WWF

REPORT

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WWF LIVING FORESTS REPORT: CHAPTER 5

SAVING FORESTS AT RISK

CONTENTS

SAVING FORESTS AT RISK

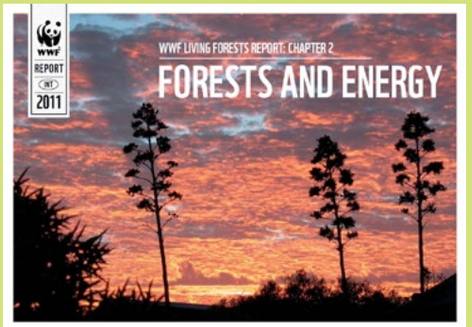
The *Living Forests Report* series has explained the reasons for and implications of an ambitious forest conservation target: Zero Net Deforestation and Forest Degradation (ZNDD) by 2020.

Achieving ZNDD will not happen by accident. It will require a huge, collective advocacy effort, along with policy changes by governments and industry. Achieving ZNDD will require a mosaic of protected and sustainably managed forests, integrated with other land uses such as farms, settlements and infrastructure. Strategies to get there include: preventing the squandering of forests through achieving good governance and control of outside pressures that lead to loss and degradation; protecting and restoring the most ecologically valuable forests; introducing incentives for sound stewardship of production forests; increasing efficiency of wood use; reducing waste; and optimizing other land uses to mitigate the pressure to access more land by clearing forests.

The prospect of success in preventing large-scale deforestation will be improved by focusing efforts on those places where threats of deforestation and degradation are greatest. So, which forests are in the firing line and what is driving deforestation? What could help to slow and stop the rate of loss? This chapter identifies where most deforestation is likely between 2010 and 2030: these are the ***deforestation fronts*** where efforts to halt deforestation must be concentrated. The chapter also provides compelling examples of *solutions* for reversing the projected trends in these deforestation fronts.

THE LIVING FORESTS REPORT

Chapter 1 – **Forests for a Living Planet** examines the causes of deforestation and the need to shift to a new model of sustainable forestry, farming and consumption with ZNDD.



Chapter 2 – **Forests and Energay** examines the safeguards needed to ensure expanding use of bioenergy helps to provide energy security, rural development and greenhouse gas (GHG) reductions without destroying valuable ecosystems or undermining food and water security.

Chapter 3 – **Forests and Climate** highlights REDD+ as a unique opportunity to cut GHG emissions from forests in time to prevent runaway climate change, but only if investments are made now.

Chapter 4 – **Forests and Wood Products** examines current and future demand for wood products and how this can best be met.

DEFORESTATION FRONTS

WWF describes places at imminent risk of large-scale deforestation as *deforestation fronts*, and defines them for the purposes of this report as follows:

Deforestation fronts are the places where the largest concentrations of forest loss or severe degradation are projected between 2010 and 2030. Collectively, these places will account for over 80 per cent of the forest loss projected globally by 2030, i.e. up to 170 million ha.

Forest loss/deforestation and degradation are defined by WWF as:

Forest loss/deforestation: Conversion of forest to another land use or significant long-term reduction of tree canopy cover. This includes conversion of natural forest to tree plantations, agriculture, pasture, water reservoirs and urban areas; but excludes logging areas where the forest is managed to regenerate naturally or with the aid of silvicultural measures.

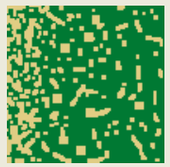
Forest degradation: Changes within forests that negatively affect the structure or function of the stand or site over many decades, and thereby lower the capacity to supply products and/or ecosystem services.

Severe forest degradation: Changes within forests that cause serious and permanent negative changes to the structure or function of the stand or site, and thereby lower the capacity to supply products and/or ecosystem services.

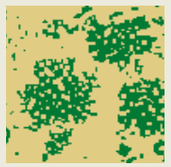
Typology of deforestation fronts

Deforestation does not progress the same way everywhere. Although inevitably a simplification, we distinguish three types of deforestation fronts:

Hard front: Gradual encroachment into an intact forest block from outside, forming a distinct edge.



Dispersed front: Numerous dispersed patches of deforestation over a large area that collectively add up to a significant area of forest loss.



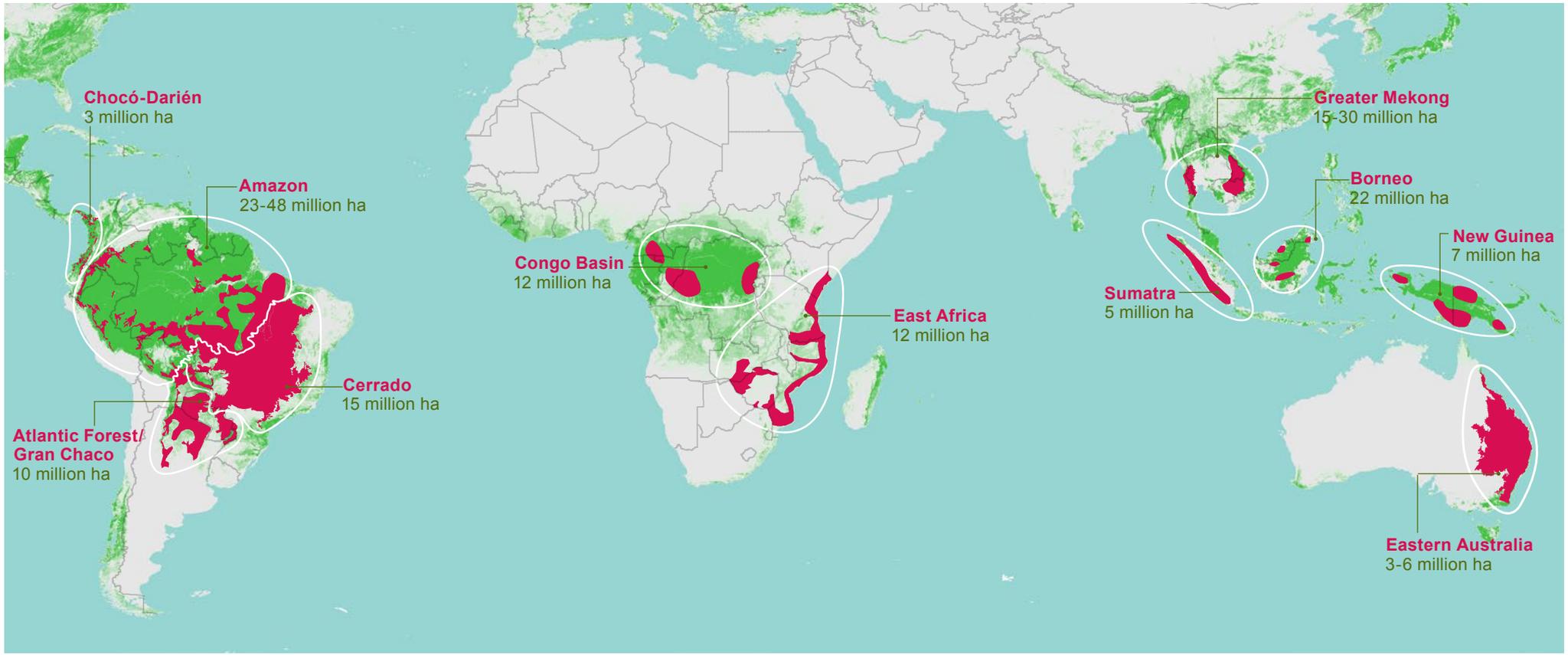
Scattered forest front: progressive loss of forest patches in a forest-grassland ecosystem.

