time, REDD+ has not received the amounts of finance originally envisaged, and is not likely to (Angelsen et al. 2017). This is partially due to the less-than-expected global mitigation commitments, but it is also linked to uncertainties related to the long-term contribution of forest-based mitigation initiatives for reduced emissions and carbon storage.

These uncertainties may relate to difficulties in transparent reporting on carbon results (Enrici and Hubacek 2018), transparent mechanisms for benefit distribution that ensure forest maintenance in the long term (Lund et al. 2016, Myers et al. 2018), and the future needs for agricultural land and subsequent changes in land value, pressures on the forest and stakeholder relations (Lapola et al. 2014). These may be affected by markets and other policy areas such as trade, as well as climate change; current and future abilities to manage conflicts (Myers et al. 2018, Sunderlin et al. 2014); the need for, and difficulty of, measuring compliance with the REDD+ safeguards (Jagger et al. 2014); and the need to match the expectations of global policy with local development needs (Sanders et al. 2017). The way that REDD+ initiatives are visualised may also affect their performance. Weatherley-Singh and Gupta (2017) argue that, to be successful, REDD+ initiatives need to balance ecological, political and economic aspects. They studied a REDD+ initiative in Madagascar that was set up with a more ecological approach, seeking to benefit smallholders and preserve biodiversity. However, despite some progress in reducing deforestation, it was challenging for the initiative to address the underlying causes of deforestation, such as the lack of intersectoral coordination, national political support and stakeholder involvement at multiple governance levels.

Directly or indirectly, existing efforts have had a positive influence on forest area by contributing to reducing the rate of annual loss. How much of this is due to climate action is difficult to discern from the available information. Despite these efforts, forest loss continues (Keenan et al. 2015), with the highest rates in poorer countries in the tropics.

FLR actions have potential to link mitigation with adaptation objectives. In many countries, restoration of forest lands contributes to increased resilience and reduced vulnerability by restoring essential ecosystem services (Stanturf et al. 2015). Despite many pledges to restore forests and landscapes (Box 13.2; see also AFR100⁷), there is a big gap in meeting restoration targets under the Bonn Challenge. For upscaling implementation, the challenges that remain to be solved include governance issues (who decides on what to do where and when), regulatory frameworks that facilitate FLR, the institutional arrangements to be able to implement them and agreement on the best way to monitor progress (Mansourian et al. 2017). Additionally, further finance will be necessary to meet the Bonn and New York goals.

To make the implementation of climate actions more transparent, countries have been asked to propose contributions to the goals of the Paris Agreement through the **Nationally Determined Contributions (NDC)**. These NDCs need to have clear and fair mitigation targets, may deal with adaptation and

Box 13.2 Seeking the Implementation of International Commitments of the Bonn Challenge in Latin America: Initiative 20x20⁸

Initiative 20x20 brings international intentions to actions on the ground and combines the objectives of three international conventions (Biodiversity, Climate and Degraded Lands). Under this initiative, several countries in Latin America and the Caribbean developed a regional mechanism to restore 20 million ha of forests and landscapes by 2020. After its launch during the Conference of Parties (COP) 20 in Lima, a dialogue was set up among more than 40 technical organisations, 20 financial organisations and 17 countries, building a coalition that should reach investments of up to USD 1 billion. As of 2018, countries and organisations have committed to restore 53.2 million ha by 2020, pledged USD 2.1 billion and committed USD 1.4 billion. Approximately USD 400 million comes from investors seeking positive social and environmental impacts as well as financial returns. Initiative 20x20 aims to attract more private investments by showing the business case for restoration, including climate mitigation and adaptation benefits.

⁷ <https://afr100.org/>

⁸ <https://initiative20x20.org/>

show a variety of ways in which countries incorporate or propose to incorporate climate actions into their national policies and strategies. NDCs are useful to monitor progress against the commitments of each country, and countries are expected to produce biannual reports. Nevertheless, commitments in the NDCs are not sufficient to maintain global warming below the 2°C limit (Rogelj et al. 2016). Even the implementation of these commitments is limited, due to lack of capacity and financial resources.

Meeting the global warming target would reduce the risk of losing species because of climate change. Without mitigation only 11 of 33 globally significant biodiversity conservation areas (GSBCA) would maintain their functions as refuge for 75 per cent of today's' species. Current mitigation commitments would bring that up to 50 per cent, while achieving the Paris Agreement target of reduced global warming would maintain the refuge function in 67 per cent of the current GSBCA (Warren et al. 2018). The Intergovernmental Panel on Climate Change (IPCC 2018) estimates that mitigation actions that can reduce global warming by another 0.5°C – from 2°C to 1.5°C – will lower the risks for biodiversity and forest area, lowering the risk of extinction by as much as 67 per cent for insects and 50 per cent for plant and vertebrate species. Even for many species not threatened by extinction, climate change will cause changes in their ecosystem and likewise affect local forest-dependent people (Pecl et al. 2017).

On the positive side, more than 100 countries include forests in their NDC, representing more than 80 per cent of the global forest area. Approximately 20 per cent of the estimated total net emission reductions to be achieved through the NDCs are expected to come from the land use, land-use change and forestry sector (Forsell et al. 2016). Forests are typically mentioned in relation to one of the instruments mentioned above (NAMA, REDD+, CDM, FLR).

Chile, for example, blended its commitments to the CBD, UNFCCC and the United Nations Convention to Combat Desertification into one single strategy: climate change and vegetational resources. This strategy operationalises its NDC and proposes to plant 100 000 ha with mainly native species and to restore and sustainably manage an additional 100 000 ha of natural forest lands (Moraga and Sartori 2017). This strategy also addresses adaptation concerns, proposing direct interventions in 267 000 ha in order to safeguard biodiversity and environmental services. Although it can be expected that if these targets are met, many people will be positively affected, the strategy itself does not make an estimate of the potential impacts on people. It remains to be seen whether Indigenous people perceive the strategy as positive for their well-being, considering that they already have serious problems with current water and land-tenure regimes. The strategy does not explicitly offer solutions to these problems. In Chile, the main challenges for climate

action implementation are considered to be the participation of all stakeholders, existing human capacities and the fact that 84 per cent of the proposed budget will depend on the availability of international finance. While the first two challenges are addressed as part of the strategy, through training of staff and consultation programmes, the third challenge depends on the international preparedness to contribute to Chile's efforts to combat climate change.

