Convention on Biological Diversity

CPF Collaborative Partnership on Forests

The Forest Factor

The role of protection, restoration and sustainable management of forests for the implementation of the Kunming-Montreal Global Biodiversity Framework

CIFOR · World Agroforestry · Convention on Biological Diversity · CITES · Food and Agriculture Organization of the United Nations · Green Climate Fund · gef · ITTO · IUCN

IUFRO · United Nations Convention to Combat Desertification · UNDP · UN environment programme · Department of Economic and Social Affairs · United Nations Climate Change · World Bank Group

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The Forest Factor

The role of protection, restoration and sustainable management of forests for the implementation of the Kunming-Montreal Global Biodiversity Framework

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Secretariat of the Convention on Biological Diversity
Montreal

Convention on Biological Diversity

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Foreword

As Parties to the Convention on Biological Diversity move forward to develop and implement their National Biodiversity Strategies and Action Plans, it is important to highlight the urgent role that conservation, restoration and sustainable management of forests must play in achieving the Kunming-Montreal Global Biodiversity Framework. Forest ecosystems host up to 80% of the world's terrestrial biodiversity and play a vital role in the livelihoods of millions of people. With the global rate of deforestation at about 10 million hectares per year and another 15 million hectares per year of forest being degraded, the importance of prioritizing sustainable forest management and increasing protected areas cannot be over-emphasized as enshrined in the Global Forest Goals of the UN Strategic Plan for Forests.

Although the deforestation rate is slowing, urgent and strategic action is required to address the major drivers of continuous forest loss, including deforestation, pests and wildfires, and to restore degraded forest ecosystems. By implementing the Global Biodiversity Framework, countries can place much greater effort on mainstreaming biodiversity into agriculture sectors, while improving sustainable forest management, reducing illegal harvesting of trees and enhancing the restoration of degraded ecosystems. Part of this effort involves capacity building for improving community forest management and transforming wood and non-wood product value chains into more sustainable and transparent alternatives to unsustainable practices which lead to deforestation, especially with indigenous peoples and local communities. Community forestry, scaling up agroforestry, integrated land-use planning and monitoring to achieve sustainable agricultural and forestry production while conserving natural forests and biodiversity can become important conservation and restoration actions.

Forests are a crucial element in most of the targets of the Global Biodiversity Framework. The Collaborative Partnership on Forests is a strong ally and advocate for countries to implement those forest-related targets. It is using its convening power to heighten the political commitment and scale up on-the-ground actions by facilitating cross-sectoral collaboration, supporting improved, coherent policy responses, and further integrating forest actions into relevant development plans and strategies.

The present document, developed in partnership with members of the Collaborative Partnership on Forests, illustrates how the conservation of forest biodiversity and sustainable forest management can be applied by Parties to achieve the goals and targets of the Global Biodiversity Framework and mutually the Global Forest Goals of the UN Strategic Plan for Forests 2017-2030.

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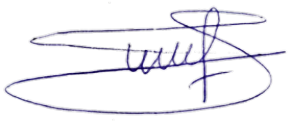


Juliette Biao
Director
United Nations Forum on Forests Secretariat

Collaborative Partnership on Forests

The Collaborative Partnership on Forests (CPF)[1] is an innovative voluntary inter-agency partnership established in 2001 to support the UN Forum on Forests and its Member States, and to enhance cooperation and coordination on forest issues. Through its resolution 2015/33, the UN Economic and Social Council defined the core functions of the CPF as a component of the International Arrangement on Forests.

The CPF is working together and with the Member States of the United Nations and other partners towards a world in which all forests are managed sustainably for the benefit of people and the planet (CPF, 2020[2]). In the CPF Joint Call to Action for Forests towards 2030 (CPF, 2023[3]), the need for collective action and renewed and enhanced commitment, anchored in international solidarity and effective cooperation is emphasized given the global climate crisis, biodiversity loss, wildfires, and the need to support vulnerable people across the globe.

The mission of the CPF is to heighten political commitment and scale up on-the-ground actions to reach the Global Forest Goals of the UN Strategic Plan for Forests 2017-2030. The CPF has committed to do so by:

- Facilitating cross-sectoral collaboration, supporting improved, coherent policy responses, and further integrating forest actions into relevant development plans and strategies.
- Helping recognize and unlock the full value of forests across global agendas on food security, climate change, biodiversity, land degradation, employment, water, energy, wildfires, sustainable production, bioeconomies and other interconnected sectors.
- Enhancing action at all levels on conservation, restoration, and the sustainable management and use of forests, ensuring that no one is left behind and that women, youth, Indigenous Peoples and local communities are empowered.
- Continuing development and dissemination of robust and transparent forest data and scientific knowledge, to enhance informed, evidence-based decision-making.

1 Members: Center for International Forestry Research - World Agroforestry (CIFOR- ICRAF), Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Food and Agriculture Organization of the United Nations (FAO), Green Climate Fund (GCF), Global Environment Facility (GEF), International Tropical Timber Organization (ITTO), International Union for Conservation of Nature (IUCN), International Union of Forest Research Organizations (IUFRO), United Nations Convention to Combat Desertification (UNCCD), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United Nations Forum on Forests (UNFF), United Nations Framework Convention on Climate Change (UNFCCC), and the World Bank Group.

2 CPF Strategic Vision Towards 2030 https://openknowledge.fao.org/server/api/core/bitstreams/f02f3a50-0401-4690-ba1b-255e445a3615/content

3 https://openknowledge.fao.org/server/api/core/bitstreams/170a3a50-7118-4f32-aae4-06dd7a74a731/content

1.0 Introduction

The purpose of this report is to highlight the role of the conservation of forest biodiversity and sustainable forest management (SFM) in achieving the goals and targets of the Kunming-Montreal Global Biodiversity Framework (KMGBF). The report i) discusses the threats to forest biodiversity relative to recent global and regional trends and data on the conservation, restoration and sustainable management of forests and ii) identifies pathways (policies and recommended actions) to improve the implementation of the KMGBF in forests. It summarizes key analytical information and data and suggests recommendations for various stakeholders to: (i) assist governments to mainstream or update forest-related policies and commitments as planned in their National Biodiversity Strategies and Action Plans (NBSAPs), (ii) assist organizations and businesses to align their policies and practices with the KMGBF to reduce impacts on biodiversity, and (iii) provides increased understanding of the relationship between sustaining biodiversity and the associated goods and services from forests.

In the KMGBF and its predecessor, the Aichi Biodiversity Targets, forests are pooled with other types of ecosystems in terms of conservation, restoration and sustainable management of biodiversity. Nevertheless, forests support the vast majority of terrestrial biodiversity (ca. 80 % of terrestrial species), support more than a billion households, cover 31% of the global terrestrial area, contribute an estimated US$ 250 to $ 539 billion directly to the global economy annually (Agrawal et al. 2013, Li et al. 2019, FAO 2020) and contributed (directly, indirectly and induced) more than US$ 1.52 trillion to world gross domestic product in 2015 (FAO 2022b). By comparison, fisheries contributed US$ 274 to 474 billion (Green Policy Platform 2023, FAO 2022a). Further, the Economics of Ecosystems and Biodiversity (TEEB) calculated the costs of lost value from forest destruction to be between US$ 2 and $5 trillion per year. Furthermore, forests are fundamental for regulating Earth's climate by exchanging carbon, water and energy with the atmosphere, while also cooling the planet (Bonan 2008, Laurance et al. 2022).

Properly managing forests is crucial to sustaining terrestrial biodiversity (e.g., Loiseau et al. 2020, Gaisberger et al. 2022), including within protected areas. Forests also provide services to other ecosystem types, including freshwater and coastal marine ecosystems, for example through mangroves and reducing flooding risks. Agricultural expansion continues to be the main driver of deforestation and forest degradation and the associated loss of forest biodiversity (FAO, 2020). Bettes et al. (2016) found that even minimal deforestation has severe consequences for vertebrate species. Other main drivers of biodiversity loss in forests include forest degradation, species exploitation and invasive species (IPBES 2023). Globally, climate change is also driving the loss of biodiversity (Holbrooke et al. 2017, Habibullah et al. 2022), although for terrestrial vertebrates, climate change appears to be less important than habitat loss or over-exploitation (Caro et al. 2022). Climate change is an important driver of community compositional change, more so than exerting direct impacts on species populations (Caro et al. 2022, Jaureguiberry et al. 2022). However, climate change interacts with other variables, including exploitation, invasive species and habitat change (e.g., Ramirez et al. 2017), resulting in exacerbated negative effects on habitats and biodiversity. More frequent and intense wildfires account now for nearly 33 percent of global tree cover loss (WRI, 2024).

The present document discusses the main aspects of how the KMGBF targets should be viewed and implemented from a forest and forest management perspective, including through reversing deforestation and degradation. Improving forest management and conservation is essential to the implementation of the KMGBF goals and targets, as well as for mitigating and adapting to climate change.

2.0 Role of forests in the Strategic Plan for Biodiversity, 2010-2020 and the Aichi Biodiversity Targets

During the period of the Strategic Plan for Biodiversity (2010-2020) and the Aichi Biodiversity Targets, Target 15 called for restoring 15% of degraded ecosystems. A target reported to have been met by more than 50 countries based on national reports to the CBD. Target 7 required better management of resources, and the area of forest certified as managed sustainably grew by 33% from 343 Mha in 2010 to 435 Mha in 2020[4]. Further, the rate of deforestation has declined consistently relative to the rate in 2010 (Figure 1). Unfortunately, however, Target 5 sought a 50% reduction in habitat losses, but the world lost >33 million ha of primary forest in the tropics over the decade[5]. At the same time, only 11.1 million ha of land were restored to tree cover[6]. Moreover, WWF (2022) reported a decline in 38% of monitored forest species. Given that the main cause of biodiversity loss is habitat loss and degradation, it is clear that the Strategic Plan for Biodiversity (2010-2020) did not fully achieve its goal to stem the loss of biodiversity, despite the strong efforts to restore degraded areas and improve management. As a result, much greater attention to forest management and restoration will be essential under the KMGBF to conserve forests and their biodiversity and mitigate climate change.

4 FAOSTAT https://www.fao.org/faostat/en/#data/SDGB
5 WRI 2023. https://research.wri.org/gfr/latest-analysis-deforestation-trends
6 WRI 2023. https://research.wri.org/gfr/forest-targets-tracker

3.0 Relationship of the Kunming-Montreal Global Biodiversity Framework to conservation, restoration and sustainable management of forests

While there is no specific target for forests in the KMGBF, there is a strong fundamental relationship expressed through most of the targets to many aspects of forest conservation, forest management and sustaining the biodiversity that resides in these ecosystems. Overall, any effort to improve forest management, reduce deforestation and degradation and/or increase forest area will have a positive impact on the associated biodiversity. Applying new knowledge, using up-to-date guidelines and applying the lessons learned from many past forest projects can assist countries to meet their KMGBF targets for forests. Specific guidance and lessons learned from recently implemented forest projects can be found on the websites of the International Tropical Timber Organization (ITTO), the Food and Agriculture Organization of the United Nations (FAO), the Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF), Global Environment Facility (GEF), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), United Nations Environment Programme (UNEP), Asian Forest Cooperation Organization (AFoCO), Regional Community Forestry Training Center for Asia and the Pacific (RECOFTC), the International Union for Conservation of Nature (IUCN) and the United Nations Development Programme (UNDP), among others (See annex).

The KMGBF presents a cohesive framework for mainstreaming biodiversity in forest management and for addressing deforestation and ecosystem degradation. Its 23 targets provide a basis for technical solutions, policy requirements, improved business practices, and equality of people when managing forests. The common theme among the targets is the understanding that biodiversity in forests provides necessary ecosystem services and that applying ecosystem-based approaches to climate change mitigation, forest management, and forest restoration can vastly improve biodiversity, ecosystem services and people's livelihoods. The targets are complementary and linked, providing direction across society, industry and government to improve the conservation of biodiversity. The targets urge improving food security such that it no longer involves the large-scale conversion of forests and other ecosystems to agricultural lands through taking an integrated comprehensive approach to spatial landscape planning and management. As an example, the FAO has identified 22 countries where food security has improved, with a consequent reduction in the rate of deforestation (SCBD 2020).

THE IMPORTANCE OF FORESTS TO THE IMPLEMENTATION OF THE KUNMING-MONTREAL GLOBAL BIODIVERSITY FRAMEWORK

While all of the GBF targets can affect forests and forestry, this report considers only those targets most directly related to the conservation, restoration and sustainable management of forests.

TARGET 1. Plan and Manage all Areas To Reduce Biodiversity Loss

Target 1 is the key to maintaining, enhancing or restoring the integrity, connectivity and resilience of all ecosystems and substantially increasing the area of natural ecosystems by 2050 (Goal A). From a forest perspective, the target is about thinking ahead at a large landscape scale through planning to stop deforestation and reduce fragmentation and other causes of degradation, especially of intact primary and other natural forests that have a high level of integrity (i.e., have only a low level of degradation and/or are extensively well managed). This target requires applying landscape management practices and SFM to ensure integrity and connectivity for forests across landscapes to sustain biodiversity.

Fragmentation occurs in all forest types. It is declining in temperate and boreal forests, but increasing in the tropics, with the highest edge densities in the Congo Basin and the Amazon forest (Ma et al. 2023). There are still intact forest landscapes in the Amazon, Democratic Republic of the Congo, on Borneo and New Guinea, which sustain some of the highest biodiversity in the world (Raven et al. 2020). However, all these areas also have suffered severe fragmentation over the last two decades (Ma et al. 2023).

Fragmentation of intact forest landscapes by unsustainable logging, with the establishment of roads and other infrastructure, results in a cascade of changes leading to land and landscape change and loss of biodiversity (Barlow et al. 2016, Potopov et al. 2017, Siegal et al. 2024). Secondary impacts following logging access and road construction include illegal hunting and logging, land conversion for agriculture, edge effects, and settlements, all of which reduce biodiversity. Most large mammal and bird species, which often have functional roles, such as seed dispersal, require large areas of natural habitats to survive (Roberge and Angelstam 2004, Morrison et al. 2007). Small forest patches cannot sustain most wide-ranging animal species populations or tree species richness, are subject to desiccation and other edge effects and have low resilience to natural disturbances and climate change (Laurance et al. 2002, Aiegal et al. 2024). A goal to conserve and/or restore biodiversity requires large forest areas with high integrity, which are vastly superior to small patches.