Zero Net Deforestation and Forest Degradation (ZNDD)
WWF envisions a world where humanity lives within the Earth's ecological limits and shares its resources equitably. We advocate ZNDD by 2020 as a critical milestone toward this goal (see chapter 1 of the *Living Forests Report*).[1] ZNDD means ***no net forest loss through deforestation and no net decline in forest quality through degradation.*** With the International Institute for Applied Systems Analysis (IIASA), we developed the **Living Forests Model** to consider a range of future forest scenarios and to project the effects of changes in diet, bioenergy, conservation policy, and fuelwood and timber demand.

The model shows that with better forest stewardship and more productive use of arable land, the current and projected demand for food, fuel and fibre could be met without further net loss of forests. Achieving ZNDD by 2020 depends on preventing further forest loss due to poor planning, weak governance, excessive consumption, inequitable or insecure land tenure and user rights, unregulated or illegal forest clearing, poor forest management, inefficient agriculture and over-harvesting of fuelwood. In the longer term, maintaining near zero forest loss will require forestry and farming practices that produce more with less land, water and pollution, along with new consumption patterns that meet the needs of the poor while eliminating waste and over-consumption by the affluent.

MAP OF DEFORESTATION FRONTS

WWF has drawn on projections in the Living Forests Model, a major literature survey and interviews with dozens of experts around the world to identify 11 places with major deforestation fronts, highlighted in this map. These places are where the bulk of global deforestation is projected to take take place over the two decades, from 2010 to 2030, under business-as-usual scenarios and without interventions to prevent losses.



THE WORLD'S MAJOR DEFORESTATION FRONTS

The table below lists the deforestation fronts and projections of likely losses, if current trends continue or changes modelled in projections come about. Projections are based on extrapolation from recent trends, expert opinion and scenario analyses where available. Most of the deforestation fronts are in the tropics, where rates of forest loss between 2010 and 2030 are expected to be highest. These figures project, from the deforestation fronts alone, losses between 2010 and 2030 of up to 170 million ha. In addition, several temperate and boreal regions are undergoing considerable degradation, even though overall forest cover is not significantly changing. These are discussed on page 6.

Table 1: Deforestation fronts and projections of loss from 2010 to 2030

Deforestation front	Projected loss (million ha) 2010 to 2030
Amazon	23-48
Atlantic Forest/Gran Chaco	10
Borneo	22
Cerrado	15
Chocó-Darién	3
Congo Basin	12
East Africa	12
Eastern Australia	3-6
Greater Mekong	15-30
New Guinea	7
Sumatra	5
Total from 11 deforestation fronts	127-170

Sources for the figures are given in the sections on the individual deforestation fronts.

THE AMAZON IS THE LARGEST DEFORESTATION FRONT. MORE THAN A QUARTER OF THE BIOME WILL BE WITHOUT FORESTS IF CURRENT TRENDS CONTINUE.

DEFORESTATION PRESSURES

	Livestock	Large-scale agriculture	Small-scale agriculture & colonization	Unsustainable logging	Pulp plantations	Fires	Charcoal and fuelwood	Mining	Infrastructure	Hydroelectric power
Amazon	■	■	■	■		■		■	■	■
Atlantic Forest/ Gran Chaco	■	■		■	■	■	■	■	■	■
Borneo		■	■	■	■	■		■	■	■
Cerrado	■	■					■	■	■	■
Chocó-Darién	■	■	■	■				■	■	
Congo Basin	■	■	■	■			■	■	■	
East Africa	■	■	■	■		■	■	■	■	
Eastern Australia	■		■	■				■		
Greater Mekong		■	■	■	■		■		■	■
New Guinea		■	■	■	■	■				
Sumatra		■	■	■	■	■			■	

Table 2: Summary of main pressures on forests in different deforestation fronts

The most common pressures causing deforestation and severe forest degradation are: large and small-scale agriculture; unsustainable logging; mining; infrastructure projects; and increased fire incidence and intensity. New roads can have a small direct impact but a large indirect effect through opening up forests to settlers and agriculture. Poor forest management, destructive logging practices and unsustainable fuelwood collection degrade forests and often instigate an increasing spiral of degradation that eventually leads to deforestation ("death by a thousand cuts"). Table 2 gives a summary of these pressures.