While every country is different, it can be expected that even implementation of these insufficient NDCs will positively impact on forest area, diversity and ecosystem services. The benefits of these impacts, however, may not accrue equally to all stakeholders. Each country will have to overcome its own implementation challenges, many of which will relate to stakeholder participation, capacities and access to additional finance.

13.2.3 Improve Education, Awareness-Raising and Human and Institutional Capacity on Climate Change Mitigation, Adaptation, Impact Reduction and Early Warning – Target 13.3

Awareness of climate change is essential to stimulate action. Education, skills and institutional capacity should allow people to implement these actions. The forest sector has a long track record of raising awareness about environmental concerns, and for many years forest extension programmes have aimed at increasing the capacity of local people to contribute to forest management and conservation (see [Chapter 4](#)). In Costa Rica, education and awareness were found to be major triggers for conservation of trees on farmlands (Louman et al. 2016). Within the context of REDD+ and the fight against illegal logging, strengthening institutional capacity has received major attention. Most of the recent REDD+ financing, estimated to be nearly USD 2 billion, has been spent on strengthening national capacities in preparation for REDD+. However, as the example of Chile shows, education, skills and institutional capacity remain major concerns for the successful implementation of forest-based mitigation and adaptation initiatives. These challenges must be addressed for Targets 13.1 and 13.2 to be fully achieved.

13.2.4 Mobilising Jointly USD 100 Billion Annually by 2020 – Target 13.A

Currently, USD 10.3 billion has been pledged to the Green Climate Fund (GCF).⁹ However, overall costs of climate change actions are estimated to be about USD 2.4 trillion for the energy sector alone (IPCC 2018). In comparison

⁹ Of this, USD 10.2 billion has been signed (www.greenclimate.fund/how-we-work/resource-mobilization).

to some climate actions in the energy, transport and industry sectors, investing in the forest sector is a relatively low-cost contribution to the overall goals of reduced atmospheric carbon concentrations and increased resilience, in particular of forest-dependent people.

Looking at past assignment of climate funds to forests (Bird et al. 2017a, 2017b, 2017c), we could expect that by 2020 about USD 3 billion per year will become available for emission reduction in forests if Target 13A is met. In theory, USD 3 billion annually could cover 12 per cent of forest emissions (Douglas and Simula 2010). Whether this will occur, however, requires further analysis of how these funds are being used. A large part of this money will still need to be spent on preparing the conditions for emission reductions to take place and be measured. It may take many years for most countries to reach such readiness. In addition, if allocation policies of climate funds do not change, this money would have to pay for FLR as well. Clearly, current fund allocations are not sufficient to make maximum use of the mitigation and adaptation potential of forests.

13.2.5 Raising Capacity for Effective Climate Change-Related Planning and Management in Least Developed Countries and Small Island Developing States, Including Focusing on Women, Youth and Local and Marginalised Communities – Target 13.B

Climate action PAMs may affect marginalised groups in different ways. Issues such as tenure clarity and security, conflict resolution, transparency in government decisions and empowerment of marginalised groups must be elements of any climate action to reduce further marginalisation of these groups (White et al. 2010). Eighty-five per cent of farmers worldwide are smallholder farmers, many of whom belong to marginalised groups and who utilise unsustainable land-use practices due to insufficient resources and/or knowledge. They contribute to greenhouse gas emissions and are often among the most vulnerable people due to their reliance on rain-fed agriculture. Women, youth and local marginalised groups also require special attention, as their level of vulnerability to climate change may differ from others. Women in the Yucatan Peninsula, for example, are more vulnerable to extreme events such as hurricanes because they communicate through different networks than the one usually used for warning systems (Soares Moraes et al. 2011). However, it has been argued that generalisations about women's vulnerability and virtuousness in reference to climate change might lead to an increase in women's responsibility without corresponding rewards (Arora-Jonsson 2011).

The relatively new global agreements on forests (the NYDF) and climate change (Paris Agreement) put even more strain on marginalised people: now

they are not only required to meet their own needs with few resources, but are also expected to contribute to global needs and priorities.

The meaningful participation of these marginalised groups in planning and management of climate actions is crucial for both successfully implementing climate action and achieving positive impacts on the people who need it most. This requires strengthening the planning and management capacities of these groups.

Australia's experience in reducing emissions by paying Aboriginal communities to reintroduce traditional burning practices on customary lands is a good example of an approach that meets climate policy goals while providing community income and social benefits and improving biodiversity conservation. In this case it also involves younger community members with their land and intergenerational transfer of land management skills (Russell-Smith et al. 2017).

The forest sector has several decades of experience in working with local marginalised groups and in less-developed countries, on which climate action can build. Within the REDD+ context, for example, safeguards have been agreed upon, including benefit-sharing mechanisms to stimulate greater participation, upholding the rights of these different groups and incentivising climate mitigation actions undertaken by them. As seen in [Box 13.1](#), however, the implementation of such safeguards beyond policy statements still lags behind, and they do not yet ensure that marginalised groups will benefit from REDD+ actions (Tehan et al. 2017).

13.3 Policy and Implementation Issues

Both FLR and REDD+ are forest-related climate actions receiving much attention in current international and national policies. For both, large sums of money have been pledged, but implementation in the field has not met expectations. While for each of these international initiatives there are a series of factors that explain (lack of) progress, two issues are common to both: they require collaboration between actors from different sectors and at different scales (local-national-international), and they require more and better financing.