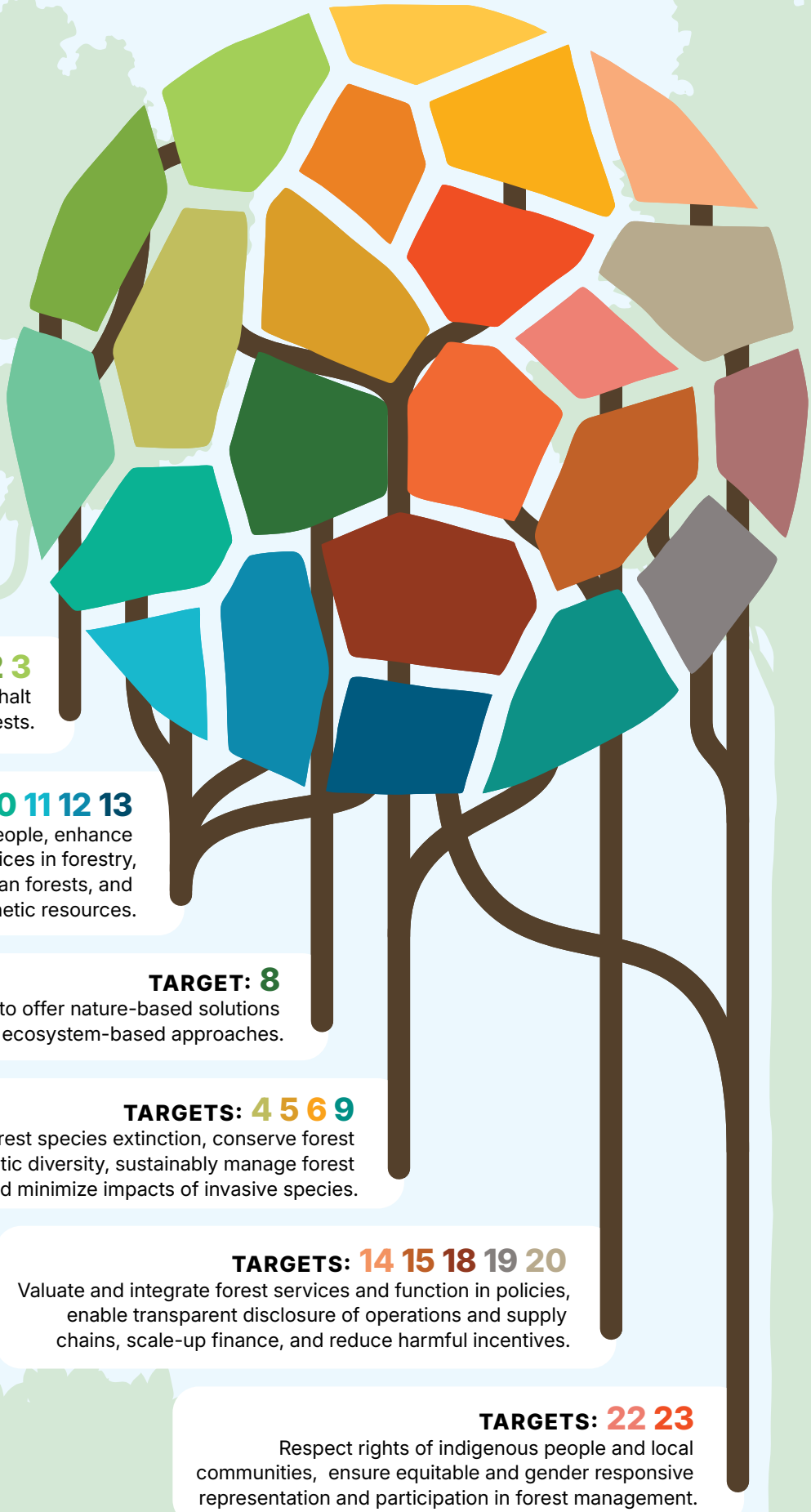
Resilience is the capacity of an ecosystem to maintain stability over time. It has been described as an emergent property of contiguous large natural forest ecosystems that results from biodiversity at all scales, from landscapes to genes (Thompson et al. 2009). Resilience, however, can be overpowered by increased fragmentation, loss of functional species, poor or excessive wood harvesting and changing environmental conditions, which can move a forest to alternative undesirable stable states (Chazdon et al. 2017, Messier et al. 2019). These altered forest states, especially in small patches (i.e., with no integrity), lose much of their biodiversity and the goods and services that they provide (Laurance et al. 2002).

Restoring forests requires consideration of spatial patterns, connectivity across landscapes and forest integrity (Churchill et al. 2013, Newton and Cantarello 2018). A key sustainable management principle is planning for biodiversity across a landscape by maintaining the integrity of forests, reducing access, enabling natural regeneration (including assisted regeneration where required), planning for connectivity, and fostering long-term forest continuity and resilience (e.g., Innes 2016, Nasi 2020, Gauthier et al. 2023).

TARGET 2. Restore 30% of all degraded ecosystems

Target 2 focusses on the restoration of degraded and deforested areas, as part of the global effort to regain lost ecosystem services, restore carbon, and improve livelihoods, especially among poorer people who are most affected by forest degradation (e.g., Duguma et al. 2019, Lapola et al. 2023). Large areas of forest have been degraded (15.2 Mha/yr) and deforested (9 to >13 Mha/yr) (FAO 2010, 2015, 2020, 2022b, Ritchie 2021) (Figure 1). In the Amazon Basin, for example, forest degradation has surpassed

CONNECTING FOREST AND GBF TARGETS



TARGETS: 1 2 3
Plan and manage areas to halt deforestation, restore and conserve forests.

TARGETS: 10 11 12 13
Restore forests' contributions to people, enhance biodiversity friendly practices in forestry, increase area and quality of urban forests, and share benefits from genetic resources.

TARGET: 8
Build forest resilience to offer nature-based solutions and ecosystem-based approaches.

TARGETS: 4 5 6 9
Halt forest species extinction, conserve forest genetic diversity, sustainably manage forest wildlife and minimize impacts of invasive species.

TARGETS: 14 15 18 19 20
Valuate and integrate forest services and function in policies, enable transparent disclosure of operations and supply chains, scale-up finance, and reduce harmful incentives.

TARGETS: 22 23
Respect rights of indigenous people and local communities, ensure equitable and gender responsive representation and participation in forest management.

Kunming-Montreal
GLOBAL BIODIVERSITY FRAMEWORK

deforestation in terms of the area affected (Matricardi et al. 2020). These global losses have resulted in a continuous decline in biodiversity and ecosystem services (such as carbon storage, clean water, and non-timber products), with interactions through climate change that have exacerbated degradation via multiple mechanisms (Peñuelas and Sardans 2020, Samec et al. 2022). Human health problems can be a direct consequence of deforestation, causing increased contact with forest species and resulting in transfer of zoonoses to people, possibly including Covid-19 and Ebola (White and Razgour 2020, Tajudeen et al. 2022).

Many forest functions are supported by biodiversity, including soil processes that are fundamental to forest growth (Lewis 2009, Brockerhoff et al. 2017). Restoring resilient forest landscapes requires an ecosystem approach, which considers forest structure, functions, and composition, with particular attention to habitats for important functional species (Travers et al. 2012, Parrotta et al. 2012). With attention to biodiversity beyond just the trees, forest resilience can be enhanced and the numerous services that can be provided by restored forests will improve livelihoods, living conditions, and human health (Parrotta et al. 2012). For example, restoration of mangrove forests provides multiple services, including protecting shorelines, reducing the effects of storm surges, supplying wood, storing carbon, and providing important habitat for many marine species. Mangroves, however, have declined by a net of 284 000 ha between 2010 and 2020 largely as a result of shrimp farming, although the rate of loss has slowed (FAO 2023). Tropical humid forests have also been declining for decades and yet harbour the greatest species richness of any forest type, and huge forest areas, such as the Amazon, play a significant role in the global climate (Bonan 2008). Restoring these forest types can have multiple benefits for people as well as climate mitigation and adaptation, if biodiversity is considered. In fact, Verdone and Seidl (2017) estimated up to US$ 9 billion in benefits from completing the Bonn Challenge, and IPBES (2018) suggested benefits of restoration, through improved ecosystem services, would be 10 times higher than the costs of restoration itself.

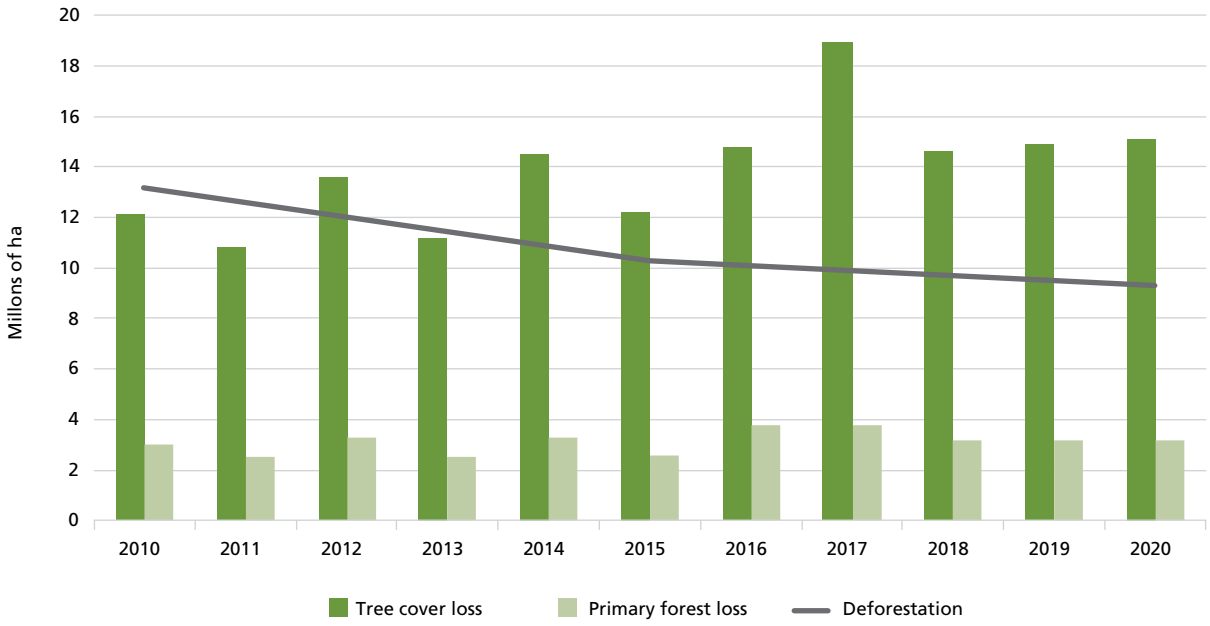
There has been a large ongoing effort towards reforestation, and Target 2 establishes an ambitious 30% area for restoration at a global scale by 2030. The international agenda for restoring forests is primarily being funded and driven by climate change initiatives (e.g., UN Decade on Ecosystem Restoration, Bonn Challenge, REDD, Global Carbon Project), but forests are not only carbon sinks. Many countries are recognizing the value of energy plantations and agroforestry as ways of reforesting with livelihood outcomes for Indigenous People and local communities. The planet is still losing forests at a net rate of >1 billion trees/year, but global tree planting effort through multiple programmes continues to be significant (FAO 2022b). Between 2000 and 2020, 130.9 million ha of land gained tree cover globally, but the loss was greater, resulting in a net loss of >1 million ha[7]. Restoration of forests is important, but it should not be considered as an offsetting mechanism for continuous forest loss, especially the loss of primary forests.

Restoring forest in Mauritius

Managed and leased by the Mauritian Wildlife Foundation (MWF), Ile aux Aigrettes is a 25-ha island off the southeast coast of Mauritius containing the last remnant of Mauritian ebony forest. Alien plant and animal species had driven the ecosystem to the brink of extinction by the 1980s. The MWF's restoration programme began with the removal of non-native plant species, revegetation with native seedlings, and the eradication of rats, cats, and mongooses. Several endemic and critically endangered species were reintroduced and monitoring has revealed steadily increasing populations. MWF's work has also made significant contributions to local livelihoods. Activities directly associated with the restoration effort have provided employment and training opportunities, and the development and promotion of ecotourism on the newly restored island has generated additional income for local communities.

7 https://research.wri.org/gfr/latest-analysis-deforestation-trends

Figure I. Global tree cover loss, primary tropical forest loss, and deforestation rate, from 2010 to 2020. Data from WRI 2023[8], and FAO 2010, 2015, 2020.



Reforestation requires looking holistically at social and environmental systems, ensuring that communities are consulted and that there is a common understanding of objectives, possibly for high value species, energy plantations, or agroforestry, among others. Regardless, restoring forests needs to take a long-term view, consider heterogeneous forests and landscapes, use ecosystem-based species selection, and have pre-established priorities for areas to be restored. Priority considerations might be to restore forests near protected areas or near key biodiversity areas, watershed or coastal protection, re-establishing landscape connectivity, and/or reforesting declining forest types.

Target 3. Conserve 30% of land, waters and seas

This target calls for the 30 % expansion and enhancement of protected and conserved areas that are managed with the aim of achieving positive outcomes for biodiversity by protecting important habitats, especially in areas with high biodiversity and respecting the rights of Indigenous Peoples and local communities. Estimates of the area of global forests occurring in protected areas vary from 16.6 percent (WCMC 2020) to 18 percent (FAO 2022b), to 21 percent according to WRI[9]. Between 2010 and 2019, protected areas increased by 2% of the global land and inland water area (UNEP-WCMC 2023). These area estimates exclude other effective area-based conservation measures (OECMs) that have become an important mechanism for sustaining forest cover. The World Resources Institute (WRI)[10] reported that Indigenous Peoples and local communities manage about 80 Mha of forests sustainably. Many tropical countries now have enabling legislation and policies to support the sustainable management and conservation of community forests by Indigenous Peoples and local communities.