■ Primary cause of forest loss and/or severe degradation

■ Important secondary cause of forest loss and/or severe degradation

■ Less important cause of forest loss and/ or severe degradation

□ Not a cause of forest loss and/or severe degradation

DEGRADATION - BOREAL AND TEMPERATE FORESTS

The deforestation fronts are predominantly in the tropics and sub-tropics because this is where most outright deforestation – the permanent loss of forest cover – is likely to take place between 2010 and 2030. At a global level, forest cover in temperate regions is increasing from a low base that is due to historical deforestation. However, forest *degradation* is still occurring in many temperate countries, through replacement of native forests with plantations of commercial species and because of increased fire, pollution, invasive pests, poor management and over-exploitation. Because this publication is focused on fronts for outright forest loss and the most severe forms of forest degradation, it does not address forest degradation more generally. The causes and vectors of forest degradation will be the subject of future investigation by WWF.

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Boreal forest in Northern Alberta, Canada near Fort McMurray. The largest forest in the world stretches around the north of Russia, Canada, Alaska and Scandinavia. Huge areas are still in a natural state. But a combination of old-growth logging, mining, and increases in fire due to climate change threaten this pristine habitat.

Do we have a boreal deforestation front?

Boreal forest covers 1,200-1,600 million ha of Russia, North America and Scandinavia; comprising roughly a third of remaining global forest.[2] Although overall forest cover in the region remains fairly stable, major changes are occurring, particularly through damage to pristine forests as a result of human-induced fires;[3,4] logging ;[5,6] and mining.[7] From 2011 to 2013, Russia and Canada accounted for 6.8 million hectares of tree cover loss, 34 per cent of the global total, mostly due to fire.[8] However, most of these losses are not associated with permanent conversion of forest to other land uses. Areas where tree cover loss has occurred will mostly be left to regenerate, though this will take a long time due to the slow growth rates of boreal trees. Most boreal tree cover loss does not therefore qualify as permanent forest loss as defined for the purpose of this report (see page 2). However, it could be argued that some boreal forest areas are becoming deforestation fronts due to severe degradation: a fully functioning forest may take hundreds of years to re-establish after a fire or clear felling, if at all.

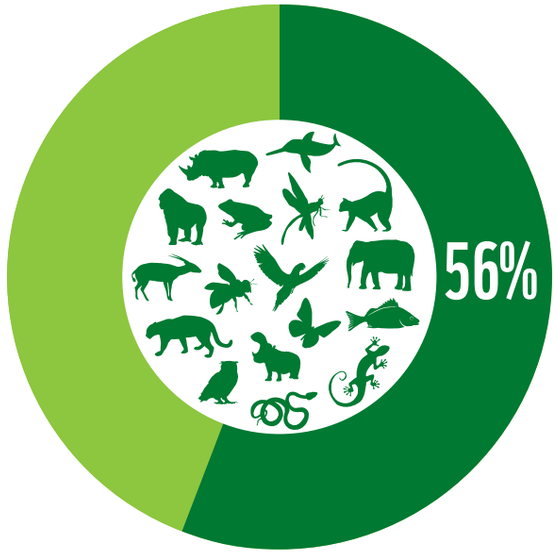
Climate change is also likely to make fundamental changes to forests in the boreal region,[9] which may affect regeneration. While the region has relatively low levels of biodiversity at a global scale, it is the world's last non-tropical forest with large, free-ranging populations of major predators and herbivores; this gives it high conservation value. For now, we treat boreal forest as a "degradation front", and thus separate from our main analysis. This may change following further research into climate change impacts on boreal forest regeneration.

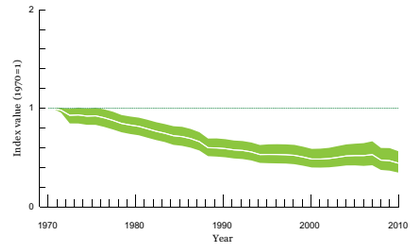
BIODIVERSITY AT RISK IN DEFORESTATION FRONTS

The 11 deforestation fronts contain some of the richest biodiversity in the world, including large numbers of endemic species. This makes them especially important in the context of sharply falling species populations.

Diversity: All the deforestation fronts are highly diverse. For instance, the **Gran Chaco** is the largest dry forest in South America, containing around 3,400 plant species, 500 birds, 150 mammals and 220 reptiles and amphibians.[11] The **Congo Basin** supports the highest biological diversity in Africa: over 400 mammal species, more than 1,000 bird species, and likely over 10,000 plant species. It is the last stronghold for forest elephant, gorilla, forest buffalo, bongo and okapi.[12] **New Guinea** is also recognized for its concentration of biodiversity: Papua New Guinea alone harbours an estimated 6 per cent of the world's species.[13] Although only 11.7 per cent remains, the **Atlantic Forest** still hosts a strikingly high biological diversity, including around 20,000 tree and shrub species, 270 mammal species,[14] 1,020 bird species and 340 amphibian species. Across these deforestation fronts, new finds occur daily. In the **Greater Mekong**, for example, 126 new species were found in 2011, including fish, snakes, frogs, bats and 82 plants. Even large mammals there remain undescribed. A joint government-WWF expedition discovered the saola (*Pseudoryx nghetinhensis*) in 1992 on the border of Lao PDR and Vietnam; it was finally photographed alive in the wild for the first time in late 2013.

Endemic species: The 11 deforestation fronts harbour unique species, many of them endangered or near extinction. Over 52 per cent of the tree species, 80 per cent of primate species, 124 forest-dependent bird species[15] (70 per cent of them threatened or endangered[16]) and 92 per cent of amphibians found in the **Atlantic Forest** are endemic.[17] Similarly, in the Brazilian **Cerrado**, there are an estimated 4,400 endemic species of higher plants, representing 1.5 per cent of the world's total vascular plant species.[18] In **East Africa**, the miombo ecosystem alone contains around 8,500 plant species, of which over half are endemic.[19]





Key

Tropical Living Planet Index

Confidence limits

This is based on trends in 3,811 populations of 1,638 species (WWF, ZSL, 2014).

THE TROPICAL LIVING PLANET INDEX SHOWS A DECLINE OF 56 PER CENT BETWEEN 1970 AND 2010[10]

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Mountain gorilla family in Virunga National Park, Democratic Republic of Congo.

TURNING BACK DEFORESTATION FRONTS

In deforestation fronts, forests are often squandered due to poor governance of land and economic activity impacting forests (see chapter 1 of the *Living Forests Report*).