13.3.1 Collaboration between Public, Private and Civic Society Actors and Their Organisations

A wide variety of actors, institutions and organisations are related to forest-based climate actions. Globally, agreements have evolved that deal with relations among countries in the framework of climate change (UNFCCC), forests (UN Forum on Forests, Bonn Challenge and NYDF) and the SDGs, all

of which consider both climate and forests. Climate actions, however, are implemented locally, with or without the support of national authorities and (inter)national civil society organisations and enterprises. The implementation of the negotiated agreements poses new challenges to the countries: (1) in the short and medium term, global development priorities may not necessarily coincide with national priorities, and (2) implementation requires the collaboration of a range of global, national and local actors.

LINKING PRIORITIES OF GLOBAL, NATIONAL AND LOCAL ACTORS

Often, contradictions exist between global and local priorities related to forests that need to be resolved. Globally, climate change mitigation receives the highest priority, since it poses serious risks for everyone and requires a concerted global action early enough to prevent future problems. Adaptation is also important and – especially in the case of small island nations – extremely urgent, but until recently it was largely a national or local problem. Although slowly changing, as reflected in the Paris Agreement text, the provision and distribution of finance to date, and the generation of knowledge and technology within the framework of the UNFCCC and SDG 13, focus more on mitigation than adaptation.

In most tropical and developing countries, adaptation is important, although their NDCs often emphasise mitigation actions to capture additional international finance, which thus far has prioritised mitigation. Until recently, the Adaptation Fund was the major source of international finance for adaptation. Two per cent of the proceeds from certified emission reductions issued from projects in the CDM of the Kyoto Protocol were set aside for this fund. This is changing with the establishment of the GCF, whose mandate is to have a 50/50 balance between investments on mitigation and adaptation.

Such contradictions are particularly relevant for global initiatives such as FLR and REDD+, which emphasise mitigation goals but have possible synergies and trade-offs with national and local adaptation goals and other SDGs. Synergies and trade-offs may differ according to the local contexts (see [Chapters 2, 6–9, 12, 15–17](#)).

A key challenge is to link international goals for emission reductions to local priorities for economic development and poverty alleviation, which have often been drivers of deforestation and degradation. Efforts to effectively translate these global goals have been challenged by local interests and issues associated with land allocation and resource development. Those seeking to implement forest conservation measures must deal with the history of land allocation decisions and conflict between traditional land users, recent smallholder immigrants and larger capital investors in agricultural development (Sanders et al 2017).

In the case of REDD+, for example, actors on the ground need to address the underlying causes from technical, social, economic and policy perspectives. Achieving that through a carbon-centric approach may be less effective than seeking multipurpose forest and tree-based management systems (MFTMS), with mitigation as a secondary result (Ellison et al. 2017). MFTMS have the advantage that they allow the addressing of locally felt needs. This is also valid for FLR initiatives. Vergara et al. (2016) show, for example, that under current carbon prices, the net present value of carbon sequestration services from landscapes is only about 25 per cent of the total present value of average landscape restoration activities in Latin America, the other 75 per cent being attributable to activities that provide locally more appreciated production and regulation services.

The potential beneficiary effects of considering more than one objective in the context of climate change are also highlighted by Locatelli et al. (2015). They found both synergies and trade-offs between agricultural and forest management strategies oriented to adaptation and mitigation. In particular, they found trade-offs where mitigation strategies caused negative impacts on people's adaptive capacity, for example through negative impacts on local land-use opportunities or the availability of water tied to large-scale biofuel plantations. Improving the integration of adaptation and mitigation can be achieved by (1) integrating climate, forest and agricultural policies and strategies across multiple scales (national to local), (2) improving the metrics for monitoring synergies and trade-offs, (3) greater international recognition of the synergies between adaptation and mitigation and the need to treat them together rather than separately (policies, finance) and (4) generating more empirical evidence of the synergies and trade-offs between adaptation and mitigation (Duguma et al. 2014a). The way these issues are addressed may greatly influence the impact of SDG 13 on forests: if PAMs continue to address mitigation and adaptation separately, many opportunities will be lost for optimising synergies and reducing trade-offs.

In the context of both FLR and REDD+, the potential synergies between adaptation and mitigation can be leveraged as a common denominator for linking global, national and local priorities. To be able to do so, however, it is important that FLR and REDD+ focus on the process as well as on the quality and dimension of the final results.

LANDSCAPE APPROACHES TO FOSTER ACTOR COLLABORATION FOR FLR AND REDD+

The benefits of sustainable forest management (SFM), FLR and REDD+ programmes depend on the level of social organisation that existed prior to, or that developed during programme activities (Akamani and Hall 2015, Duchelle et al. 2018). For example, in Honduras, those in a community forestry programme responded quicker to post-hazard recovery assistance after

Hurricane Mitch than communities outside the programme.¹⁰ Whether such benefits reach the people that need it most depends on their access to the programme. In Ghana, access was linked to previous ties with the people and institutions that set up a community forest programme and not necessarily linked directly with the needs of the local people (Akamani and Hall 2015).

A landscape approach is a learning process that fosters collaboration and social organisation, allowing landscape managers to adapt to changing circumstances, involve stakeholders and achieve multiple objectives within defined geographic spaces (Sayer et al. 2013). Experiences have shown that landscape approaches have the potential to facilitate the process of linking global to local priorities (Minang et al. 2014). Numerous landscape initiatives are being implemented. Among the major benefits perceived by the stakeholders in these initiatives are improved institutional planning and coordination, greater collaboration among sectors, and forest planning that serves national and local needs (Hart et al. 2015).

Embracing multiple objectives is a lesson learned from landscape approaches relevant for the implementation of SFM, FLR and REDD+. This is an important factor that determines success, allows for coordination among various programmes and opens financing possibilities from different sources (Hart et al. 2015, see also Box 13.2). Leadership, trust, vision, common concern and the existence of bridging organisations are essential elements for successful governance of socio-ecological systems (Hayes and Persha 2010, Lorenzo et al. 2014). In an analysis of FLR in South Asia these same factors have also been mentioned as success factors (IUFRO et al. 2018). These factors, however, rarely form part of formal planning cycles.