Protected areas form a fundamental component of a national strategy to sustain and conserve biodiversity but require ecological representation, sufficient area for species conservation, and effective management. Yang et al. (2020) and Jung et al. (2020) suggested that optimizing the placement of new PAs could be done by assessing low levels of

8 https://www.wri.org/insights/tracking-global-tree-cover-gain

9 https://research.wri.org/gfr/forest-designation-indicators/protected-forests#:~:text=Approximately per cent2021 per cent20percent per cent20of per cent20global,some per cent20form per cent20of per cent20legal per cent20protection.

10 https://research.wri.org/gfr/social-governance-issues-indicators/indigenous-community-forests

The Emerald Triangle Protected Forests Complex, Cambodia, Thailand and Lao PDR

Conservation of large mammals, including tigers, elephants, Eld's deer and Serow, across a shared border was a main focus of this ITTO/CBD project. The project was also about peace-building along a contested border region and helped bring the countries closer together to sustain important threatened wildlife. Main foci included understanding animal movements to retain landscape connectivity, reducing forest use through developing alternative livelihoods, landscape planning and improving forest management. The project empowered local communities by creating community forests and has successfully established sustained protected areas across the now peaceful borders.

human disturbance in areas of known high biodiversity, such as KBAs and intact forests. Although deforestation within protected areas continues in the tropics, PAs have 41% lower rates than in non-protected areas (Geldmann et al. 2019, Leberger et al. 2021, Wolf et al. 2021). This deforestation could be entirely eliminated if the protected areas were well managed (Bowker et al. 2017). Wolf et al. (2021) found, after adjusting for management effectiveness, that only 6.5% of current protected areas are fully protected. Larger, well-managed protected areas support higher mammal species diversity than similar areas under less restrictive management, with a particularly strong effect for large, threatened species (Laurance et al 2000, Cazalis et al. 2020, Kittner et al. 2020, Ferreira et al. 2020, Rija et al. 2020). For protected areas to be effective, integrity can be increased if adjacent forests are managed sustainably as buffer zones to provide sufficient habitat for the various species (Laurance et al. 2012, Gaveau et al. 2012, Gaisberger et al. 2022). The World Conservation Monitoring Centre (WCMC 2020) reported that only 7.84% of the world's terrestrial surface is both protected and connected. In only a very few cases are the largest animal species or rare tree species sustained within a protected area alone (Craigie et al. 2010, Barnes et al. 2017).

Hence, in establishing new protected areas, consideration needs to be given to size and intactness, ecological representation, value for biodiversity, placement on a landscape, connectivity (e.g., Robinson et al. 2024), and the effectiveness of buffer zones. Consideration should also be given to protecting remaining primary forests, especially in countries where little remains. Protecting large intact primary forest landscapes is an important consideration because of the carbon they store, the complete biodiversity they sustain, and their value as benchmarks for SFM. While expanding or establishing new protected areas, due consideration should also be given to safeguarding the tenure rights of Indigenous Peoples and local communities.

Target 4. Halt species extinctions, protect genetic diversity, and reduce human-wildlife conflicts

The global species extinction rate is about 1000 times higher than the average over the past 10 million years (De Vos et al. 2017), with more than 44,000 species currently threatened with extinction (IUCN 2023). Climate change will cause that rate to rise dramatically (Roman-Palacios and Wiens 2020), and reduced populations of species can result in genetic erosion, reducing the capacity of species and ecosystems to adapt to changes (De Vos et al. 2017, Pinto et al. 2024).

More than 80%[11] of all terrestrial species require forest habitats but deforestation has substantially decreased the total forest area over the past 20 years, with 10 million to

11 https://www.un.org/sustainabledevelopment/wp-content/uploads/2019/07/15_Why-It-Matters-2020.pdf

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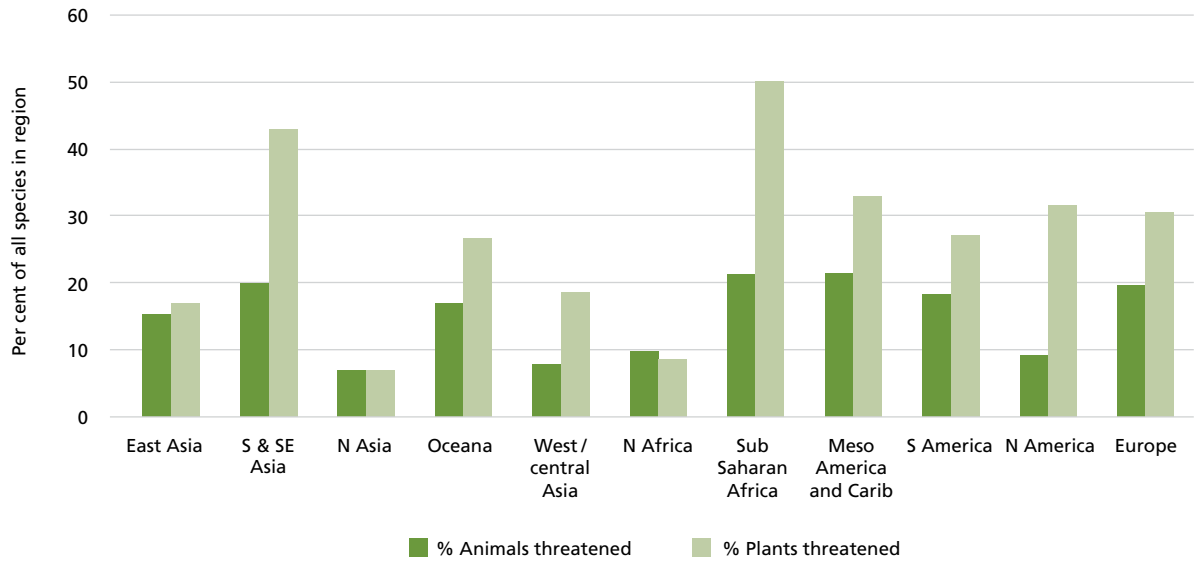
13 million ha of forest lost annually (FAO 2020, Figure 1), resulting in declining biodiversity (IPBES 2016, 2019). WRI (2024) reported that another 3.7 Mha of primary tropical forest was recently lost[12]. Biodiversity is essential for forest functioning in natural forests, acting through seed dispersal, pollination, nitrogen fixation, carbon sequestration and storage, redundancy, facilitation, soil processes, and creating resilience (Brokerhoff et al. 2017, IPBES 2016, 2019).

Human-wildlife conflict is a serious threat to food security, conservation, and human health resulting from zoonoses, predation on livestock, and damage to crops, and a threat to some wildlife populations (Nyamwamu 2016, Shaffer et al. 2019). An example from Tanzania estimated crop losses by wildlife of US$ 154, and for livestock of US$ 106, annually per household (Hariohay and Roskraft 2016). Improved control methods are essential to both protect the wildlife and the livelihoods of local people. Awareness raising, decentralizing buffer zone management to local communities, compensating the loss and incentivizing buffer zone communities for their efforts and contributions to wildlife protection are some of the effective measures to reduce human-wildlife conflicts.

To recover and sustain biodiversity, forest conservation and restoration is critical with >61% of vulnerable, endangered and critically endangered species occurring in forests (26,995 species, IUCN 2023), with very high numbers in tropical areas (Figure 2). Among tree species, only 50% have been evaluated by IUCN, but Botanic Gardens International (2021) lists 17,510 trees as threatened. Among the genera that are traded internationally, CITES now lists more than 1100 tree species on its Appendices 1 and 2, owing primarily to excessive logging, for example, of rosewoods and sandalwoods. Further, there has been a 38% decline in populations of all forest wildlife species that were monitored between 1970 and 2023 (WWF 2022), suggesting that it is not possible to recover the vast majority of threatened terrestrial biodiversity without major efforts to conserve and restore forest landscapes, especially in the tropics, where deforestation is highest. Overexploitation is also a recognized driver of the decline of hunted wildlife species; this issue is discussed directly below under Target 5.

Recovering endangered species requires individual species recovery plans in many cases but reducing the drivers of population loss – deforestation and forest degradation,

Figure II. Numbers of threatened forest species by region. Data from IUCN.



12 https://research.wri.org/gfr/latest-analysis-deforestation-trends

over-exploitation, and climate change is essential for the long-term persistence of species. Further, reforestation and forest conservation play a major role in the protection of threatened species.

Targets 5 and 9. Ensure sustainable, safe and legal harvesting and trade of wild species and manage wild species sustainably to benefit people

These two targets provide a new focus in the GBF, specifically through better wildlife management. Wild forest species are harvested primarily for food, clothing and medicines, while relatively few species are taken as trophies or other ornaments. There is also a very large illegal take for trafficking, resulting in species declines that also have human health effects because of the close contact with animals (Tajudeen et al. 2022).

Because of the importance of hunted species to local economies, these species are often selected as indicators of SFM (Brown et al. 2020, Samejima et al. 2020, Oettel and Lapin 2021). A report by the World Wildlife Fund (WWF 2022) found a decline in about a third of forest species that are monitored, but most forest species used for foods and medicines and/or trafficked (such as pangolins, opossums, and many primates) are not monitored, especially in developing countries. Over-exploitation for food and medicines is a main cause of the depletion of many forest species (Fa et al. 2002, Harrison 2011, IPBES 2019, 2022). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES 2022) indicated that unsustainable hunting is a threat to 1,341 wild mammal species, including 669 species assessed as threatened. For example, Ripple et al. (2016) estimated that 301 species of forest mammals in developing countries were listed as threatened owing specifically to hunting. Further, Morton et al. (2021) suggested that 61.6% of the traded bird, mammal, and reptile species are declining, with 16.4% already facing local extirpations.

Wild species are important for global food security, and the specific importance of bushmeat to Indigenous People and local communities is well known (Nasi and Van Vliet 2011, IPBES 2022). While the global value of bushmeat to forest people is difficult to determine, in Cameroon the value was estimated at more than US$ 1.5 million/yr (Lescuyer and Nasi 2016), and in the Congo Basin, more than 4 million tons are consumed annually (Nasi and Van Vliet 2011), indicating its massive importance to food for rural people. Given the importance of wild species to human well-being, especially in the tropics, forest restoration of certain habitats can play a major role in increasing global food supply, while at the same time reducing human-wildlife conflict (see Target 4). Similarly, improved wildlife management in the tropics is also essential, which means working directly with communities to provide training and alternative food sources, reducing forest access roads, local enforcement, and increasing forest area (Wilkie et al. 2000).

Target 6. Reduce the introduction of invasive alien species by 50 percent and minimize their impacts

Invasive species are another significant driver of forest biodiversity loss (Doherty et al. 2016, Mollet et al. 2017) and are the sole cause of 16% of animal and plant extinctions, primarily in forests (IPBES 2023). Threats from invasive species to biodiversity and ecosystem services are increasing globally, with an estimated rate of new introductions of about 200 alien species per year (IPBES 2023). This target asks Parties to reduce that rate by half and to work to eliminate priority invasives to reduce the loss of native biodiversity and their impacts on ecosystems.

Land use change and climate change are known to enhance the invasive success and impacts of many species and 75% of recorded impacts are in terrestrial systems. In particular, habitats disturbed by human activities, such as through shifting cultivation, supply opportunities for invasive species to become established (e.g., Gonzalez-Moreno et al. 2015). Climate change increases the success of invasive species, in part because warming temperatures allow survival in areas that were previously cold-limiting, and in some cases because invasive species can migrate faster than the communities that they invade, including from the south into boreal forests (Sanderson et al. 2012). Often, the effects of an invasive species in forests are direct, such as through competition, herbivory, disease, or predation. Forest restoration can be problematic if highly competitive invasive species have invaded degraded areas (Weidlich et al. 2020). However, the effects of invasive species can be more subtle. For example, Linders et al. (2019) found that soil biogeochemical cycling and transfer of energy between

trophic levels produced greater effects on local biodiversity than the direct effects of an invasive tree (*Prosopis juliflora*) in East Africa.

IPBES (2023) recommended that management outcomes to mitigate or eliminate invasive species should integrate site-specific ecosystem-based approaches that improve ecosystem function and resilience. Important means to reduce invasive species include managing pathways, especially at border crossings and in shipments of goods, rapid response following detection, and especially by managing forests to maintain the full suite of native species and recovering disturbed habitats so the invasives have reduced opportunities.

Target 8. Minimize the impacts of climate change on biodiversity and build resilience

Climate change is affecting forests through increased disturbances such as drought, wildfires, invasive species, diseases, pests, and direct tree mortality (IPCC 2019, Seidl et al. 2017). Excessive and repetitive disturbances can result in a different and undesirable forest state with fewer ecosystem services and make recovery difficult (Anderson-Teixeira et al. 2013). Regardless, forests remain an essential component for mitigation of and adaptation to global climate change, primarily through forest conservation, restoration, and sustainable use (IPCC 2019), as also recognized in the UN Strategic Plan for Forests 2030 and its Global Forest Goals and the Sustainable Development Goals.

Without halting and reversing deforestation, climate goals cannot be met. Forests are an integral part of the climate solution (CPF, 2021[13]). Forests contain an estimated 662 billion tonnes of carbon, which is >50% of the global terrestrial carbon stock, with about 16% in the aboveground biomass (AGB) (Duncanson et al. 2023). Forests provide a net carbon sink that absorbs a net 7.6 billion tonnes of CO_2/yr, which is about twice as much as they emit (Harris et al. 2021), and forests absorb about 30% of the global CO_2 emissions annually (FAO 2022b). The Intergovernmental Panel on Climate Change (IPCC 2019) reported that the largest potential for reducing emissions is through reduced deforestation and forest degradation (0.4–5.8 GtCO2-eq yr–1), and natural forest regrowth alone may have the potential to sequester 23% of the global carbon emissions (Cook-Patton et al. 2020). While the deforestation rate has been declining (Figure 1), it remains very high and despite regional differences and efforts by governments, conservationists, and corporations to stem the losses, the overall rate of commodity-driven deforestation did not decline between 2001 to 2018 (Curtis et al. 2018).

Extreme wildfires are another rapidly emerging threat to forest biodiversity. Driven by climate change and the destruction of forests and wildlife habitats are spreading to new areas such as boreal forests which now account for nearly one-quarter of total wildfire emissions (FAO, 2020).