The full value of forest biodiversity and ecosystem services is not recognized by local or export markets. Nor is this value safeguarded effectively in public policies and governance systems. Forests are replaced by other land uses that generate higher short-term financial returns, or face gradual depletion through unsustainable harvesting, hunting, fires and other disturbances. Thus forest loss occurs in spite of the risks that declining forest ecosystem services pose to society.

Reversing deforestation fronts will require measures to remedy the fundamental market and governance failures that drive poor land-use choices and practices. But where to start?

Land-use decisions are influenced by many actors: property owners or communities with land or resource access rights deciding how to use their land; governments shaping economic policies, regulations and spatial plans; investors assessing the risk and return of a business activity in a given place; corporations managing global supply chains and anticipating market trends; and consumers deciding what to buy or which politicians to elect.

Coherent and fair incentives to maintain the integrity of forest ecosystems will need to integrate these diverse interests and actors and shape the myriad systems influencing land-use choices. Systemic, integrated approaches to improved land-use decision-making are needed both in specific places and in global supply chains. In this chapter, we describe five measures with strong potential to prevent deforestation: strengthened protected area networks, valuation of ecosystem services, REDD+, deforestation-free supply chains, and forest safeguards for roads and other infrastructure. Finally, we propose the landscape approach as a potential framework for integrating these different intervention strategies to find enduring responses to deforestation pressures.

REVERSING DEFORESTATION FRONTS WILL REQUIRE MEASURES TO REMEDY THE FUNDAMENTAL MARKET AND GOVERNANCE FAILURES THAT DRIVE POOR LAND-USE CHOICES AND PRACTICES.

Community meeting at Nazare village discussing project development. Capim River, Paragominas, Para State, Brazil.
Good governance – by governments, communities and industry – lies at the heart of efforts to reduce deforestation rates.

PROTECTED AREAS AS DEFENCES AGAINST DEFORESTATION

Effective protected area networks are a means of ensuring that representative sanctuaries of biodiversity survive in deforestation fronts. They can also serve as reservoirs for future restoration. Expanding and strengthening protected area networks is therefore one of the most important strategies available to mitigate the impact of deforestation fronts.

Research suggests that most protected areas, most of the time, conserve ecosystems and wildlife better than alternative management approaches.[20] Deforestation fronts contain protected areas that have retained forests, even though forest loss is occurring right up to their borders.[21] A recent World Bank study[22] found protected areas more effective in preventing forest conversion than other land-use designations, with size, national park status, and management by indigenous people included among the key success factors.

However, poorly governed and under-resourced protected areas are unlikely to withstand intense deforestation pressures and not all protected areas have been effective in conserving natural ecosystems,[23] including within deforestation fronts.[24] Documented examples of protected area downgrading, downsizing and degazettement (PADDD[25]) in deforestation fronts, including the Greater Mekong, Amazon, Congo Basin and Coastal East Africa, can be found at: **www.padddtracker.org**. Along with expanding the area under protection, success depends on strengthening management and building capacity.

Any investments in protected areas as defences against deforestation thus need to be predicated on careful assessment of the conditions for success of the protection options under consideration. For example, indigenous peoples' reserves often serve as very effective conservation instruments,[26] but require different political and institutional enablers from protected areas on state-owned land. Strict protection areas will face different challenges than less formal "protected landscape" approaches.[27] Protected areas that are pristine due to their remoteness will require new and strengthened management to remain effective when the development frontier presses up against their boundaries. In critical situations, where a wave of deforestation is affecting an area, the need to respond quickly will often be in tension with the time required to run truly inclusive processes, build political will and create the capacities and institutional foundations for enduring and effective forms of protected area governance.

Even well-governed protected areas are not a panacea. In deforestation fronts, protected areas can easily become islands in generally converted landscapes, lacking the connectivity and size needed to conserve ecological systems and biodiversity. Hence, protected area networks need to be recognized more broadly as cornerstones of sustainable land-use mosaics, and valued additionally for the provision of ecosystem services in support of inclusive "green economies". Such economies would reverse the business-as-usual projections for deforestation fronts by setting an alternative development trajectory where natural capital is maintained and the depletion of ecosystem services associated with deforestation avoided.

To support such economies, countries will often need to enlarge their protected area networks, enable local people to become more involved in their governance, and generate more funding for management activities needed to secure and maintain the health of ecosystems within and around protected areas.