The main challenges of landscape approaches are a lack of political coherence, sustainable finance and, despite increased collaboration, full stakeholder engagement (Hart et al. 2015). To overcome some of these challenges, jurisdictional approaches are being applied, in particular in relation to REDD+ and zero-deforestation initiatives. Such approaches align landscape planning initiatives to (sub)national administrative areas and their authorities, seeking political backing of the initiatives. While these address the issue of political coherence, their success also depends on sustainable finance and full engagement. In Mozambique, such a jurisdictional approach is seen as a strategy to access finance from different sources (Box 13.3).

Since landscape approaches typically bring multiple disciplines together, they can be useful processes to coordinate the implementation of other SDGs. They offer opportunities to maximise synergies and reduce trade-offs among SDGs. By focusing on sustainable use of natural resources, these approaches are important for the achievement of SDGs 1 (No Poverty), 2 (Zero Hunger),

¹⁰ Personal observation.

Box 13.3 A Landscape Approach in Practice: The Zambezia Integrated Landscape Management Programme

In Mozambique, the main drivers of deforestation and forest degradation are agriculture, illegal logging and wood extraction for domestic use. During the 2015 COP21 in Paris, Mozambique signed a Letter of Intent (LOI) with the FCPF Carbon Fund on the purchase of carbon emission reductions up to a value of USD 50 million. Under this LOI, the country committed to implementing REDD+ and established the jurisdictional Zambezia Integrated Landscape Management Programme (ZILMP). It promotes innovative and decentralised governance arrangements at the provincial and district levels and coordinates activities implemented with impacts on emissions from deforestation and forest degradation. The programme covers nine districts in the Zambezia Province – an area of 53 000 km², of which 66 per cent is covered by forests with an estimated current annual deforestation rate of 0.62 per cent.

The Zambezia Sustainable Development Platform is a new model for multi-stakeholder engagement in which, for the first time in Mozambique, civil society, the private sector, academia and government have an adequate forum to discuss issues related to natural resource management. The platform creates opportunities for broad discussions and learning among stakeholders.

The ZILMP works with several government initiatives financed by the World Bank: (1) the Conservation Areas for Biodiversity and Development Project (USD 46.3 million), (2) the Agriculture and Natural Resources Landscape Management Project (USD 40 million) and (3) the Mozambique Forest Investment Project (USD 47 million). Despite different entry points and focuses, all the projects have a common goal: to enhance the living conditions of communities through the sustainable use of forests and other natural resources. Activities to reduce the emissions from deforestation and forest degradation include: (1) conservation agriculture with the communities surrounding the Gilé National Reserve, (2) introduction of 4000 clean cook stoves and (3) spatial analysis to prioritise activities across the landscape.

Adapted from: The World Bank (2015).

6 (Clean Water and Sanitation), 13 (Climate Action), 14 (Life below Water) and 15 (Life on Land). This is particularly relevant since these SDGs are inter-related. Poor people are in general more vulnerable to climate change, so reducing poverty will decrease vulnerability, while at the same time reducing climate change through mitigation measures will reduce the climate-related hazards to which these people may become exposed. Hunger is often exacerbated by climate-related events, such as droughts or floods. Water resources

are directly affected by climate change, as is life below water and life on land. Any level of achievement of the SDG 13 goals, even if insufficient to remain under the 2°C limit, will have a positive influence on moving towards the other goals, compared to not implementing any climate action at all. Applying landscape approaches will facilitate making such linkages at the local level.

On the other hand, SDGs 5 (Gender Equality), 10 (Reduced Inequalities), and 16 (Peace, Justice and Institutions) are instrumental to the implementation of landscape approaches.

Landscape approaches are not a panacea for the local implementation of climate action; due to their relatively recent nature, little evidence can yet be presented on how they contribute to the success of such implementation. However, they build on lessons learned from past experiences with similar approaches, and when they adhere to implementation principles (Sayer et al. 2013) they can offer great opportunities to address the challenges of better implementation for SDG 13 targets having positive impacts on forests and people.

13.3.2 Finance for Implementation

Estimating the amount of funding currently invested in climate change is challenging. In 2013 some USD 331 billion was invested globally for climate-related activities (Buchner et al. 2014), although not all of this was classified as official climate funds. These funds fall well short of the needs for mitigation and adaptation: the same authors suggest, based on their review of other publications, that to transform only the energy sector to a low-carbon sector requires about USD 1 trillion a year until 2030. Currently, investors and international finance organisations are focused on this sector since it promises more straightforward links to emission reductions than those in the land-use sector (Duguma et al. 2014b). However, the forest-based offset market is growing (Forest Trends 2018), and is likely to increase as emission-reduction targets become tougher and low-cost energy transition options are taken up.

Of the USD 61 billion official climate fund monies spent between 2011 and 2015, only 3 per cent was dedicated to forests (Bird et al. 2017a, 2017b, 2017c, MDB 2017, OECD 2015), and most of that for mitigation purposes. If this trend continues, and the USD 100 billion annual target (Target 13.A) is reached, after 2020 about USD 3 billion annually would become available. This is well below the estimated opportunity cost of avoided deforestation (Douglas and Simula 2010) – USD 25 billion USD per year – and would also need to cover adaptation investments. Investment levels, particularly for forest and forest-based adaptation, lag behind needs. There are several reasons for this: (1) it is difficult to determine specific adaptation needs of forests and forest-dependent people due to the uncertainty about long-term climate changes and the variability of

responses for different species and forest types to changing climatic conditions; (2) because of lack of experience with the analysis of climate-change impacts and management responses, there is no continuous learning process that can catalyse the adaptation of forest management to address climate change impacts (Lawrence and Haasnoot 2017); and (3) forest managers are generally reluctant to implement new practices without clear evidence of benefits.