The United Nations REDD+ programme has been successful in verified emission reductions of about 11.61 GtCO2eq[14]. In 40 REDD+ countries, projects reduced deforestation by 47% and degradation by 58%, in the first 5 years (Guizar-Coutiño 2022). Globally, REDD+ projects may have reduced what would have been a loss of 3.67 tCO_2e/ha annually from forests (Atmadja et al. 2022).

Many tree planting efforts are underway, primarily to store carbon as a climate mitigation strategy. Despite these many efforts, the area of forests restored will need to be increased by a factor of 40 to fulfill the potential contribution of tropical and subtropical forests towards limiting global warming to below 2°C (Atmadja et al. 2022). Examples of ongoing global forest restoration programmes include:

- Bonn Challenge: 60+ countries are restoring 350 million hectares of degraded and deforested lands by 2030
- Great Green Wall: restore 100 Mha by 2030
- Trillion Trees (WWF, WCS, BirdLife International): planted 340,000 trees by 2023
- 1 Trillion Tree Initiative (1T.org): private industry and carbon credits effort; 148 million trees planted by 2023
- The Billion Tree Campaign (UNEP): 12 billion trees (about 121 Mha) planted by 2011

13 CPF, 2021, Challenges and Opportunities in Turning the Tide on Deforestation, Joint Statement of the Collaborative Partnership on Forests, https://openknowledge.fao.org/server/api/core/bitstreams/16e22031-d17c-4cde-b3f2-7e8984604f8c/content

14 https://redd.unfccc.int/info-hub.html

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- African Forest Landscape Restoration Initiative: plan to restore 100 Mha by 2030
- Initiative 20x20: plans to reforest 50 Mha in South and Central America by 2030
- UN New York Declaration on Forests aims for 350 Mha under restoration activities by 2030.

In providing guidance for a country's next submission of nationally determined contributions, the United Nations Framework Convention on Climate Change (UNFCCC) recently noted "Further emphasizes the importance of conserving, protecting and restoring nature and ecosystems towards achieving the Paris Agreement temperature goal, including through enhanced efforts towards halting and reversing deforestation and forest degradation by 2030, and other terrestrial and marine ecosystems acting as sinks and reservoirs of greenhouse gases and by conserving biodiversity, while ensuring social and environmental safeguards, in line with the Kunming-Montreal Global Biodiversity Framework"[15]. However, increases in a global carbon market plantations, largely through "carbon farming", could jeopardize forest biodiversity if planted forest plans do not recognize the important role that biodiversity plays in ecosystem functioning. Further, the drive to net zero could lead to a fourfold surge in the global demand for timber by 2050 (World Bank 2016), while FAO (2022c) estimated an increased demand of up to 45% for roundwood by the same date. Such demand would trigger an increase in illegal logging in the developing world due to supply constraints.

Locally at all latitudes, forest biophysical impacts through shifts in biophysical processes (the water and energy balances), far outweigh the effects of CO_2, promoting local climate stability by reducing extreme temperatures in all seasons and times of day (Laurence et al. 2022). Global climate change mitigation is complemented by the ability of forests to regulate rainfall and stabilize local climate, helping to minimize the effects of extreme weather, making forests essential for climate change adaptation and resilience (FAO 2022).

Careful planning is essential to ensure that biodiversity conservation is an associated main objective in carbon forest projects (e.g., Bond et al. 2024). As an example, optimizing for biodiversity and carbon outcomes simultaneously delivers 95% of the maximum potential biodiversity benefit and 89% of the maximum carbon sequestration benefit (Strassburg et al. 2020). Furthermore, biodiversity benefits provided by protected, restored, and sustainably managed forests are essential to enhancing the adaptive capacity and resilience of people and ecosystems (UNFCCC 2021, FAO 2022). Concepts that include both biodiversity and climate benefits include ensuring that safeguards are in place (e.g., Cancun Safeguards), restoring heterogeneous forests associated with natural forests where possible to enable natural regeneration process to function, restoring forests near or connecting to protected areas, working with Indigenous People and local communities to improve management on tenured lands, managing for resilience and long-term adaptive capacity, using agroforests to benefit communities, and including planted forests in landscape management planning.

Target 10. Enhance Biodiversity and Sustainability in Agriculture, Aquaculture, Fisheries, and Forestry

Protected areas alone, even at 30% of the planet, cannot maintain biodiversity because most biodiversity resides in non-protected areas (e.g., Anderson and Mammides 2020). SFM is an important objective for forest and biodiversity conservation and is essential if biodiversity is to be maintained globally in the managed forest area of at least 1.15 billion ha. Social, economic, and environmental well-being are at the core of the SFM concept and principles and it is possible, based on decades of research, to conduct forestry in a sustainable manner (Putz et al. 2008, Putz and Thompson 2020).

The UN has established a strategic plan for forests[16], and several indicator processes are available for assessing SFM, including the Montreal Process, Forest Europe, and the Global Core Set. Certification is a third-party mechanism that is used to successfully indicate SFM (e.g., Burivalova et al. 2016), although there are exceptions, and more study is required (Blackman et al. 2018, Wolff and Schweinle 2022). Between the two major certifying agencies, Programme for the Endorsement of Forest Certification (PEFC) and Forest Stewardship Council (FSC), about 13%

15 UNFCCC COP28 decision: FCCC/PA/CMA/2023/L.17 *33*

16 https://daccess-ods.un.org/access.nsf/Get?OpenAgent&DS=A/RES/71/285&Lang=E

Asian Forest Cooperation Organization project to improve community forest management in Philippines, Indonesia and Thailand

This project was designed to enhance procedures and policies for formulation and development of community-level forest management plans through participatory planning processes. The work was facilitated by the introduction and implementation of GIS and remote sensing in tenured community forests (CFs). Management plans were developed through capacity-building in each of the forests. The project implemented and provided training for alternative livelihoods (cacao, handicrafts, mushrooms) to reduce forest impacts and increase local incomes. The project resulted in a review of CF policies in all three countries, including a new CF law in Thailand.

of the global forest area has been certified as sustainably managed, meaning that the majority of forests likely are not managed sustainably.

Governments have begun to employ other mechanisms to improve forest management, including enabling management by Indigenous Peoples and local communities on tenured lands, promoting agro-forestry, and developing alternative livelihoods to reduce impacts in forests (cf. Targets 22/23). Agencies including ITTO, UNDP, AFoCO and others have implemented successful projects in tropical forests using these methods in combination to improve forest management and to empower local communities (ITTO 2017, AFoCO 2022).

Forests and forest biodiversity are greatly impacted by socio-economic drivers outside the forestry sector. It is essential that biodiversity is mainstreamed through policy across these relevant sectors and government departments, including agriculture, mining, transportation, tourism, energy, and infrastructure development. For example, FAO addresses global challenges, including food insecurity and malnutrition, poverty and inequality, and land degradation and biodiversity loss, through coordinated efforts of its global Committee on Forestry (COFO) and Committee on Agriculture (COAG). It is also critical to enhance cross-sectoral coordination so that the forest sector does not operate in isolation, including through EIA where required to ensure that there are no long-term impacts of economic development on biodiversity. Planning and assessment require that a monitoring programme, with trained staff, is in place to enable baseline data against which to measure change.

Implementation of SFM can be increased if companies that use forest products examine their supply chains to determine that the materials acquired were produced sustainably. Governments themselves can set an example through procurement policies requiring sustainable forest products. Certification can enable access to certain markets where retailers use only certified wood, and respond to consumer demands for sustainability. Efforts to improve consumer awareness about deforestation and forest degradation can result in pressure on companies to manage sustainably. However, mainstreaming biodiversity in forestry requires prioritizing forest policies, plans, programmes, and investments (Harrison et al. 2022) to provide positive impacts by considering biodiversity as an equal objective to wood products. To accomplish this, governments must improve enforcement, eliminate corruption, and improve their commitments to conservation and sustainability.

The EU regulation on deforestation-free products

In 2023, the European Union adopted Regulation 2023/1115 on "deforestation-free" products to counter deforestation resulting from the expansion of agricultural land that that has replaced natural forests with fields and plantations to produce commodities. As a major economy and consumer of such commodities linked to deforestation and forest degradation, the EU is partly responsible for this problem and is leading an effort to reverse the problem of forest losses. Under the Regulation, any operator or trader who places these commodities on the EU market, or exports from it, must be able to prove that the products do not originate from recently deforested land or have contributed to forest degradation.


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Targets 11 and 13. Restore, maintain and enhance nature's contributions to people and increase the sharing of benefits from genetic resources, digital sequence information and traditional knowledge

Over half of the world's GDP is estimated to be moderately or highly dependent on nature and its services (World Economic Forum 2020), and forest ecosystem services themselves are estimated to be worth at least US$ 150 trillion (Kappen et al. 2020). An example from Malaysia estimated that their forest ecosystem services are valued at >$2.7 billion (Nitanan et al. 2020). Unfortunately, many important forest services provided by biodiversity have no markets (e.g., pollination, clean water), and so have no apparent economic value, indicating that much of the true value of forests is not counted. Further, the potential value of undiscovered medicinal products, as covered under the Nagoya Protocol, is lost through reductions in biodiversity.

Governments have been encouraged to consider adding ecosystem services, especially from forests, to their methods of national accounting, but uptake has been problematic (Venables 2016). In this way, the true value of biodiversity and the services it provides will become apparent to governments and communities. Further, nature-based solutions need to be considered and used as part of an overall strategy to help mitigate and adapt to the adverse effects of climate change (e.g., Seddon et al. 2020). Nature-based solutions, such as mangrove conservation and restoration, offer alternatives to "hard" infrastructure, while also providing other services to people.

Target 12. Enhance green spaces and urban planning for human well-being and biodiversity

This target considers the importance of urban forests to human health and well-being. Ensuring the availability and accessibility of urban forests is particularly important given the increasing trend towards urbanization, which risks separating people further from nature and reducing opportunities to understand biodiversity and the ecosystem services it provides. Urban green spaces provide respite from city life and offer places to improve well-being (Endreny et al. 2017). Further, green and blue spaces can provide important habitats for species, improve habitat connectivity, provide ecosystem services, and help mediate extreme events, if managed properly. The target specifically calls for the area, quality, connectivity, accessibility, and benefits from such areas to be increased to enhance native biodiversity, ecological connectivity and integrity, and improve human health and well-being and connection to nature. Some cities, such as Singapore, have understood this concept for decades and have created an integrated urban green network for walking.

Improving and increasing urban green spaces requires planning for areas where expansion is expected, and municipal rules requiring the inclusion of forests in areas where redevelopment and urban renewal are occurring.

Target 14. Integrate biodiversity in decision-making at every level

Just as most biodiversity exists outside protected areas, most activities that have an impact on biodiversity are not controlled by government environmental agencies and occur through developments that may not consider the long-term effects on environmental impacts, such as roads and other corridors and agricultural expansion. The multiple values of biodiversity are not widely reflected in decision-making, instead, they are considered as externalities (e.g., pollination, pest control, water regulation, oxygen production) (Nijkamp et al. 2008, Brokerhoff et al. 2017).

A whole-of-government approach is needed if forest biodiversity conservation is to be accomplished. Training on ecosystem services for infrastructure and planning departments as well as improved education for all ages, is essential to foster a wider understanding of the value of sustaining biodiversity. Mainstreaming biodiversity among sectors is essential for conservation. To accomplish this, all sectors both public and private, need to assess their impacts on biodiversity and develop policies that reduce those impacts in the future. Further, to mainstream biodiversity into decision-making, policymakers, land managers, and businesses need a regularly updated and consistent supply of information on biodiversity and the benefits it provides (Vardon et al. 2019, Hein et al. 2020). Ultimately, a system of environmental national accounting is required to reconcile true development costs through understanding the contributions of biodiversity to society.

Target 15. Businesses assess, disclose and reduce biodiversity-related risks and negative impacts
Target 18 Reduce harmful Incentives by at least $500 billion per year, and scale up positive incentives for biodiversity

In 2021, FAO, the UNDP and the UNEP[17] estimated the value of subsidies for agricultural producers globally at almost USD 540 billion per year and noted that this support is heavily biased towards measures that are distorting (thus leading to inefficiency), unequally distributed, and harmful to the environment and human health. Repurposing those agricultural subsidies to include positive incentives for agroforestry, forestry and biodiversity could help avoid the harmful impacts embodied in 86 percent of such subsidies.

Eradicating deforestation from supply chains is still not a priority for most forestry or agriculture-related companies, and the pressure to change practices by financial institutions, buyers, and policymakers remains too weak to drive significant progress (CDP 2023). Of the more than 1000 companies reporting their efforts on reducing deforestation to CDP (formerly the Carbon Disclosure Project), only about 10% monitored their supply chains to ensure that they were free from deforestation. Worse still, only 5% of companies have assessed their impacts on nature, with less than 1% understanding their dependencies[18]. 'Green' supply chains are an essential aspect of reducing deforestation and degradation. Working with companies that harvest or use forest products can improve biodiversity outcomes through adaptive programmes once they understand the issues.

Governments can provide positive incentives for SFM and forest biodiversity management through tax breaks or grants for compliance with specific conservation objectives, issuing and renewing licenses and permits conditional on performance, and subsidies and investments for achieving biodiversity outcomes. Such incentives could apply along the value chain by requiring companies to report on how they have assured that their entire chain is sustainable. Conversely, perverse subsidies, such as those fostering agricultural development or plantations on forest lands could be eliminated or redesigned for development only on degraded agricultural lands.

Target 19. Mobilize $200 billion per year for biodiversity from all sources, including $30 billion through international finance

Insufficient funding has continually hampered efforts to conserve and manage biodiversity. This target suggested several mechanisms to increase the funding available for the management of biodiversity and can be linked to the Biodiversity Funding Initiative (BIOFIN)[19], which has compiled funding avenues for biodiversity conservation. An additional concept is the use of a carbon tax that is dedicated to forest conservation and restoration; for example, Costa Rica instituted a 3.5% carbon tax on fossil fuel companies in 1997 that now generates US$ 26.5 million per year. That revenue is used to pay landowners for conservation and restoration activities through the National Forest Fund (Barbier et al. 2020). A similar tax has been instituted in Colombia.