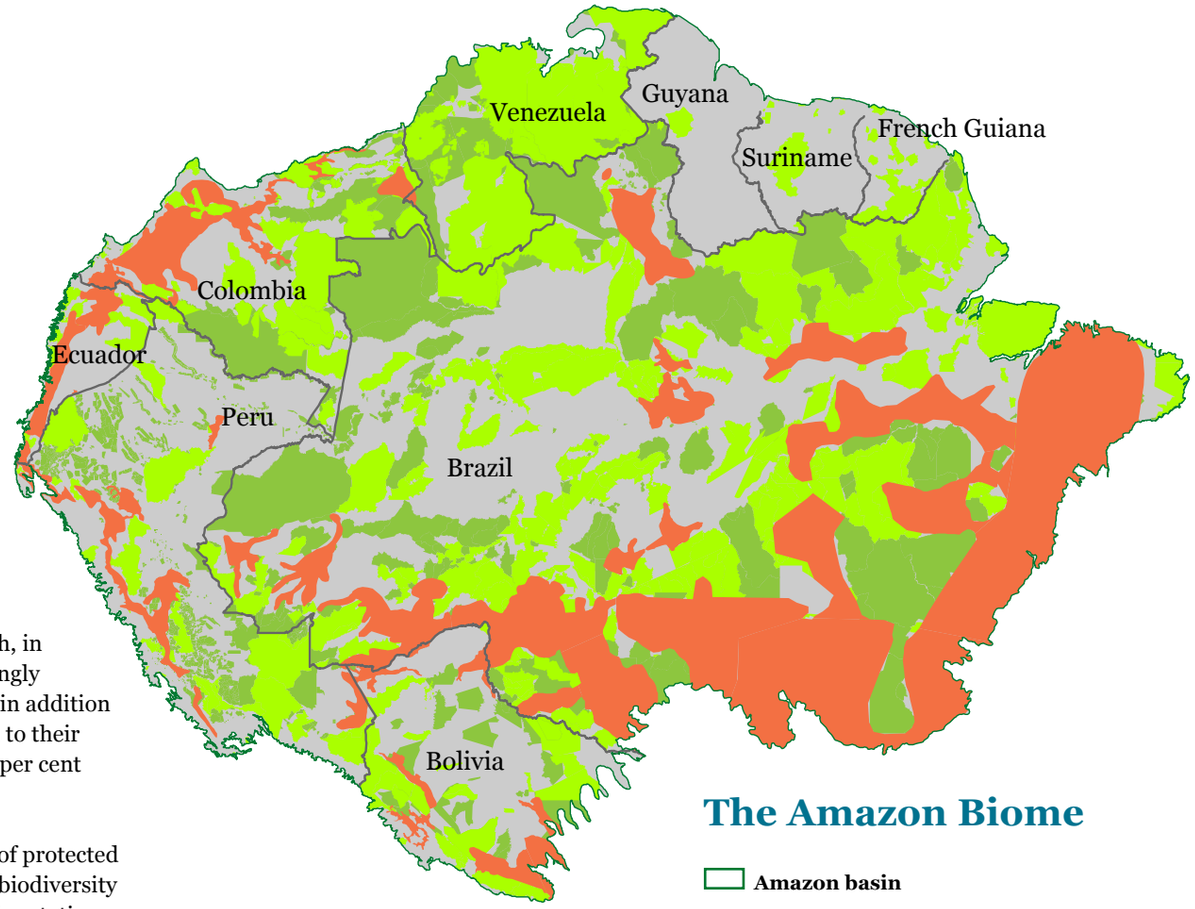
AMAZON PROTECTED AREAS AND INDIGENOUS TERRITORIES – A "BIODIVERSITY SAFETY NET"

Protected areas and indigenous territories are the most proven mechanisms for conserving natural ecosystems and cultures.

In the Amazon in particular, indigenous territories – which, in 2010, represented 31.1 per cent of the biome – are increasingly recognized for their importance in conserving ecosystems, in addition to their primary role of securing indigenous peoples' rights to their ancestral lands. By 2013, other protected areas covered 25 per cent of the Amazon biome.

Combined with community-conserved areas, this network of protected areas and indigenous territories represents the Amazon's "biodiversity safety net", and serves as an important defence against deforestation. For example, in Rondonia in northwest Brazil, this network has helped curb rampant deforestation from infrastructure development. In the heart of the Amazon, blocks of well-designed and well-managed protected areas enhance the resilience of the region.

As economic development in the Amazon increases, policy and conservation measures must be strengthened to ensure that protected areas and indigenous territories continue to effectively safeguard forests and the livelihoods of those who depend upon them.



VALUING ECOSYSTEM SERVICES

Avoiding projected forest loss in the 11 deforestation fronts would maintain a suite of benefits.

Forests deliver a range of critical ecosystem services: carbon sequestration; food security; water services; disaster risk reduction; tourism; and a host of cultural and social benefits.[28] Governments have formally recognized some of the highest quality natural forests in the world as homelands of indigenous peoples. Others are protected to secure clean, plentiful supplies of drinking water for cities located downstream, or because they conserve crop wild relatives needed for agricultural improvement programmes. Others protect sacred natural sites that are critical to the belief systems of local communities.

Understanding and valuing these benefits, including where appropriate the economic benefits, can help tip the balance in favour of land-use choices that maintain rather than convert forests. They can stimulate and provide the justification for a range of place-based solutions, which include creating new protected areas, other forms of legal or voluntary set-asides, implementing sustainable forestry practices and restoring forests.

The Economics of Ecosystems and Biodiversity (TEEB) process generated a series of studies that outlined the range of economic benefits provided by natural ecosystems and brought these to the attention of new audiences around the world.[29] Tools of varying degrees of sophistication are available to help stakeholders assess the value of biodiversity and ecosystem services.[30] Much experience has been gained in compensating the communities or individuals who are responsible for maintaining these services, through payments for ecosystem services (PES) schemes.