Being able to show evidence of the full costs and benefits of trees in the landscape should leverage private finance from a range of different actors (Vergara et al. 2016). This is particularly relevant if you want to capture more private investment that contributes to both mitigation and adaptation. In the context of the Bonn Challenge and the NYDF, it will be difficult to reach the target to restore 350 million ha of land by 2030 without such private finance.

To achieve the climate goals, small and medium-sized enterprises and communities also need to be involved: they are affected by climate change and need to adapt; they contribute to the problem of deforestation and degradation, yet can also provide important contributions to solutions (de Jong et al. 2018). Their access to climate finance, however, is limited (MacQueen et al. 2014), and is often negatively influenced by unclear land-tenure regimes (van Dijk and Savenije 2009). In the forest sector of many countries, there is also a failure to apply existing legislation, along with weak control mechanisms, weak institutions and a lack of political will to make the necessary transformational changes (van Dijk and Savenije 2009).

Another issue that calls for careful attention is the potential in climate finance for both synergies and trade-offs across different sectors and different scales. Synergies exist between the agricultural and forest sectors: protection of forests is essential for regular and clean water flows (Ellison et al. 2017); in agroforestry systems, ecosystem services are provided as well as agricultural crops and tree products; and in the restoration of degraded landscapes, trees and other conservation measures can contribute to future agricultural crop production. Trade-offs may also occur. Forest programmes focusing only on carbon, for example, may reduce local capacities for adaptation (Duguma et al. 2014a, Locatelli et al. 2015). Finance that facilitates synergies will be more efficient than finance generating trade-offs.

Reducing direct finance and other incentives (e.g. tax deductions) for land uses that negatively affect forests and their ecosystem services is as important for forest-based mitigation and adaptation as increasing the availability and sustainable and inclusive use of finance. More than USD 380 billion is invested annually in the land-use sectors (FAO 2017), and only a small proportion of this considers the negative impacts of land use on forests and their functions and services. Many financed land-use activities still threaten the quality or quantity of forests. For example, in many tropical countries, the expansion of

extensive livestock management and large-scale monocultures of agro-commodities impinges on forest areas. At the same time, inadequate or overbearing legislation and regulation provide opportunities for corruption and cause high transaction costs for legal forest use (Navarro and Bermudez 2006). Transport infrastructure development, mining and hydropower are having increasing impacts on forests, with associated effects on the rights, lives and livelihoods of local people. The stakes for these projects are often much higher than for agricultural development, and it often requires well-organised political and social movements to counter them (Bebbington et al. 2018).

Experiences with climate finance show that much of the assigned money (1) does not enter the forest sector and, in some cases, may be detrimental to the forest sector (e.g. by promoting large-scale commercial agriculture through subsidies or facilitating finance), (2) is not used efficiently in that it addresses mitigation and adaptation issues separately rather than addressing them jointly from the outset, and (3) if invested in the forest sector, is not used efficiently since it is invested in conditions where existing policy frameworks, institutional settings and available human resources cause high transaction costs that discourage the management of forests and trees.

Many opportunities lie in the conversion of business-as-usual investments into investments that improve local climate resilience of forests and people while contributing to low-carbon development. Considering that at the global level, USD 380 billion is invested annually in land uses that impact forests or otherwise increase emissions, investors should seriously consider reducing the climate risks of their investments. To help change the mindset of the investors, it is necessary to have a good understanding of who finances what and why beneficiaries prefer one type of finance over another. In addition, it is necessary to identify which locally relevant policy, regulatory, planning and development arrangements could facilitate directing that mindset towards greater investment in resilience and low-carbon development.

13.4 Conclusions

Climate change affects all people, land uses and land covers. Implementation of SDG 13 is critical for forests and for the people that interact with and depend on them. Successful achievement of the SDG 13 targets alone will not be sufficient to ensure conservation and better management of existing forests and restoration of degraded forest lands. Coordination is necessary because SDG 13 is closely interrelated with other SDGs, especially SDG 5 (Gender Equality), SDG 10 (Reduced Inequalities), SDG 12 (Responsible Consumption and Production), SDG 16 (Peace, Justice and Institutions) and SDG 17 (Partnerships for the Goals). Their implementation and awareness of their impact on forests are prerequisites for achieving SDG 13. This requires a high degree of intersectoral coordination

and collaboration among stakeholders at all levels, a clear focus on ecosystem services generated by forests (e.g. climate regulation, hydrological services) and the identification of the policy and practice linkages between adaptation and mitigation in forest ecosystems and the people who depend on them.

Reaching the Paris goals and SDG 13 targets also depends on the development of new programmes and funding models. Our analysis finds two cross-cutting issues that offer potential to facilitate such transformational change: (1) new types of relationships among the various actors involved, and (2) alternative approaches to land-use investments. Considerable evidence and experience provide a foundation on which to build these new relationships and investment approaches.

For example, activities that aim to support Targets 13.3 and 13.B can improve local participation in integrated land-use planning approaches with multiple development and conservation goals, which will increase the willingness of local people to implement climate actions. When local stakeholders have the capacity to negotiate and the results of this process are guaranteed to be implemented by local, provincial, national or international authorities, there is a clear indication that improved outcomes for forests, people and climate can be achieved. While many of these landscape-level initiatives are relatively new, they show promise in bringing together diverse interests to identify shared goals and build more sustainable forest management solutions. Lessons can be learned from these initiatives to strengthen SFM, FLR and jurisdictional approaches to REDD+ that will not only support wider implementation of SDG 13 and the Paris Agreement, but can also contribute to achieving the synergies and balance the trade-offs that may result from the application of adaptation and mitigation actions.