While all developing countries require increased funding for biodiversity conservation, priorities for funding can be determined by assessing where the biodiversity is rich but losses are most severe. For example, work by Waldren et al. (2013) developed a method to determine how limited available funding can achieve the highest impact by determining that the 40 most severely underfunded countries contain 32% of all threatened mammalian diversity and occur in some of the world's most biodiversity-rich areas. Similarly, Wilson et al. (2007) suggested that by investing in a sequence of conservation actions targeted towards specific threats, protecting many more plant and vertebrate species is possible compared to equality of funding.

Regardless of how priorities are decided, dramatically increased funds must be dedicated to restoring forests if biodiversity is to be conserved and climate change is to be mitigated. In this context, mobilizing private finance is crucial. This can be achieved through financing activities that contribute to the conservation, restoration and

17 FAO, UN Development Programme & UN Environment Programme. 2021. A multi-billion-dollar opportunity – Repurposing agricultural support to transform food systems. https://doi.org/10.4060/cb6562en

18 https://www.worldbenchmarkingalliance.org/news/nature-benchmark-press-release-2022/

19 https://www.biofin.org/

sustainable use of biodiversity as well as aligning financial flows by directing them away from activities harmful to biodiversity. Without a whole-of-society approach, mobilizing $200 billion would be a significant challenge.

Target 22. Ensure participation in decision-making and access to justice and information related to biodiversity for all Target 23 Ensure gender equality and a gender-responsive approach for biodiversity action

Community forest (CF) management has become an important mechanism to improve the potential for sustainable forest management, and many countries now view it as a cornerstone of their effort to reduce degradation and to combat illegal forest activities. CFs may be managed by Indigenous peoples or other local communities. An analysis by Sze et al. (2022) showed that, for the 12 years between 2000 and 2012, the annual deforestation rates inside tenure-secure indigenous forestlands were significantly lower than those outside them in Bolivia (2.8 times lower), Brazil (2.5 times lower) and Colombia (2 times lower). However, in unsecured Indigenous territories, the deforestation rates have increased in Brazil over the past decade (Silva-Junior et al. 2023). Walker et al. (2020) found that areas under Indigenous control and protected areas in the Amazon basin stored 58% (41,991 MtC) of the region's carbon in 2016 but were responsible for just 10% (−130 MtC) of the net change (−1,290 MtC). These studies together indicate that both biodiversity and carbon gains can be made by securing indigenous lands in the tropics. From a financial perspective, securing indigenous forestland tenure is also a relatively cost-effective measure for climate change mitigation; when compared with other carbon capture and storage measures, the costs of securing tenure are 5 to 29 times lower than the estimated costs for coal-fired power plants and 7 to 42 times lower than for natural gas-fired power plants (Ding et al. 2016, Blackman and Veit 2018).

An important aspect of managing community forests is the involvement of all members of the community, including men, women, disadvantaged persons and Indigenous People, while avoiding control by elites (e.g., Mrema 2017), and ensuring a strong and committed management committee. For example, there is some evidence that women are more open to conservation initiatives than men, and so achieving multiple forest objectives is more likely when women serve on management committees (e.g., Ray et al. 2017). In part, this is because of the different role they have in forests as compared to men, including collecting firewood, foods and medicines. As a result, the perspective of women on the value of forests is a valuable input to local management (Ota et al. 2020), hence forest management, especially in community forests, can benefit from developing inclusive management committees.

4.0 Relationship of the KMGBF to other global processes

The KMGBF is fully supportive and will enhance the achievement of the objectives of key global processes including the Sustainable Development Goals (SDGs), Global Forest Goals, the UNFF, and the objectives of UNFCCC, CITES, the Convention on the Conservation of Migratory Species (CMS) and the United Nations Convention to Combat Desertification (UNCCD). In the case of the SDGs, most KMGBF targets address aspects of SDG 15 through forest management but other targets, including improved human health, reduced poverty, and climate change mitigation are also supported. Many land degradation neutrality (LDN) targets pledged by countries under the UNCCD include measures to restore and increase forest cover.

Many of the indicators across the processes are either the same or subsets of those of other process indicators, such that a single number (or simple calculation) can be used across various processes for reporting many of the targets. For example, at its twenty-sixth session, the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the CBD has recommended the endorsement of SDG indicator 15.3.1, the proportion of land that is degraded over total land area, as a component indicator under Target 2 of the KMGBF. This recommendation paves the way for enhanced synergies in reporting between the UNCCD, which is the custodian agency for this indicator, and the CBD. The indicator could be used by Parties to the CBD as a proxy for terrestrial ecosystem degradation to set a baseline for tracking progress towards restoration.

Governments need to consider the global processes with a single overarching view towards sustaining biodiversity and ecosystem services. While the processes were developed separately, they are linked (Table 1), including through the similarity of their various indicators and implementation mechanisms. For example, planting trees to store carbon can reduce desertification, enhance biodiversity, include valuable tree species, and provide habitat for migratory species, if planned properly among agencies, including through NBSAPs. Conversely, afforestation and tree-planting schemes in non-forest ecosystems (e.g., rangelands and grasslands) can have significant negative outcomes and should be avoided unless scientifically justified by the historic, ecological, and socioeconomic characteristics of the targeted area.

Table 1. Relationship between the KMGBF targets and other global processes and conventions.

GBF TARGET	GLOBAL FOREST GOALS	SDGS	OTHER GLOBAL PROCESSES
TARGET 1 – Spatial planning	1.3, 3.2, 3.3, 5.4*	15	UNFCCC, UNCCD
TARGET 2 – Restore degraded areas	1.1, 1.2, 1.3, 5.4	1, 3, 6, 13, 15	UNFCCC, UNCCD, CITES
TARGET 3 – Protected areas	3.1, 5.4	15	CMS
TARGET 4 – Threatened species	1.1, 1.3, 2.5, 3.1, 3.3	15.5	CMS, CITES
TARGET 5 – Wildlife management	1.3, 2.3, 2.4, 2.5, 3.1	15	CMS
TARGET 6 – Invasive alien species			CMS
TARGET 7 - Pollution		3, 6, 11	
TARGET 8 – Climate change	1 all, 2.5	13, 15	UNFCCC, UNCCD
TARGET 9 – Wildlife management	1.3, 2.3, 2.5, 3.1	15	CMS
TARGET 10 – Sustainable management	1.2, 1.3, 2.5, 3.2, 3.3, 5.4, 6.4	1, 3, 6, 13, 15	UNFCCC, UNCCD, CMS, CITES
TARGET 11 – Ecosystem services	2.4, 3.3, 5.4	1, 2, 6, 15	CITES
TARGET 12 – Urban green space		3, 11	
TARGET 13 – Nagoya Protocol		1, 2, 3, 15.6	
TARGET 14 – Cross-sectoral policy	5.1, 5.3, 5.4, 6.3	15, 16, 17	UNFCCC, UNCCD, CMS, CITES
TARGET 15 – Improve businesses	2.2, 2.4	8, 9, 12, 15	CITES
TARGET 16 – Reduce consumption		12	UNFCCC, UNCCD, CMS, CITES
TARGET 17 – Biosafety		12	
TARGET 18 – Incentives		15	UNFCCC, UNCCD, CMS, CITES
TARGET 19 – Improve funding	4 all	17	
TARGET 20 – International cooperation	6 all	17	CMS, CITES
TARGET 21 – Improve data and monitor	4.5, 6.5	15	CMS, CITES
TARGET 22/23 – Gender, Indigenous and local communities and disadvantaged people	1.4, 5.3, 6.5	1, 4, 5, 12, 15	UNFCCC, UNCCD

* assumes that SFM is spatially planned

5.0 Suggested recommendations to enhance implementation of the KMGBF in forests

GOVERNMENTS, NATIONAL FOREST AUTHORITIES, PRACTITIONERS, PARTNERS

- Consider developing cross-sectoral, participatory, integrated and biodiversity-inclusive **landscape-level management plans** to include protected areas, permanent forest estate, agricultural zones, KBAs, and potential future infrastructure development.
- For **restoration of forests**, priority consideration should be given to forests adjacent to natural forests, protected forests and their buffer areas, near or in key biodiversity areas, watershed and coastal protection, re-establishing landscape connectivity and integrity, and/or reforesting of declining forest types.
- Restore forests to native species to **create heterogeneous forests and mosaic landscapes**, in part through natural regeneration by restoring forests near existing forests.
- For establishing **new protected areas**, consideration needs to be given to size and intactness, ecological representation, value for biodiversity, placement on a landscape, the effectiveness of buffer zones, protecting remaining primary forests as well as tenure rights of the indigenous peoples and local communities.
- **Recover endangered species** through implementing individual species recovery and reintroduction plans, and by reducing the drivers of decline of populations of individual species, including through maximizing results of ecosystem restoration and initiatives such as the UN Decade on Ecosystem Restoration.
- **Enhance sustainable use management of animals and trees** by working directly with communities to provide training and alternative food sources, reducing forest access roads, improving enforcement, and increasing forest area combined with awareness raising, incentives, and compensation for the loss.
- Use **nature-based solutions and ecosystem-based approaches** in place of hard infrastructure where feasible.
- Climate change restoration projects must become **more than tree-planting exercises**, through an ecosystem-based approach that requires consideration of non-carbon benefits.
- Adopt **climate adaptive sustainable management of forests** in response to the ongoing and predicted effects of climate change.
- Holistically consider the global forest processes to facilitate synergies in both actions and reporting.

GOVERNMENTS, INDUSTRIES, FINANCE SECTOR AND BUSINESSES

- To encourage and enable industrial reporting of the impacts of its operations on forest biodiversity.
- Ensure that actions are taken to progressively reduce negative impacts on biodiversity, increase positive impacts, and mitigate biodiversity-related risks for businesses and financial institutions.
- Agricultural support policies can be redesigned to avoid incentives for land expansion and instead **implement positive subsidies** to encourage sustainable intensification, agroecological systems, agroforestry, where appropriate, and the sustainability of forest-based value chains.[20]
- Expand application of forest certification schemes, in a participatory way, especially in the tropics, to assess progress towards SFM and to raise community awareness.

20 FAO, 2022 (SOFO 2022)

- **Re-purpose harmful subsidies** by requiring that subsidized plantations and new agriculture only occur on degraded lands.
- Conduct a review of relevant national policies to ensure that **forest biodiversity is mainstreamed** in decisions, especially in the economic development, tourism, agriculture and transportation sectors.
- Consider **valuing the ecosystem services** from the forests to the methods of the national accounting system and mainstreaming them into national fiscal and forest policies and strategies.
- Ensure that procurement of forest products by the government and the private sector fully follows the principles and standards of **green value chains**.

GOVERNMENTS AND COMMUNITY FOREST ORGANIZATIONS

- Address **governance issues,** especially where tenure is uncertain for community forests and indigenous territories. Secured tenure enhances buy-in and more certainty for local communities to manage their forest areas along with transferring management authority to the local community.
- Consult **Indigenous Peoples and local communities** to avoid conflicts (e.g., local need areas for fuelwood and medicines) and apply community forestry practices with government guidance wherever applicable.
- Ensure that **gender equality** is a pre-condition for forest governance structures at all levels including a forest management committee.
- Develop and implement **alternative livelihood programmes** through inclusive and participatory processes engaging all groups of the communities. Livelihood programmes must require the sustainable use of biodiversity and green supply chains and have a requirement to follow a formal plan, with mentoring and monitoring of alternative livelihood outcomes.
- **Learn and adapt new programmes** from the multiple available case studies of successful community forests as well as from failed enterprises.

6.0 Conclusion

Forests are relied on by billions of people for primary productivity, nutrient recycling, food, oxygen, shelter, clean water, wood and non-wood products, all of which result from biodiversity (Brockerhoff et al. 2017, IPBES 2016). Despite the importance to humans and the health of the planet, forests are being lost and degraded at a rapid rate (FAO 2020, 2022) along with the associated biodiversity (IPBES 2019). Attention to forest protection, restoration, and management is essential for the global conservation of biodiversity, and therefore for achieving the KMGBF and for sustaining livelihoods. Although forest ecosystems are not specified among the 23 KMGBF targets, there are implications for forests for each of the targets: forests maintain the vast majority of terrestrial biodiversity, including most threatened species, and as a result, there are implications for forests for each of the targets. Recovery and conservation of global forest biodiversity require paying attention to SFM and ecosystem services (Targets 10 and 11), threatened species (Target 4), protected areas (Target 3), and ecosystem restoration using a spatially planned ecosystem-based approach (Targets 1 and 2).

Forest type and tree species richness affect biodiversity, and diversity can be an important factor in ecosystem functions, the provision of services, and providing redundancy that ensures ecosystem resilience and stability (Target 11). The widespread degradation of forests, including replacement by vast plantations, has significant negative consequences, including increased susceptibility to natural or anthropogenic disturbances (Winfield et al. 2015), causing cascading effects on the ultimate state of the ecosystem (Bahamondez and Thompson 2016, Flores et al. 2024), and resulting in reduced benefits to humans (Barnes et al. 2017).

Major foci under the KMGBF should be: 1) the protection of primary and natural forests, 2) greater application of SFM, especially in tropical forests, and 3) forest restoration in particular areas where the probability of success is highest, such as adjacent to natural forests and in river valleys prone to flooding. For the latter, planning restoration for areas within community forests where tenure has been assured, buffer zones around protected areas that are well managed, and areas where governments at all levels have committed to restoring forests, and adjacent to primary forests, would all result in improved probabilities of success. Achieving the targets of the KMGBF is an urgent global issue that cannot be accomplished without a significant global effort towards forest conservation and sustainable management of these ecosystems in line with UNSPF and its associated Global Forest Goals.