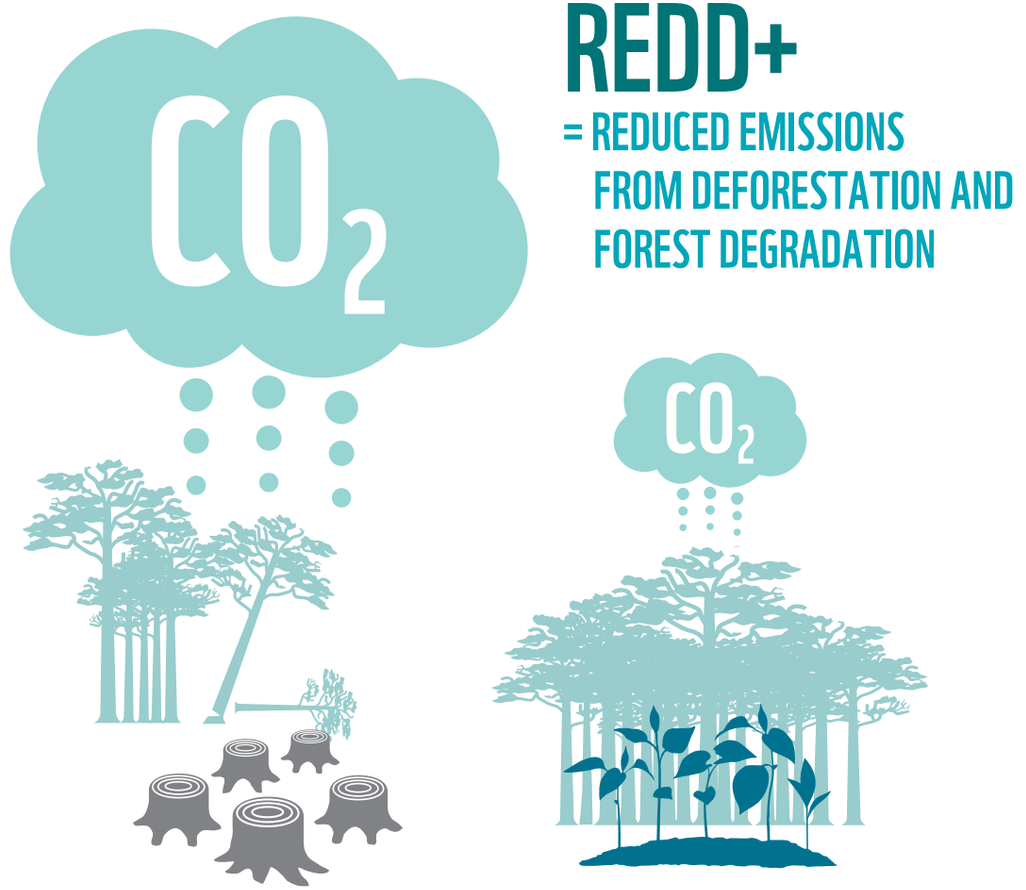
REDD+

Deforestation and forest degradation contribute significantly to global greenhouse gas (GHG) emissions.[31]

In response, the UN Framework Convention on Climate Change (UNFCCC) has developed a mechanism – known as REDD+ – for providing incentives to developing countries to reduce GHG emissions from deforestation and forest degradation, and enhance forest carbon storage by improving forest management (see Chapter 3 of *Living Forests Report*). This mechanism differs from earlier efforts to prevent forest loss, as incentives are based on results achieved (emissions reductions), and results are assessed at the national level rather than at the project level (though sub-national results may be recognized as an interim measure). Ensuring results are evident at a national level is necessary for the integrity of the global climate change regime under the UNFCCC.

Financial support for REDD+ has reached over US$9 billion.[32] This represents a significant increase in international funding for forest conservation but is still not enough to address the problem at scale.[33] While REDD+ finance can come from a wide variety of sources, to date it has mainly been public finance. Much of the REDD+ finance has gone into establishing the technical and institutional capacities of countries to implement REDD+ activities and measure their results. Norway,[34] Germany[35] and the World Bank Carbon Fund[36] have established programmes that are piloting results-based payments for REDD+ at national and sub-national scales. The recent increase in pledges[37] made by major corporations and investor groups to deforestation-free supply chains and investments (see page 15) is expected to play a vital complementary role in achieving REDD+ objectives.

Emission reductions from deforestation and forest degradation need to be measured at the national and global level. However, the first REDD+ projects were mostly smaller, unconnected projects. Increasingly, actions are at a sub-national "jurisdictional" scale. Many supporters and beneficiaries of REDD+ implementation efforts – from the World Bank Carbon Fund to large forest countries such as Brazil and Indonesia – are taking an approach that gives preference to work at state, province or district levels, in recognition of the unique advantages that work on this scale can afford (see DRC case study).[38]



Jurisdictional REDD+ programmes work on sizeable, sub-national landscapes, nested within national level frameworks. They focus on building capacities, safeguards and engagement for REDD+ from the bottom up with communities, businesses and local and national governments.

With this approach, REDD+ can be implemented and tested on a scale that is ecologically meaningful because it can contain intact ecosystems, and socially and politically meaningful because it aligns with recognized jurisdictions, such as government-designated provinces, departments or districts. Expanding jurisdictional REDD+ with existing sub-national administrations, within national development policies, could help counter threats in deforestation fronts while addressing issues related to poverty alleviation, land rights and equitable resource governance.

DEMOCRATIC REPUBLIC OF CONGO REDD+ CASE STUDY

The Democratic Republic of Congo (DRC) contains 60 per cent of the forests in the Congo Basin (roughly 150 million ha[2]), an area of immense biological richness. With only 6 per cent of Congolese having access to electricity, the remainder – nearly 67 million people – depends on the forest for firewood and charcoal. The livelihoods of 40 million people depend directly on forests: for subsistence farming, timber for homes, and firewood/charcoal for cooking and heating. This is leading to increased deforestation.

The Maï-Ndombe REDD+ project in DRC has built up the capacities needed to deliver REDD+ and created the first large-scale REDD+ and green development pilot programme in the Congo Basin. The project covers 13 million ha of forest (the size of Austria and Switzerland combined) with high biodiversity and high risks of deforestation due to its proximity to the capital Kinshasa.

The project was developed using an integrated approach bringing together government, community, civil society organizations and the private sector at local, sub-national and national levels. It aims to reduce emissions from deforestation and forest degradation of 29Mt CO_2 equivalent by 2020, while recognizing tenure security and sharing REDD+ benefits to improve long-term livelihood security, with particular attention on vulnerable groups.

At the local level, the project started as a capacity-building exercise to empower indigenous peoples and local communities to participate effectively in the REDD+ process in ways that recognize and address their rights. It plans to address deforestation and degradation through capacity building, payments for environmental services, community forestry, reduced impact logging, creating land-use plans including conservation concessions and strengthening governance. The jurisdictional programme aims to develop "a model provincial green development program that provides alternatives and rewards performance to address the challenges of climate change, poverty reduction, natural resource conservation and protection of biodiversity".

It is an exciting time for REDD+ in DRC. Already, some of the "transformational" impacts set as objectives by the government are beginning to be realized. Communities are working together to develop land-use maps and plans. The government is recognizing their work and their value in the REDD+ process.[39] Communities are beginning to demonstrate real commitments to reductions of deforestation and forest degradation, with less slash-and-burn and more sustainable agroforestry. Global policymakers should match DRC's ambition and commitment. Several forest countries have shown their readiness for REDD+ and will soon outpace the overall process if more aggressive action on REDD+ finance is not taken at the global level.

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A community land-use mapping exercise as part of the Mai-Ndombe REDD+ project in DRC.

"DEFORESTATION-FREE" SUPPLY CHAINS

Major private sector actors have pledged to eliminate deforestation from their supply chains and investments.