Though there is significant investment in climate finance, little of it is going to the forest sector, while at the same time billions of dollars are invested in ways that are detrimental to forests, such as subsidies or finance to increase the scale of commercial agriculture. Another important factor is that funding allocated to forests is not used efficiently to address the requirements of both mitigation and adaptation. In other cases, current policies, laws and regulations can cause high transaction costs that discourage the improved management of forests and trees. With good design, conditions associated with international funds for REDD+ can improve forest governance and transparency, and international and national funds are becoming more aware of the need for integrated finance to address the role of forests and climate change in a multifaceted way. However, current efforts are not sufficient to (1) avoid the continuing forest loss or the detrimental impacts that climate change is having on forest health, vitality and diversity or (2) increase the rate of FLR and its contributions to both mitigation and adaptation. Many are now looking to the private sector as a new actor in climate governance and as the primary source of funds for climate

actions related to forests and forest landscapes. This requires appropriate regulations and strong business cases built on clear evidence of the positive impacts of investment on climate, economic development and financial returns.

Increased forest-based climate actions will increase the capacity of forests to contribute to mitigation and reduce the vulnerability of forest-dependent people. Embedding forests into the climate policies, measures and actions under SDG 13 can generate a virtuous cycle, deriving greater benefits from forests for people, reducing the future rate of climate change and ensuring that forests and forest-dependent people are more resilient and have the capacity to anticipate and adapt to future change.

References

- Akamani, K. and Hall, T. E. 2015. Determinants of the process and outcomes of household participation in collaborative forest management in Ghana: A quantitative test of a community resilience model. *Journal of Environmental Management* 147:1–11.
- Angelsen, A., Brockhaus, M., Duchelle, A. E. et al. 2017. Learning from REDD+: a response to Fletcher et al. *Conservation Biology* 31(3):718–20.
- Arora-Jonsson, S. 2011. Virtue and vulnerability: Discourses on women, gender and climate change. *Global Environmental Change* 21:744–51.
- Avelino, J., Cristancho, M., Georgiou, S. et al. 2015. The coffee rust crises in Colombia and Central America (2008–2013): Impacts, plausible causes and proposed solutions. *Food Security* 7(2):303–21.
- Bebbington, A. J., Bebbington, D. H., Sauls, L. A. et al. 2018. Resource extraction and infrastructure threaten forest cover and community rights. *Proceedings of the National Academy of Sciences* 115(52):13164–73.
- Bird, N., Watson, C. and Schalatek, L. 2017a. *The global climate finance architecture. Climate funds update*. Washington, DC: Heinrich Boll Stiftung.
- Bird, N., Watson, C., Schalatek, L. and Keil, K. 2017b. *Climate finance thematic briefing: REDD+ finance. Climate funds update*. Washington, DC: Heinrich Boll Stiftung.
- Bird, N., Watson, C., Schalatek, L. and Keil, K. 2017c. *Climate finance thematic briefing: Adaptation finance. Climate funds update*. Washington, DC: Heinrich Boll Stiftung.
- Brockhaus, M., Korhonen-Kurki, K., Sehring, J. et al. 2017. REDD+, transformational change and the promise of performance-based payments: A qualitative comparative analysis. *Climate Policy* 17(6):708–30.
- Buchner, B., Abramskiehn, D., Stadelmann, M. et al. 2014. *The global landscape of climate finance 2014*. Climate Policy Initiative. Available at: <https://climatepolicyinitiative.org/wp-content/uploads/2014/11/The-Global-Landscape-of-Climate-Finance-2014.pdf> (Accessed 29 July 2019).
- Dale, V. H., Joyce, L. A., McNulty, S. et al. 2001. Climate change and forest disturbances: Climate change can affect forests by altering the frequency, intensity, duration, and timing of fire, drought, introduced species, insect and pathogen outbreaks, hurricanes, windstorms, ice storms, or landslides. *BioScience* 51(9):723–34.

- De Jong, W., Pokorny, B., Katila, P., Galloway, G. and Pacheco, P. 2018. Community forestry and the Sustainable Development Goals: A two way street. *Forests* 9(6):331.
- Douglas, J. and Simula, M. 2010. *The future of the world's forests: Ideas vs ideologies* (vol. 7). Berlin: Springer Science and Business Media.
- Duchelle, A. E., Seymour, F., Brockhaus, M. et al. 2018. *REDD+: Lessons from national and subnational implementation* (Ending Tropical Deforestation Series). Washington, DC: World Resources Institute.
- Duguma, L. A., Minang, P. A. and van Noordwijk, M. 2014a. Climate change mitigation and adaptation in the land use sector: From complementarity to synergy. *Environmental Management* 54(3):420–32.
- Duguma, L. A., Wambugu, S. W., Minang, P. A. and van Noordwijk, M. 2014b. A systematic analysis of enabling conditions for synergy between climate change mitigation and adaptation measures in developing countries. *Environmental Science & Policy* 42:138–48.
- Ellison, D., Morris, C. E., Locatelli, B. et al. 2017. Trees, forests and water: Cool insights for a hot world. *Global Environmental Change* 43:51–61.
- Enrici, A. and Hubacek, K. 2018. Challenges for REDD+ in Indonesia: A case study of three project sites. *Ecology and Society* 23(2):7.
- FAO 2017. *The future of food and agriculture. Trends and challenges*. Rome: FAO.
- Flannigan, M., Stocks, B., Turetsky, M. and Wotton, M. 2009. Impacts of climate change on fire activity and fire management in the circumboreal forest. *Global Change Biology* 15(3):549–60.
- Forest Trends 2018. *Voluntary carbon markets insights: 2018 outlook and first-quarter trends*. Available at: www.forest-trends.org/publications/voluntary-carbon-markets/ (Accessed 30 January 2019).
- Forsell, N., Turkovska, O., Gusti, M. et al. 2016. Assessing the INDCs' land use, land use change and forest emission projections. *Carbon Balance and Management* 11:26. <http://doi.org/10.1186/s13021-016-0068-3>.
- Hart, A. K., Milder, J. C., Estrada-Carmona, N. et al. 2015. Integrated landscape initiatives in practice: Assessing experiences from 191 landscapes in Africa and Latin America. In Minang, P., van Noordwijk, M., Freeman, O. E. et al. (eds.) *Climate-smart landscapes: Multifunctionality in practice*. Nairobi: World Agroforestry Centre (ICRAF), pp. 89–101.
- Hayes, T. and Persha, L. 2010. Nesting local forestry initiatives: Revisiting community forest management in a REDD+ world. *Forest Policy and Economics* 12(8):545–53.
- IPCC 2018. *Global warming of 1.5°C. Summary for policy makers*. Available at: www.ipcc.ch/report/sr15/ (Accessed 30 January 2019).
- IUFRO, Global Partnership on Forest and Landscape Restoration and Bonn Challenge 2018. *International knowledge-sharing workshop, a contribution to the implementation of the Bonn Challenge. Best practices for the implementation of forest landscape restoration in South Asia*. Summary report. Available at: www.iufro.org/fileadmin/material/science/spps/spdc/Sri_Lanka_2018/FLR-Knowledge-sharing_WS-Sri_Lanka-Summary_Report.pdf (Accessed 30 January 2019).
- Jagger, P., Brockhaus, M., Duchelle, A. et al. 2014. Multi-level policy dialogues, processes, and actions: Challenges and opportunities for national REDD+ safeguards measurement, reporting, and verification (MRV). *Forests* 5(9):2136–2162.