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ANNEX Sources of information for conserving and managing forests to sustain biodiversity

INFORMATION ON FOREST SPATIAL PLANNING, INCLUDING:

- https://www.itto.int/direct/topics/topics_pdf_download/topics_id=6522&no=1&disp=inline
- http://www.fao.org/3/cc2229en/cc2229en.pdf
- https://www.recoftc.org/sites/default/files/publications/resources/recoftc-0000150-0001-en.pdf
- https://www.tandfonline.com/doi/full/10.1080/26395916.2019.1697756
- https://www.undp.org/publications/integrated-spatial-planning-workbook
- https://www.sciencedirect.com/science/article/pii/S2666719322000826
- https://www.researchgate.net/profile/John-Stanturf/publication/324360108_Implementing_Forest_Landscape_Restoration-A_Practitioner's_Guide/links/5c3fd2b0299bf12be3cd9bb2/Implementing-Forest-Landscape-Restoration-A-Practitioners-Guide.pdf (IUFRO Guidelines)
- https://portals.iucn.org/library/node/49061 (IUCN guidelines on connectivity)
- https://portals.iucn.org/library/sites/library/files/documents/2018-022-En.pdf

PLANNING GUIDELINES TO ASSIST LANDSCAPE RESTORATION THAT CAN BE USED TO SUPPLEMENT THE BASIC DIRECTION PROVIDED BY THE PROGRAMME OF WORK ON FOREST BIOLOGICAL DIVERSITY INCLUDE:

- https://www.itto.int/direct/topics/topics_pdf_download/topics_id=6511&no=1&disp=inline
- https://www.itto.int/direct/topics/topics_pdf_download/topics_id=4690&no=1&disp=inline
- https://www.tandfonline.com/doi/full/10.1080/26395916.2019.1697756
- https://www.undp.org/publications/integrated-spatial-planning-workbook
- https://www.sciencedirect.com/science/article/pii/S2666719322000826 (review)
- https://www.researchgate.net/profile/John-Stanturf/publication/324360108_Implementing_Forest_Landscape_Restoration-A_Practitioner's_Guide/links/5c3fd2b0299bf12be3cd9bb2/Implementing-Forest-Landscape-Restoration-A-Practitioners-Guide.pdf (IUFRO Guidelines)
- https://portals.iucn.org/library/sites/library/files/documents/2018-022-En.pdf
- https://www.mdpi.com/2073-445X/10/1/28 (review of principles)
- https://data.apps.fao.org/ferm/?lang=en (map database of ongoing projects)
- https://onlinelibrary.wiley.com/doi/10.1111/rec.13035 (ecosystem restoration review)
- https://www.jstor.org/stable/26269330, and https://www.mdpi.com/1999-4907/9/11/726 (defining degraded forests)

RECENT GUIDELINES AND INFORMATION ON PROTECTED AREAS:

- https://www.fao.org/3/cb8356en/cb8356en.pdf FAO (2022) Guidelines for establishing protected areas
- http://www.car-spaw-rac.org/?Procedure-for-listing-Protected-Areas-under-the-SPAW-Protocol (UNEP)
- https://www.cbd.int/doc/publications/cbd-ts-44-en.pdf Making Protected Areas Relevant: A guide to integrating protected areas into wider landscapes, seascapes and sectoral plans and strategies. CBD Technical Series 44.
- https://www.30x30.solutions/
- Keenleyside, K.A., Dudley, N., Cairns, S., Hall, C.M., and Stolton, S. 2012 Ecological restoration for protected areas: Principles, guidelines and best practices. IUCN, Gland, Switzerland https://www.iucn.org/resources/publication/ecological-restoration-protected-areas-principles-guidelines-and-best
- https://doi.org/10.2305/IUCN.CH.2019.PATRS.3.en (IUCN)

SPECIES CONSERVATION IN FORESTS:

- Multiple tools for species conservation at: https://portals.iucn.org/library/
- E.g., https://portals.iucn.org/library/node/51362 IUCN Global Species Action Plan
- https://www.cpsg.org/new-initiatives/species-conservation-planning-tools-library
- https://www.speciesmonitoring.org/guidelines-and-tools.html
- Human-wildlife conflict: https://portals.iucn.org/library/sites/library/files/resrecfiles/WCC_2020_RES_101_EN.pdf
- https://africanelephantfund.org/sites/default/files/gbb-uploads/elephant-technical.pdf
- https://wwf.panda.org/discover/our_focus/wildlife_practice/problems/human_animal_conflict/
- https://www.fao.org/documents/card/en/c/cee38ed6-0a07-57f8-a2d1-ea00ffde4684/ (Human-wildlife conflict in Africa)
- Alien species: https://giasipartnership.myspecies.info/en

MANAGEMENT OF WILDLIFE:

- FAO issue of Unasylva on Wildlife Management: https://landportal.org/node/83871
- Collaborative Partnership on Wildlife: https://www.fao.org/forestry/wildlife-partnership/87684/en/
- https://www.ipbes.net/sustainable-use-assessment

LIMITED GUIDANCE FOR INVASIVE SPECIES MANAGEMENT IN FORESTS IS AVAILABLE FROM:

- https://portals.iucn.org/library/sites/library/files/documents/2018-030-En.pdf
- https://www.fao.org/sustainable-forest-management/toolbox/tools/tool-detail/en/c/230818/
- https://pipap.sprep.org/content/guidelines-invasive-species-management-pacific

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References

AFoCO. 2022. Improved local community livelihoods through Increased Income from non-timber forest products (NTFP): modelling scalable community-based enterprises in Asia. https://afocosec.org/wp-content/uploads/2023/11/PROJECT-BRIEF-035-20231124.pdf

Agrawal, A., Cashore, B., Hardin, R., Shepherd, G., Benson, C. and Miller, D. 2013. Economic contributions of forests. UNFF Background paper 1.

Anderson, E., and Mammides, C. 2020. The role of protected areas in mitigating human impact in the world's last wilderness areas. Ambio, 49(2): 434-441.

Anderson-Teixeira, K.J., Miller, A.D., Mohan, J.E., Hudiburg, T.W., Duval, B.D. and DeLucia, E.H. 2013. Altered dynamics of forest recovery under a changing climate. Global Change Biology 19(7): 2001-2021.

Atmadja, S.S., Duchelle, A.E., De Sy, V., Selviana, V., Komalasari, M., Sills, E.O. and Angelsen, A. 2022. How do REDD+ projects contribute to the goals of the Paris Agreement? Environmental Research Letters 17(4): 044038.

Armenteras, D., Espelta, J.M., Rodríguez, N. and Retana, J. 2017. Deforestation dynamics and drivers in different forest types in Latin America: Three decades of studies (1980–2010). Global Environmental Change 46: 139-147.

Bahamondez, C., and Thompson, I.D. 2016. Determining forest degradation, ecosystem state and resilience using a standard stand stocking measurement diagram: theory into practice. Forestry 89(3): 290-300.

Barbier, E.B., Lozano, R., Rodríguez, C.M., and Troëng, S. 2020. Adopt a carbon tax to protect tropical forests. Nature 578(7794): 213 - 216. https://doi.org/10.1038/d41586-020-00324-w

Barlow, J., Lennox, G.D., Ferreira, J., Berenguer, E., Lees, A.C., Mac Nally, R., Thomson, J.R., Ferraz, S.F.D.B., Louzada, J., Oliveira, V.H.F., and Parry, L. 2016. Anthropogenic disturbance in tropical forests can double biodiversity loss from deforestation. Nature 535(7610): 144–147.

Barnes, M.D., Craigie, I.D., Dudley, N., and Hockings, M. 2017. Understanding local-scale drivers of biodiversity outcomes in terrestrial protected areas. Annals of the New York Academy of Sciences 1399(1): 42-60.

Barnes, A.D., Allen, K., Kreft, H., Corre, M.D., Jochum, M., Veldkamp, E., Clough, Y., Daniel, R., Darras, K., Denmead, L.H. and Farikhah Haneda, N. 2017. Direct and cascading impacts of tropical land-use change on multi-trophic biodiversity. Nature Ecology & Evolution 1(10): 1511-1519.

Bernal, B., Murray, L.T., and Pearson, T.R.H. 2018. Global Carbon Dioxide Removal Rates from Forest Landscape Restoration Activities. Carbon Balance and Management 13(1): art. 22. https://cbmjournal.biomedcentral.com/articles/10.1186/s13021-018-0110-8

Strassburg, B.B., Iribarrem, A., Beyer, H.L., Cordeiro, C.L., Crouzeilles, R., Jakovac, C.C., Braga Junqueira, A., Lacerda, E., Latawiec, A.E., Balmford, A. and Brooks, T.M. 2020. Global priority areas for ecosystem restoration. Nature 586(7831): 724-729.

Betts, M.G., Wolf, C., Ripple, W.J., Phalan, B., Millers, K.A., Duarte, A., Butchart, S.H., and Levi, T. 2017. Global forest loss disproportionately erodes biodiversity in intact landscapes. Nature 547(7664): 441-444.

Blackman, A., and Veit, P. 2018. Titled Amazon indigenous communities cut forest carbon emissions. Ecological Economics 153: 56-67.

Blackman, A., Goff, L., and Planter, M.R. 2018. Does eco-certification stem tropical deforestation? Forest Stewardship Council certification in Mexico. Journal of Environmental Economics and Management 89: 306-333.

Bonan, G.B. 2008. Forests and climate change: forcings, feedbacks, and the climate benefits of forests. Science 320 (5882): 1444–1449. doi.org/10.1126/science.1155121

Bond, A,J., O'Connor, P.J., and Cavagnaro, T.R. 2024. Carbonservation with demonstrated biodiversity and carbon gains: Carbon can pay but biodiversity must lead. Environmental Management: https://doi.org/10.1007/s00267-023-01928-4

Botanic Gardens International. 2021. State of the world's trees. https://www.bgci.org/our-work/projects-and-case-studies/global-tree-assessment/

Bowker, J.N., De Vos, A., Ament, J.M., and Cumming, G.S. 2017. Effectiveness of Africa's tropical protected areas for maintaining forest cover. Conservation Biology 31(3): 559-569.

Branco, P.S., Merkle, J.A., Pringle, R.M., King, L., Tindall, T., Stalmans, M., and Long, R.A. 2020. An experimental test of community-based strategies for mitigating human–wildlife conflict around protected areas. Conservation Letters 13(1): e12679.

Brockerhoff, E.G., Barbaro, L., Castagneyrol, B., Forrester, D.I., Gardiner, B., González-Olabarria, J.R., Lyver, P.O.B., Meurisse, N., Oxbrough, A., Taki, H., and Thompson, I.D. 2017. Forest biodiversity, ecosystem functioning and the provision of ecosystem services. Biodiversity and Conservation 26: 3005-3035.

Brown, G.S., Pollock, L., DeWitt, P.D., and Dawson, N. 2020. Responses of terrestrial animals to forest characteristics and climate reveals ecological indicators for sustaining wildlife in managed forests. Forest Ecology and Management 459: 117854.

Burgiel, S.W., and A.A. Muir. 2010. Invasive Species, Climate Change and Ecosystem-Based Adaptation: Addressing Multiple Drivers of Global Change. Global Invasive Species Programme (GISP), Washington, DC, US, and Nairobi, Kenya.

Burivalova, Z., Hua, F., Koh, L.P., Garcia, C., and Putz, F. 2017. A critical comparison of conventional, certified, and community management of tropical forests for timber in terms of environmental, economic, and social variables. Conservation Letters 10(1): 4-14.

Cardoso, P., Amponsah-Mensah, K., Barreiros, J.P., Bouhuys, J., Cheung, H., Davies, A., Kumschick, S., Longhorn, S.J.,

Martínez-Munoz, C.A., Morcatty, T.Q., and Peters, G. 2021. Scientists' warning to humanity on illegal or unsustainable wildlife trade. Biological Conservation 263: 109341.

Caro, T., Rowe, Z., Berger, J., Wholey, P., and Dobson, A. 2022. An inconvenient misconception: Climate change is not the principal driver of biodiversity loss. Conservation Letters 15(3): e12868.

Cazalis, V., Princé, K., Mihoub, J.B., Kelly, J., Butchart, S.H. and Rodrigues, A.S. 2020. Effectiveness of protected areas in conserving tropical forest birds. Nature Communications 11(1): 4461.

CDP Inc. 2023. The Forest Transition: from Risk to Resilience. https://www.cdp.net/en/forests

Chazdon, R.L., Brancalion, P.H.S., Lamb, D., Laestadius, L., Calmon, M., and Kumar, C. 2017. A policy-driven knowledge agenda for global Forest and landscape restoration. Conservation Letters 10(1):125–132. https://doi.org/10.1111/conl.12220

Chomba, C., Senzota, R., Chabwela, H., Mwitwa, J., and Nyirenda, V. 2012. Patterns of human-wildlife conflicts in Zambia, causes, consequences and management responses. Journal of Ecology and the Natural Environment 4(12): 303-313. https://www.academia.edu/download/92116735/9E4133C11472.pdf

Churchill, D.J., Larson, A.J., Dahlgreen, M.C., Franklin, J.F., Hessburg, P.F., and Lutz, J.A. 2013. Restoring forest resilience: from reference spatial patterns to silvicultural prescriptions and monitoring. Forest Ecology and Management 291: 442-457.

Cook-Patton, S.C., Leavitt, S.M., Gibbs, D., Harris, N.L., Lister, K., Anderson-Teixeira, K.J., Briggs, R.D., Chazdon, R.L., Crowther, T.W., Ellis, P.W., and Griscom, H.P. 2020. Mapping carbon accumulation potential from global natural forest regrowth. Nature 585(7826): 545-550.

Craigie, I.D., Baillie, J.E., Balmford, A., Carbone, C., Collen, B., Green, R.E. and Hutton, J.M. 2010. Large mammal population declines in Africa's protected areas. Biological conservation 143(9): 2221-2228.

Curtis, P.G., Slay, C.M., Harris, N.L., Tyukavina, A., and Hansen, M.C. 2018. Classifying drivers of global forest loss. Science 361(6407): 1108-1111.

Daskalova, G.N., Myers-Smith, I.H., Bjorkman, A.D., Blowes, S.A., Supp, S.R., Magurran, A.E., and Dornelas, M. 2020. Landscape-scale forest loss as a catalyst of population and biodiversity change. Science 368(6497): 1341-1347.

De Vos, J.M., Joppa, L.N., Gittleman, J.L., Stephens, P.R. and Pimm, S.L. 2015. Estimating the normal background rate of species extinction. Conservation Biology 29(2): 452-462.