Examples include the Consumer Goods Forum's zero net deforestation by 2020 initiative;[40] the Banking Environment Initiative to provide deforestation-free financing;[41] numerous commitments by individual retailers, brands and traders;[42] and place-specific actions such as the Brazilian soy industry's moratorium on purchasing soy from lands that have been deforested in the Amazon.[43] Many producers in the forestry and agriculture sectors have also committed to cease or strictly limit forest conversion associated with their operations.

Governments can create market preferences for products sourced from legal and sustainable sources or support producer countries to take actions to limit forest loss.

Many voluntary commodity certification standards have some form of prohibition on the clearing of forests and other natural ecosystems, though these vary greatly. These include requirements on: maintaining and enhancing high conservation values; legal compliance; protection of peat soils; and respecting local and indigenous peoples' rights to give or withhold free, prior, and informed consent to activities affecting their territories. If such efforts can be mainstreamed, they offer enormous potential to decouple food and fibre production from forest loss.

Yet many private sector actors have not made robust commitments to eliminate deforestation, let alone put such commitments into practice. To transform markets, campaigners and progressive companies will need to work together to expose deforestation-linked practices and their impacts, and make it harder for those implicated to stay in business. At the same time, care is needed to avoid deforestation becoming a single-issue cause divorced from concerns over rights, livelihoods and other environmental issues.

Governments need to support the switch to deforestation-free commodities. In producer jurisdictions, they can strengthen laws, policies and governance systems to enable land zoning and permits that are consistent with maintaining forests. In consumer jurisdictions they can create market preferences for products sourced from legal and sustainable sources or support producer countries to take actions to limit forest loss. Governance measures such as the EU Timber Regulation and the Lacey Act in the United States, for example, bar trade in products

containing illegally sourced wood. They are examples of consuming jurisdictions inserting governance safeguards into supply chains that start in other countries.

Fair, efficient and effective application of the notion of "deforestation-free" supply chains will require:

- Regulations and spatial-planning processes in jurisdictions within deforestation fronts that support voluntary commitments to limit forest conversion;
- Verification that builds on existing certification systems, and strengthens their safeguards on the conversion of forests and other natural ecosystems where necessary;
- Positioning of deforestation-free as a critical aspect of sustainable production, but not a proxy for, or superior trait to, full sustainability;
- Respect for the rights, needs and aspirations of indigenous, traditional and local communities in decisions over land use;
- Safeguards to prevent indirect land-use change (e.g., when farmers displaced by deforestation-free commercial developments encroach deeper into the forest);
- Complementary measures to ensure that a narrow focus on deforestation does not neglect measures to prevent forest degradation (the source of 50 per cent of forest-related GHG emissions), or create additional pressures on grasslands and other non-forest ecosystems (leakage);
- Efficient integration of deforestation-free safeguards with other pre-project processes (e.g., environmental and social impact assessments, high conservation value (HCV) assessments, participatory mapping of community lands);
- That companies previously involved in deforestation redress their social and environmental legacies before they qualify as deforestation-free suppliers.

FOREST-FRIENDLY INFRASTRUCTURE

We are living in an explosive era of infrastructure expansion,[44] and dams, roads, railways, canals, ports, pipelines and mines are potentially a major cause of future forest loss.

Infrastructure projects in remote areas are often magnets for people seeking employment and other economic opportunities. When governance conditions are weak, people who move to such areas in search of work, or remain after temporary jobs conclude, may clear forests to build settlements, secure land, graze livestock or plant crops and gardens. To eke out a living, they may exert further pressure on nearby forests by hunting and gathering wild foods or cutting fuelwood or high-value timber.[45] Large mines can signal the presence of valuable ores and minerals and trigger artisanal mining rushes that devastate large tracts of forested land, as is happening in Peru.[46] New highways and access roads can make once-remote forests accessible to settlers, and make farming and extractive activities more commercially viable due to easier transport to urban markets or ports. Roads can also fragment intact forests and disrupt wildlife migration. In all such instances, infrastructure is an indirect cause of forest loss.

So, what can be done to reduce the impacts of infrastructure on forests without undermining local economic opportunities? Those financing, building or regulating infrastructure can actually do quite a lot to mitigate social and environmental impacts.

The starting point is upfront impact assessment. An assessment can cover an individual project, the cumulative impact of a series of projects, or comprise a strategic review of proposed development plans or policies at macro-scale. Whatever the scale, an assessment can inform decisions on whether a proposal goes ahead, how it is managed during implementation, and how it can be integrated into the wider land-use mosaic and spatial plans. Potential negative impacts can be addressed through a sequence of measures known as the "mitigation hierarchy". In order of priority, these are:

- Avoiding or preventing harm by exploring alternative locations, layouts, technologies, sequencing and timing (e.g., re-routing highways around indigenous reserves, restricting third-party use of project access roads, "fix it first" policies to upgrade existing transport links rather than develop new ones);
- Minimizing harm by reducing spatial extent, duration and/or intensity of human interference (e.g., repatriation of migrant workers when construction is complete, creating wildlife crossings under or over major highways);
- Restoring or repairing harm that cannot be avoided or prevented (e.g., decommissioning access roads when they are no longer needed, forest restoration after mining operations have finished);
- Offsetting residual negative effects through positive interventions (e.g., reintroduction of species or other conservation measures in the wider landscape).

Many of these measures will also help investors and project managers to mitigate financial risks, and to some degree are already embedded in best practice safeguards and guidelines.[47] However, much can be done to improve the quality of assessments and effective application of mitigation measures.

Forest safeguards can be created or greatly strengthened in the regulatory systems governing infrastructure approval, installation and operation in many countries. They can be better addressed in the operational systems of those installing and managing infrastructure. Greater transparency and effective stakeholder consultation, not just "box ticking", are key areas where improvements are needed.[48] The systematic strengthening of forest safeguards in infrastructure regulation and practice is thus one of the major opportunities to prevent further forest loss.