- Jindal, R., Swallow, B. and Kerr, J. 2008. Forestry-based carbon sequestration projects in Africa: Potential benefits and challenges. *Natural Resources Forum* 32(2):116–30.
- Keenan, R. J., Reams, G. A., Achard, F. et al. E. 2015. Dynamics of global forest area: Results from the FAO Global Forest Resources Assessment 2015. *Forest Ecology and Management* 352:9–20.
- Lapola, D. M., Martinelli, L. A., Peres, C. A. et al. 2014. Pervasive transition of the Brazilian land-use system. *Nature Climate Change* 4(1):27.
- Laurance, W. F. and Williamson, G. B. 2001. Positive feedbacks among forest fragmentation, drought, and climate change in the Amazon. *Conservation Biology* 15(6):1529–35.
- Lawrence, J. and Haasnoot, M. 2017. What it took to catalyse uptake of dynamic adaptive pathways planning to address climate change uncertainty. *Environmental Science & Policy* 68:47–57.
- Liu, Y. Y., van Dijk, A. I., de Jeu, R. A. et al. 2015. Recent reversal in loss of global terrestrial biomass. *Nature Climate Change* 5(5):470.
- Locatelli, B., Pavageau, C., Pramova, E. and Di Gregorio, M. 2015. Integrating climate change mitigation and adaptation in agriculture and forestry: opportunities and trade-offs. *Wiley Interdisciplinary Reviews: Climate Change* 6(6):585–98.
- Lorenzo, J., Carrera, F., de camino, R. and Villalobos, R. 2014. *Participatory forest governance in Ibero America: Social and political impacts of the Model Forests approach*. Salt Lake City, Utah, USA. IUFRO XXIV World Congress.
- Louman, B., Gutiérrez, I., Le Coq, J. F. et al. 2016. Avances en la comprensión de la transición forestal en fincas costarricenses. *Revibec: Revista de la Red Iberoamericana de Economía Ecológica* 26:0191–206.
- Lund, J. F., Sungusia, E., Mabele, M. B. and Scheba, A. 2016. Promising change, delivering continuity: REDD+ as conservation fad. *World Development* 89:124–39.
- Macqueen, D., Andaya, E., Begaa, S. et al. 2014. *Prioritising support for locally controlled forest enterprises*. London: IIED. Available at: <https://pubs.iied.org/pdfs/13572IIED.pdf> (Accessed 30 January 2019).
- Mansourian, S., Dudley, N. and Vallauri, D. 2017. Forest landscape restoration: progress in the last decade and remaining challenges. *Ecological Restoration* 35(4):281–8.
- MDB 2017. *Joint report on multilateral development banks' 2016 climate finance*. Available at: https://publications.iadb.org/bitstream/handle/11319/8505/2016_joint_report_on_mdbs_climate_finance.pdf?sequence=1&isAllowed=y (Accessed 30 January 2019).
- Minang, P. A., van Noordwijk, M., Freeman, O. E., Mbow, C., de Leeuw, J. and Catacutan, D. (eds.) 2014. *Climate-smart landscapes: Multifunctionality in practice*. ASB Partnership for The Tropical Forest Margins.
- Moraga, J. and Sartori, A. 2017. *Estrategia Nacional de Cambio Climatico y Recursos Vegetacionales*. Santiago, Chile. CONAF. Available at: www.conaf.cl/cms/editorweb/ENCCR/ENCCR-3a_Edicion-17mayo2017.pdf (Accessed 29 July 2019).
- Murdiyarso, D., Purbopuspito, J., Kauffman, J. B. et al. 2015. The potential of Indonesian mangrove forests for global climate change mitigation. *Nature Climate Change* 5(12):1089.