Ding, H., Veit, P., Gray, E., Reytar, K., Altamirano, J.C., Blackman, A., and Hodgdon, B. 2016. Climate Benefits, Tenure Costs. WRI.

Doherty, T.S., Glen, A.S., Nimmo, D.G., Ritchie, E.G., and Dickman, C.R. 2016. Invasive predators and global biodiversity loss. Proceedings of the National Academy of Sciences 113(40): 11261-11265.

Du, E., Dong, D., Zeng, X., Sun, Z., Jiang, X., and de Vries, W. 2017. Direct effect of acid rain on leaf chlorophyll content of terrestrial plants in China. Science of the Total Environment 605: 764-769.

Duguma, L.A., Atela, J., Minang, P.A., Ayana, A.N., Gizachew, B., Nzyoka, J.M., and Bernard, F. 2019. Deforestation and forest degradation as an environmental behavior: unpacking realities shaping community actions. Land 8(2): 26.

Duncanson, L., Liang, M., Leitold, V., Armston, J., Krishna Moorthy, S.M., Dubayah, R., Costedoat, S., Enquist, B.J., Fatoyinbo, L., Goetz, S.J., and Gonzalez-Roglich, M. 2023. The effectiveness of global protected areas for climate change mitigation. Nature Communications 14(1): 2908.

Endreny, T., Santagata, R., Perna, A., De Stefano, C., Rallo, R.F. and Ulgiati, S. 2017. Implementing and managing urban forests: A much needed conservation strategy to increase ecosystem services and urban wellbeing. Ecological Modelling 360: 328-335.

Fa, J.E., Peres, C.A., and Meeuwig, J. 2002. Bushmeat exploitation in tropical forests: an intercontinental comparison. Conservation biology 16(1): 232-237.

FAO 2023. The world's mangroves, 2010-2020. Rome. https://doi.org/10.4060/cc7044en

FAO. 2022a. State of the world fisheries and aquaculture. Rome, Italy.

FAO, 2020. State of the world's forests. Rome, Italy

FAO. 2022b. State of the world's forests. Rome, Italy.

FAO. 2022c. Global forest sector outlook 2050: Assessing future demand and sources of timber for a sustainable economy – Background paper for The State of the World's Forests 2022. FAO Forestry Working Paper No. 31. Rome. https://doi.org/10.4060/cc2265en

FAO. 2021. FRA 2020 remote sensing survey. Forestry Paper 186. https://openknowledge.fao.org/items/4076510e-693a-42be-ad61-f6f4f8ef283f

FAO. 2010, 2015, and 2020. Global forest resources assessment. Rome, Italy.

Ferreira, G.B., Collen, B., Newbold, T., Oliveira, M.J.R., Pinheiro, M.S., de Pinho, F.F., Rowcliffe, M., and Carbone, C. 2020. Strict protected areas are essential for the conservation of larger and threatened mammals in a priority region of the Brazilian Cerrado. Biological Conservation 251: 108762.

Flores, B.M., Montoya, E., Sakschewski, B., Nascimento, N., Staal, A., Betts, R.A., Levis, C., Lapola, D.M., Esquível-Muelbert, A., Jakovac, C., and Nobre, C.A. 2024. Critical transitions in the Amazon forest system. Nature 626(7999): 555-564.

Gaisberger, H., Fremout, T., Kettle, C.J., Vinceti, B., Kemalasari, D., Kanchanarak, T., Thomas, E., Serra-Diaz, J.M., Svenning, J.C., Slik, F., and Eiadthong, W. 2022. Tropical and subtropical Asia's valued tree species under threat. Conservation Biology 36(3): e13873.

Gauthier, S., Kuuluvainen, T., Macdonald, S.E., Shorohova, E., Shvidenko, A., Bélisle, A.C., Vaillancourt, M.A., Leduc, A., Grosbois, G., Bergeron, Y., and Morin, H. 2023. Ecosystem management of the boreal forest in the era of global change. Pages 3-49 in M. Girona, H. Morin, S. Gauthier, and Y. Bergeron (eds.) Boreal forests in the face of climate change: Sustainable management. Springer International Publishing.

Gaveau, D.L.A., Curran, L.M., Paoli, G.D., Carlson, K.M., Wells, P., Besse-Rimba, A., Ratnasari, D., and Leader-Williams, N. 2012. Examining protected area effectiveness in Sumatra:

importance of regulations governing unprotected lands. Conservation Letters 5(2): 142-148.

Geldmann, J., Barnes, M., Coad, L., Craigie, I.D., Hockings, M., and Burgess, N.D. 2013. Effectiveness of terrestrial protected areas in reducing habitat loss and population declines. Biological Conservation 161: 230-238.

Gray, E., Veit, P., Altamirano, J.C., Ding, H., Rozwalka, P., Zuniga, I., Witkin, M., Borger, F.G., Pereda, P., Lucchesi, A., and Ussami, K. 2015. The economic costs and benefits of securing community forest tenure: evidence from Brazil and Guatemala. World Resources Institute, Washington, DC.

Green Policy Platform. 2023. https://www.greenpolicyplatform.org/sectors/fisheries#:~:text=Wild per cent20fish per cent20stocks per cent20are per cent20of, per cent24274 per cent20billion per cent20to per cent20global per cent20GDP.

Guizar-Coutiño, A., Jones, J.P., Balmford, A., Carmenta, R., and Coomes, D.A. 2022. A global evaluation of the effectiveness of voluntary REDD+ projects at reducing deforestation and degradation in the moist tropics. Conservation Biology 36(6): p.e13970.

Hariohay, K.M. and Røskaft, E., 2015. Wildlife induced damage to crops and livestock loss and how they affect human attitudes in the Kwakuchinja Wildlife Corridor in Northern Tanzania. Environment and Natural Resources Research 5(3): 56-73.

Harris, N.L., Gibbs, D.A., Baccini, A., Birdsey, R.A., De Bruin, S., Farina, M., Fatoyinbo, L., Hansen, M.C., Herold, M., Houghton, R.A., and Potapov, P.V. 2021. Global maps of twenty-first century forest carbon fluxes. Nature Climate Change 11(3): 234-240.

Harrison, R.D. 2011. Emptying the forest: hunting and the extirpation of wildlife from tropical nature reserves. BioScience 61(11): 919-924.

Harrison, R.D., Shono, K., Gitz, V., Meybeck, A., Hofer, T., and Wertz-Kanounnikoff, S. 2022. Mainstreaming biodiversity in forestry. FAO Forestry Paper No. 188. Rome, FAO, and Bogor, Indonesia, CIFOR.

Hein, L., Bagstad, K.J., Obst, C., Edens, B., Schenau, S., Castillo, G., Soulard, F., Brown, C., Driver, A., Bordt, M., Steurer, A., Harris, R., and Caparrós, A. 2020. Progress in natural capital accounting for ecosystems. Science 367 (6477): 514-515.

Hughes, A.C. 2017. Understanding the drivers of Southeast Asian biodiversity loss. Ecosphere 8(1): e01624.

Innes, J.L. 2016. Sustainable forest management: from concept to practice. Pages 21-52, In J.L. Innes and A.V. Tikina (eds), Sustainable Forest Management. Routledge.

IPBES. 2023. Summary for Policymakers of the Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Roy, H.E., Pauchard, A., Stoett, P., Renard Truong, T., Bacher, S., Galil, B.S., Hulme, P.E., Ikeda, T., Sankaran, K.V., McGeoch, M.A., Meyerson, L.A., Nuñez, M.A., Ordonez, A., Rahlao, S.J., Schwindt, E., Seebens, H., Sheppard, A.W., and Vandvik, V. (eds.). IPBES secretariat, Bonn, Germany. https://doi.org/10.5281/zenodo.7430692

IPBES. 2022. Thematic Assessment Report on the Sustainable Use of Wild Species of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Fromentin, J.M., Emery, M.R., Donaldson, J., Danner, M.C., Hallosserie, A., and Kieling, D. (eds.). IPBES secretariat, Bonn, Germany. DOI: https://doi.org/10.5281/zenodo.6448567

IPBES. 2019. Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E.S. Brondizio, J. Settele, S. Díaz, and H.T. Ngo (eds). IPBES secretariat, Bonn, Germany. https://doi.org/10.5281/zenodo.3831673

IPBES. 2018. The IPBES assessment report on land degradation and restoration. Montanarella, L., Scholes, R., and Brainich, A. (eds.). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany. https://doi.org/10.5281/zenodo.3237392

IPBES. 2016. The methodological assessment report on scenarios and models of biodiversity and ecosystem services. S. Ferrier, K.N. Ninan, P. Leadley, R. Alkemade, L.A. Acosta, H.R. Akçakaya, L. Brotons, W. W.L. Cheung, V. Christensen, K.A. Harhash, J. Kabubo-Mariara, C. Lundquist, M. Obersteiner, H.M. Pereira, G. Peterson, R. Pichs-Madruga, N. Ravindranath, C. Rondinini, and B.A. Wintle (eds.). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany. https://doi.org/10.5281/zenodo.3235428

IPCC 2019: P.R. Shukla, J. Skea, R. Slade, R. van Diemen, E. Haughey, J. Malley, M. Pathak, J. Portugal Pereira (eds.). Technical Summary, 2019. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M, Belkacemi, J. Malley, (eds.)]. https://doi.org/10.1017/9781009157988.002

ITTO. 2017. The bright green hotspot: outcomes of the Emerald Triangle Protected Forests Complex project, 2000- 2016. Yokohama, Japan. https://www.itto.int/direct/topics/topics_pdf_download/topics_id=5393&no=1&disp=inline

IUCN. 2023. Red list of threatened species. https://www.iucnredlist.org/

IUCN. 2019. Protected areas and climate change. Briefing paper. https://www.iucn.org/sites/default/files/2022-07/protected_areas_and_climate_change_briefing_paper_december_2019-final.pdf

Jaureguiberry, P., Titeux, N., Wiemers, M., Bowler, D.E., Coscieme, L., Golden, A.S., Guerra, C.A., Jacob, U., Takahashi, Y., Settele, J., and Díaz, S. 2022. The direct drivers of recent global anthropogenic biodiversity loss. Science Advances 8(45): eabm9982. https://www.science.org/doi/abs/10.1126/sciadv.abm9982

Jung, M., Arnell, A., De Lamo, X., García-Rangel, S., Lewis, M., Mark, J., Merow, C., Miles, L., Ondo, I., Pironon, S., and Ravilious, C. 2021. Areas of global importance for conserving terrestrial biodiversity, carbon and water. Nature Ecology & Evolution 5(11): 1499-1509.

Kappen, G., Kastner, E., Kurth, T., Puetz, J., Reinhardt, A. and Soininen, J., 2020. The staggering value

of forests—and how to save them. Boston Consulting Group. (bcg. com/publication/2020/the-staggering-value-of-forest-and-how-to-save-them).

Karanth, K.K., and Vanamamalai, A. 2020. Wild serve: A novel conservation intervention to monitor and address human-wildlife conflict. Frontiers in Ecology and Evolution 3: 198. https://doi.org/10.3389/fevo.2020.00198

Kiffner, C., Binzen, G., Cunningham, L., Jones, M., Spruiell, F., and Kioko, J. 2020. Wildlife population trends as indicators of protected area effectiveness in northern Tanzania. Ecological Indicators 110: 105903.

Lapola, D.M., Pinho, P., Barlow, J., Aragão, L.E., Berenguer, E., Carmenta, R., Liddy, H.M., Seixas, H., Silva, C.V., Silva-Junior, C.H., and Alencar, A.A. 2023. The drivers and impacts of Amazon forest degradation. Science 379(6630): eabp8622.

Lawrence, D., Coe, M., Walker, W., Verchot, L. and Vandecar, K., 2022. The unseen effects of deforestation: biophysical effects on climate. Frontiers in Forests and Global Change 5: 756115.

Laurance, W.F., Carolina Useche, D., Rendeiro, J., Kalka, M., Bradshaw, C.J., Sloan, S.P., Laurance, S.G., Campbell, M., Abernethy, K., Alvarez, P., and Arroyo-Rodriguez, V. 2012. Averting biodiversity collapse in tropical forest protected areas. Nature 489 (7415): 290-294.

Laurance, E.F., Lovejoy, T.E., Vasconcelos, H.L., Bruna, E.M., Didham, R.K., Stouffer, P.C.,

Gascon, C., Bierregaard, R.O., Laurance, S.G., and Sampaio, E. 2002. Ecosystem decay of Amazonian forest fragments: A 22-year investigation. Conservation Biol. 16: 605–618.

Lawrence, D., Coe, M., Walker, W., Verchot, L., and Vandecar, K. 2022. The unseen effects of deforestation: biophysical effects on climate. Frontiers in Forests and Global Change 5: 756115. doi.org/10.3389/ffgc.2022.756115

Leberger, R., Rosa, I.M., Guerra, C.A., Wolf, F., and Pereira, H.M. 2020. Global patterns of forest loss across IUCN categories of protected areas. Biological Conservation 241: 108299.

Lescuyer, G., and Nasi, R. 2016. Financial and economic values of bushmeat in rural and urban livelihoods in Cameroon: Inputs to the development of public policy. International Forestry Review 18(1): 93-107.

Lewis, O.T. 2009. Biodiversity change and ecosystem function in tropical forests. Basic and Applied Ecology 10(2): 97-102.

Linders, T.E.W., Schaffner, U., Eschen, R., Abebe, A., Choge, S.K., Nigatu, L., Mbaabu, P.R., Shiferaw, H., and Allan, E. 2019. Direct and indirect effects of invasive species: Biodiversity loss is a major mechanism by which an invasive tree affects ecosystem functioning. Journal of Ecology 107(6): 2660-2672.

Loiseau, N., Mouquet, N., Casajus, N., Grenié, M., Guéguen, M., Maitner, B., Mouillot, D., Ostling, A., Renaud, J., Tucker, C., and Velez, L. 2020. Global distribution and conservation status of ecologically rare mammal and bird species. Nature Communications 11(1): 5071.

Li, Y., Mei, B., and Linhares-Juvenal, T. 2019. The economic contribution of the world's forest sector. Forest Policy and Economics 100: 236-253.

Ma, J., Li, J., Wu, W. and Liu, J. 2023. Global forest fragmentation change from 2000 to 2020. Nature Communications 14(1): 3752. https://www.nature.com/articles/s41467-023-39221-x

Matricardi, E.A.T., Skole, D.L., Costa, O.B., Pedlowski, M.A., Samek, J.H., and Miguel, E.P. 2020. Long-term forest degradation surpasses deforestation in the Brazilian Amazon. Science 369(6509): 1378-1382.

Messier, C., Bauhus, J., Doyon, F., Maure, F., Sousa-Silva, R., Nolet, P., Mina, M., Aquilué, N., Fortin, M.-J., and Puettmann, K. 2019. The functional complex network approach to foster forest resilience to global changes. Forest Ecosystems 6: 21. https://doi.org/10.1186/s40663-019-0166-2

Mollot, G., Pantel, J.H., and Romanuk, T.N. 2017. The effects of invasive species on the decline in species richness: a global meta-analysis. Advances in Ecological Research 56: 61-83.

Morrison, J.C., Sechrest, W., Dinerstein, E., Wilcove, D.S., and Lamoreux, J.F. 2007. Persistence of large mammal faunas as indicators of global human impacts. Journal of Mammalogy 88(6): 1363-1380.

Mrema, J.P. 2017. Forest resources and local elite capture: revisiting a community-based forest management 'success case' in Tanzania. Pages 131-141 In A. Williams and P. Le Billon, Corruption, Natural Resources and Development. Edward Elgar Publishing. UK.

Nasi, R., and van Vliet, N. 2011. Empty forests, empty stomachs? Bushmeat and livelihoods in Congo and Amazon basins. International Forestry Review 13(3): 355-368.

Newton, A.C., and Cantarello, E. 2015. Restoration of forest resilience: an achievable goal? New Forests 46(5-6): 645-668.

Nijkamp, P., Vindigni, G., and Nunes, P.A. 2008. Economic valuation of biodiversity: A comparative study. Ecological Economics 67(2): 217-231.

Nitanan, K.M., Shuib, A., Sridar, R., Kunjuraman, V., Zaiton, S., and Herman, M.A. 2020. The total economic value of forest ecosystem services in the tropical forests of Malaysia. International Forestry Review 22(4): 485-503.

Nyamwamu, R.O., 2016. Implications of human-wildlife conflict on food security among small holder agropastoralists: a case of smallholder maize (Zea mays) farmers in Laikipia County, Kenya. World Journal of Agricultural Research 4(2): 43-48.

Oleson, K.L., Falinski, K.A., Audas, D.M., Coccia-Schillo, S., Groves, P., Teneva, L., and Pittman, S.J. 2018. Linking landscape and seascape conditions: science, tools and management. Pages 319-364 in: S.J. Pittman, Seascape Ecology. Wiley-Blackwell.

Oettel, J., and Lapin, K. 2021. Linking forest management and biodiversity indicators to strengthen sustainable forest management in Europe. Ecological Indicators 122: 107275.

Ota, E., Mukul, S.A., Gregorio, N., and Herbohn, J. 2020. Community-based management of tropical forests: lessons learned and implications for sustainable forest management. Burleigh-Dodds, Cambridge, UK. http://dx.doi.org/10.19103/AS.2020.0074.24

Parrotta, J.A., Wildburger, C., and Mansourian, S. (eds). 2012. Understanding relationships between biodiversity, carbon, forests and People. IUFRO World Series 31.

Peñuelas, J., and Sardans, J. 2021. Global change and forest disturbances in the Mediterranean basin: Breakthroughs, knowledge gaps, and recommendations. Forests 12(5): 603.

Pinto, A.V., Hansson, B., Patramanis, I., Morales, H.E. and van Oosterhout, C. 2024. The impact of habitat loss and population

fragmentation on genomic erosion. Conservation Genetics 25(1): 49-57.

Plotkin, J.B., Potts, M.D., Leslie, N., Manokaran, N., LaFrankie, J., and Ashton, P.S. 2000. Species-area curves, spatial aggregation, and habitat specialization in tropical forests. Journal of theoretical biology 207(1): 81-99.

Prieto-Torres, D.A., Díaz, S., Cordier, J.M., Torres, R., Caron, M., and Nori, J. 2022. Analyzing individual drivers of global changes promotes inaccurate long-term policies in deforestation hotspots: The case of Gran Chaco. Biological Conservation 269: 109536.

Potapov, P., Hansen, M.C., Laestadius, L., Turubanova, S., Yaroshenko, A., Thies, C., Smith, W., Zhuravleva, I., Komarova, A., Minnemeyer, S., and Esipova, E. 2017. The last frontiers of wilderness: Tracking loss of intact forest landscapes from 2000 to 2013. Science Advances 3(1): e1600821.

Putz, F.E., and Thompson, I.D. 2020. Defining sustainable forest management (SFM) in the tropics. In: J. Blaser and P Hardcastle (eds.) Achieving sustainable forest management in the tropics. Burleigh Dodds Science Publishing. Cambridge, UK.

Putz, F.E., Zuidema, P.A., Pinard, M.A., Boot, R.G.A., Sayer, J.A., Sheil, D., Sist, P., Elias, and Vanclay, J.K. 2008. Improved tropical forest management for carbon retention. PLoS Biology 6(7): .e166.

Raven, P.H., Gereau, R.E., Phillipson, P.B., Chatelain, C., Jenkins, C.N. and Ulloa Ulloa, C. 2020. The distribution of biodiversity richness in the tropics. Science Advances 6(37): eabc6228.

Ray, B., Mukherjee, P., and Bhattacharya, R.N. 2017. Attitudes and cooperation: does gender matter in community-based forest management? Environment and Development Economics 22(5): 594-623.

Rija, A.A., Critchlow, R., Thomas, C.D., and Beale, C.M. 2020. Global extent and drivers of mammal population declines in protected areas under illegal hunting pressure. PLoS One 15(8): e0227163.

Ripple, W.J., Abernethy, K., Betts, M.G., Chapron, G., Dirzo, R., Galetti, M., Levi, T., Lindsey, P.A., Macdonald, D.W., Machovina, B., and Newsome, T.M. 2016. Bushmeat hunting and extinction risk to the world's mammals. Royal Society Open Science 3(10): 160498.

Ritchie, H. 2021. Deforestation and forest loss. Our World in Data. https://ourworldindata.org/deforestation

Roberge, J.-M., and Angelstam, P. 2004. Usefulness of the umbrella species concept. Conserv. Biol. 18: 76–85.

Robinson, J.G., LaBruna, D., O'Brien, T., Clyne, P.J., Dudley, N., Andelman, S.J., Bennett, E.L., Chicchon, A., Durigan , C., Grantham, H., Kinnaird, M., Lieberman, S., Maisels, F., Moreira, A. Rao, M., Stokes, E., Walston, J., and Watson, J.E.M. 2024. Scaling up area-based conservation to implement the Global Biodiversity Framework's 30x30 target: the role of nature's strongholds. PLOS Biology https://doi.org/10.1371/journal.pbio.3002613

Román-Palacios, C. and Wiens, J.J. 2020. Recent responses to climate change reveal the drivers of species extinction and survival. Proceedings of the National Academy of Sciences 117(8): 4211-4217.

Samec, P., Kučera, A., and Tomášová, G. 2022. Soil degradation processes linked to long-term forest-type damage. In P. Samec (ed.) Forest Degradation Under Global Change. IntechOpen.

Samejima, H., Ong, R., Lagan, P., and Kitayama, K. 2012. Camera-trapping rates of mammals and birds in a Bornean tropical rainforest under sustainable forest management. Forest Ecology and Management 270: 248-256.

Sanderson, L.A., McLaughlin, J.A., and Antunes, P.M. 2012. The last great forest: a review of the status of invasive species in the North American boreal forest. Forestry 85(3): 329-340.

(SCBD) Secretariat of the Convention on Biological Diversity. 2020. Global Biodiversity Outlook 5. Montreal, Canada.

SCBD. 2002. Programme of work on forest biological diversity. Decision Vl/22.

Seddon, N., Chausson, A., Berry, P., Girardin, C.A., Smith, A. and Turner, B., 2020. Understanding the value and limits of nature-based solutions to climate change and other global challenges. Philosophical Transactions of the Royal Society B 375(1794): 20190120.

Seidl, R., Thom, D., Kautz, M., Martin-Benito, D., Peltoniemi, M., Vacchiano, G., Wild, J., Ascoli, D., Petr, M., Honkaniemi, J. and Lexer, M.J. 2017. Forest disturbances under climate change. Nature Climate Change 7(6):.395-402.

Shaffer, L.J., Khadka, K.K., Van Den Hoek, J. and Naithani, K.J., 2019. Human-elephant conflict: A review of current management strategies and future directions. Frontiers in Ecology and Evolution 6: 235.

Siegel, T., Magrach, A., Laurance, W.F., and Luther, D. 2024. A global meta-analysis of the impacts of forest fragmentation on biotic mutualisms and antagonisms. Conservation Biology: e14206. https://doi.org/10.1111/cobi.14206

Silva-Junior, C.H., Silva, F.B., Arisi, B.M., Mataveli, G., Pessôa, A.C., Carvalho, N.S., Reis, J.B., Silva Júnior, A.R., Motta, N.A., e Silva, P.V.M., and Ribeiro, F.D. 2023. Brazilian Amazon indigenous territories under deforestation pressure. Scientific Reports 13(1): 5851.

Sze, J.S., Carrasco, L.R., Childs, D., and Edwards, D.P. 2022. Reduced deforestation and degradation in Indigenous Lands pan-tropically. Nature Sustainability 5(2): 123-130.

Tajudeen, Y.A., Oladunjoye, I.O., Bajinka, O., and Oladipo, H.J. 2022. Zoonotic spillover in an era of rapid deforestation of tropical areas and unprecedented wildlife trafficking: into the wild. Challenges 13(2): 41. Https://www.doi.org/10.3390/challe13020041

Thompson, I.D., Ferreira, J., Gardner, T., Guariguata, M., Lian, P.K., Okabe, K., Pan, Y., Schmitt, C.B., Tylianakis, J., Barlow, J. and Kapos, V. 2012. Forest biodiversity, carbon and other ecosystem services: relationships and impacts of deforestation and forest degradation. Pages 21-50 in J.A. Parrotta, C. Wildburger, and S. Mansourian (eds) Understanding relationships between biodiversity, carbon, forests and People. IUFRO World Series 31.

Thompson, I.D., Mackey, B., McNulty, S., and Mosseler, A. 2009 Forest resilience, biodiversity, and climate change. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 43.

Travers, A., Elrick, C., Kay, R., and Vestergaard, O. 2012. Ecosystem-based adaptation guidance: moving from principles to practice. UNEP, Nairobi.

UNEP-WCMC and IUCN. 2024. Protected Planet: The World Database on Protected Areas (WDPA)[On-line], [February 2024], Cambridge, UK: UNEP-WCMC and IUCN. Available at: https://doi.org/10.34892/6fwd-af11

Vardon, M., H. Keith, H., Obst, C., and Lindenmayer, D. 2019. Putting biodiversity into the national accounts: creating a new paradigm for economic decisions. Ambio 48: 726-731.

Venables, A.J., 2016. Using natural resources for development: why has it proven so difficult?. Journal of Economic Perspectives 30(1): 161-184.

Verdone, M., and Seidl, A. 2017. Time, space, place, and the Bonn Challenge global forest restoration target. Restoration Ecology 25(6): 903-911.

Waldron, A., Mooers, A.O., Miller, D.C., Nibbelink, N., Redding, D., Kuhn, T.S., Roberts, J.T. and Gittleman, J.L. 2013. Targeting global conservation funding to limit immediate biodiversity declines. Proceedings of the National Academy of Sciences 110(29): 12144-12148.

Walker, W.S., Gorelik, S.R., Baccini, A., Aragon-Osejo, J.L., Josse, C., Meyer, C., Macedo, M.N., Augusto, C., Rios, S., Katan, T., and de Souza, A.A. 2020. The role of forest conversion, degradation, and disturbance in the carbon dynamics of Amazon indigenous territories and protected areas. Proceedings of the National Academy of Sciences 117(6): 3015-3025.

WCMC. 2020. Protected planet report. https://livereport.protectedplanet.net/

Weidlich, E.W.A., Flórido, F.G., Sorrini, T.B. and Brancalion, P.H.S. 2020. Controlling invasive plant species in ecological restoration: A global review. Journal of Applied Ecology 57(9): 1806–1817.

White, R.J., and Razgour, O. 2020. Emerging zoonotic diseases originating in mammals: a systematic review of effects of anthropogenic land-use change. Mammal Review 50(4): 336-352.

Wilkie, D., Shae, E., Rotberg, F., Morelli, G., and Auzel, P. 2000. Roads, development, and conservation in the Congo Basin. Conservation Biology 14(6) 1614-1622.

Wilson, K.A., Underwood, E.C., Morrison, S.A., Klausmeyer, K.R., Murdoch, W.W., Reyers, B., Wardell-Johnson, G., Marquet, P.A., Rundel, P.W., McBride, M.F. and Pressey, R.L. 2007. Conserving biodiversity efficiently: what to do, where, and when. PLOS Biology 5(9): p.e223.

Wingfield, M.J., Brockerhoff, E.G., Wingfield, B.D., and Slippers, B. 2015. Planted forest health: the need for a global strategy. Science 349(6250): -836.

Wolf, C., Levi, T., Ripple, W.J., Zárrate-Charry, D.A., and Betts, M.G. 2021. A forest loss report card for the world's protected areas. Nature Ecology & Evolution 5(4): 520-529.

World Bank. 2016. World Bank Group Forest Action Plan FY16 - 20. Washington DC.

Wolff, S., and Schweinle, J. 2022. Effectiveness and economic viability of forest certification: A systematic review. Forests 13(5): 798.

World Economic Forum. 2020. Nature Risk Rising. https://www3.weforum.org/docs/WEF_New_Nature_Economy_Report_2020.pdf

WRI, 2024 https://www.wri.org/insights/global-trends-forest-fires

WWF 2022. Living Planet Report. Washington, DC.

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