- Myers, R., Larson, A. M., Ravikumar, A. et al. 2018. Messiness of forest governance: How technical approaches suppress politics in REDD+ and conservation projects. *Global Environmental Change* 50:314–324.
- Navarro, G. and Bermudez, G. 2006. *Rentabilidad del manejo de bosques naturales y su competitividad respecto a otros usos de la tierra en Costa Rica*. Serie de Cooperación Técnica Economía y Gobernanza Forestal, vol. 4. Turrialba, Costa Rica: Tropical Agricultural Research and Higher Education Center (CATIE).
- Nepstad, D. C., Stickler, C. M., Soares-Filho, B. and Merry, F. 2008. Interactions among Amazon land use, forests and climate: Prospects for a near-term forest tipping point. *Philosophical Transactions of the Royal Society B: Biological Sciences* 363(1498):1737–46.
- OECD 2015. *Climate Fund Inventory: Report and database*. Available at: www.oecd.org/env/cc/database-climate-fund-inventory.htm (Accessed 30 January 2019).
- Oliver, C. D., Nassar, N. T., Lippke, B. R. and McCarter, J. B. 2014. Carbon, fossil fuel, and biodiversity mitigation with wood and forests. *Journal of Sustainable Forestry* 33(3):248–75.
- Osman-Elasha, B., Adger, N., Brockhaus, M. et al. 2009. Future socio-economic impacts and vulnerabilities. In Seppala, R., Buck, A. and Katila, P. (eds.) *Adaptation of forests and people to climate change. A Global Assessment Report*. IUFRO World Series Vol. 22. Helsinki: IUFRO, pp. 101–22.
- Pan, Y., Birdsey, R. A., Fang, J. et al. 2011. A large and persistent carbon sink in the world's forests. *Science*: 333(6045):988–93.
- Pecl, G. T., Araújo, M. B., Bell, J. D. et al. 2017. Biodiversity redistribution under climate change: Impacts on ecosystems and human well-being. *Science*: 355 (6332):eaai9214.
- Reed, J., van Vianen, J. and Sunderland, T. 2015. *From global complexity to local reality: Aligning implementation pathways for the Sustainable Development Goals and landscape approaches* (vol. 129). Bogor, Indonesia: CIFOR.
- Rogelj, J., den Elzen, M., Höhne, N. et al. 2016. Paris Agreement climate proposals need a boost to keep warming well below 2°C. *Nature Climate Change* 534:631–9.
- Russell-Smith, J., Monagle, C., Jacobsohn, M. et al. 2017. Can savanna burning projects deliver measurable greenhouse emissions reductions and sustainable livelihood opportunities in fire-prone settings? *Climatic Change* 140(1):47–61.
- Sanders, A. J. P., da Silva Hyldmo, H., Prasti H. et al. 2017. Guinea pig or pioneer: Translating global environmental objectives through to local actions in Central Kalimantan, Indonesia's REDD+ pilot province. *Global Environmental Change* 42:68–81.
- Sayer, J. A., Margules, C., Boedhihartono, A. K. et al. 2017. Measuring the effectiveness of landscape approaches to conservation and development. *Sustainability Science* 12(3):465–76.
- Sayer, J., Sunderland, T., Ghazoul, J. et al. 2013. Ten principles for a landscape approach to reconciling agriculture, conservation, and other competing land uses. *Proceedings of the National Academy of Sciences* 110(21):8349–56.
- Soares Moraes, D., Gutiérrez Montes, I., Romero Pérez, R. et al. 2011. *Capitales de la comunidad, medios de vida y vulnerabilidad social ante huracanes en la costa yucateca: Un acercamiento a través de la experiencia de San Felipe, Yucatán*. Serie técnica. Informe técnico no. 385. Turrialba, Costa Rica: CATIE, IICA, IMTA.

- Stanturf, J. A., Kant, P., Lillesø, J.-P. B. et al. 2015. *Forest landscape restoration as a key component of climate change mitigation and adaptation*. World Series, vol. 34. Vienna, Austria: International Union of Forest Research Organizations (IUFRO).
- Stringer, L. C., Dougill, A. J., Fraser, E. et al. 2006. Unpacking 'participation' in the adaptive management of social–ecological systems: A critical review. *Ecology and Society* 11(2):39.
- Sunderlin, W. D., Larson, A. M., Duchelle, A. E. et al. 2014. How are REDD+ proponents addressing tenure problems? Evidence from Brazil, Cameroon, Tanzania, Indonesia, and Vietnam. *World Development* 55:37–52.
- Swamy, L., Drazen, E., Johnson, W. R. and Bukoski, J. J. 2018. The future of tropical forests under the United Nations Sustainable Development Goals. *Journal of Sustainable Forestry* 37(2):221–56.
- Tehan, M. F., Godden, L. C., Young, M. A. and Gover, K. A. 2017. *The impact of climate change mitigation on indigenous and forest communities: International, national and local law perspectives on REDD+*. Cambridge: Cambridge University Press.
- Turnhout, E., Gupta, A., Weatherley-Singh, J. et al. 2017. Envisioning REDD+ in a post-Paris era: Between evolving expectations and current practice. *Wiley Interdisciplinary Reviews: Climate Change* 8(1):e425.
- Van Dijk, A. I. and Keenan, R. J. 2007. Planted forests and water in perspective. *Forest Ecology and Management* 251:1–9.
- Van Dijk, K. and Savenije, H. 2009. Towards national financing strategies for sustainable forest management in Latin America. Overview of the present situation and the experience in selected countries. *Forestry Policy and Institutions Working Paper 21*. Rome: FAO.
- Vergara, W., Gallardo-Lomeli, L., Ríos, A. R. et al. 2016. *The economic case for landscape restoration*. Washington, DC: World Resources Institute.
- Warren, R., Price, J., VanDerWal, J., Cornelius, S. and Sohl, H. 2018. The implications of the United Nations Paris Agreement on climate change for globally significant biodiversity areas. *Climatic Change* 147(3–4):395–409.
- Weatherley-Singh, J. and Gupta, A. 2017. An ecological landscape approach to REDD+ in Madagascar: Promise and limitations? *Forest Policy and Economics* 85:1–9.
- Webb, E. E., Heard, K., Natali, S. M. et al. 2017. Variability in above-and below ground carbon stocks in a Siberian larch watershed. *Biogeosciences* 14(18):4279–94.
- White, A., Hatcher, J., Khare, A. et al. 2010. Seeing people through the trees and the carbon: Mitigating and adapting to climate change without undermining rights and livelihoods. In Mearns, R. and Norton, A. (eds.) *The social dimensions of climate change: Equity and vulnerability in a warming world*. World Bank, pp. 277–301. Available at: <https://openknowledge.worldbank.org/bitstream/handle/10986/2689/520970PUB0EPI11C010disclosed0Dec091.pdf?sequence=1&isAllowed=y> (Accessed 29 July 2019).
- World Bank. 2015. *Zambézia Integrated Landscape Management Programme*. Brochure. Maputo, Mozambique.
- Zarin, D. J., Harris, N. L., Baccini, A. et al. 2016. Can carbon emissions from tropical deforestation drop by 50% in 5 years? *Global Change Biology* 22(4):1336–47.