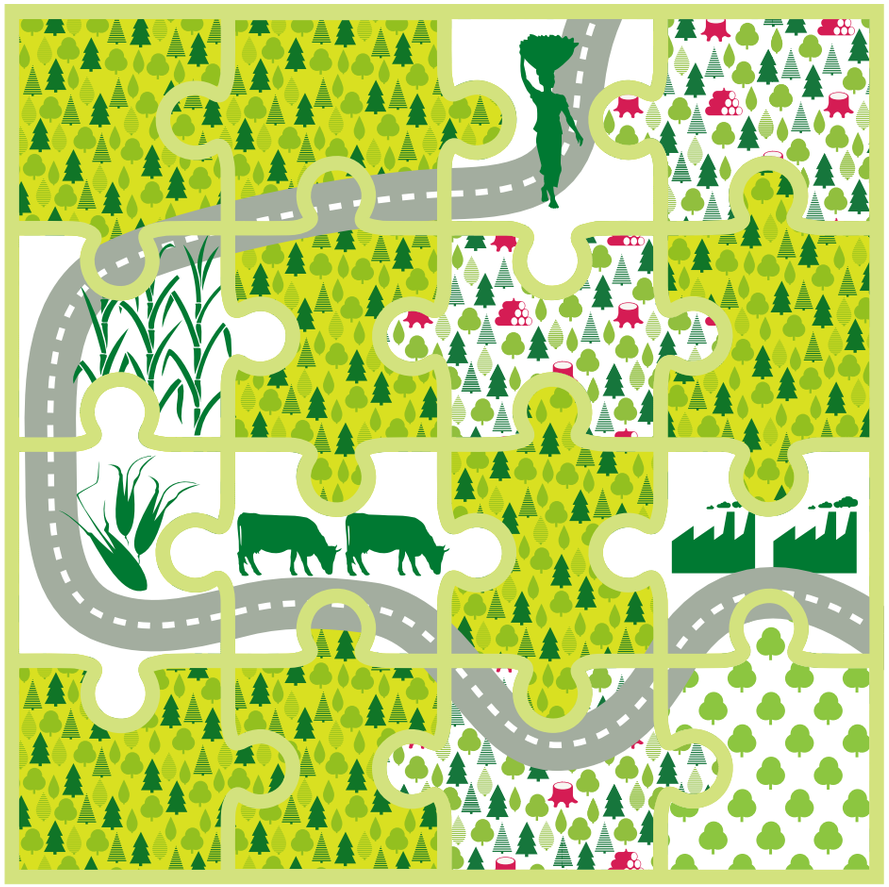
OPTIMAL LAND-USE CHOICES AND LANDSCAPE APPROACHES

The landscape is the scale at which supply chains and investment portfolios from multiple sectors intersect with the specifics of local governance regimes, ecological dynamics and the rights, needs and aspirations of local people.

From a conservation perspective, the landscape is often an area large enough to maintain viable populations of key species and healthy ecological processes. It is a scale where sustainable land-use mosaics can be developed, and inclusive processes facilitated to inform and negotiate trade-offs over impacts and benefits of competing land uses. Jurisdictional REDD+ (see page 13) can also be effectively implemented at a landscape level.

The "landscape approach"[49] is a term used to describe collaborative initiatives in specific places that span multiple sectors and go beyond the scale of individual farms, forest management units and protected areas. Essentially, it means coherent intervention at a landscape scale to secure food, fibre and energy production, improvements in social welfare, water security and ecosystem conservation.

Applying a landscape approach to prevent large-scale deforestation is ultimately about encouraging land-use choices that retain forests for multiple purposes and optimize the productive capacity of the surrounding landscape. It can combine official protection of critical sites, voluntary "deforestation-free" measures, sustainable forest management within production forests, REDD+ and other measures to secure payments for environmental services.



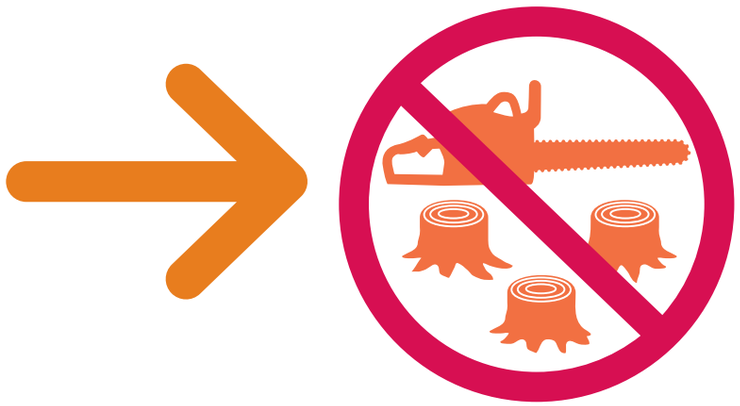
A landscape approach should result in smart land-use choices that maintain and enhance ecological values such as biodiversity, ecosystem services and resilience, environmental flows and water quality in rivers, groundwater quality, soil health and stored carbon. In the socio-economic sphere, it should lead to land-use choices that respect the rights and aspirations of indigenous peoples and local communities and secure local livelihoods and equitable distribution of the benefits of productive activity.

WAYS FORWARD

Earlier chapters in the *Living Forests Report* have shown that ZNDD is possible without disastrous consequences for supplies of food, energy and wood products, or for biodiversity in other biomes. This chapter casts further light on the scale of the challenge in realizing ZNDD in practice.

WWF is using deforestation fronts to prioritize our efforts to achieve ZNDD in the places where, without conservation efforts, losses will be greatest. Within deforestation fronts, we need location-specific strategies that focus on the most important direct and indirect drivers of forest loss. Such strategies may have to be modified over time as events unfold. Care will be needed to avoid leakage, or the displacement of deforestation from one area to another.

Achieving ZNDD certainly won't be easy. Decisions made in deforestation-front countries and in the domestic and export markets for their products will determine whether tropical forests retreat to a few isolated remnants or continue to play a central role in providing ecosystem services, resources, income and cultural value.



Critical measures to curb the social, economic and environmental harm caused by deforestation fronts are:

- Expanding and strengthening networks of indigenous reserves and protected areas, along with governance arrangements to ensure these networks are able to withstand intense deforestation pressures;
- Presenting public and private sectors with stronger evidence and valuation of ecosystem services from forests, and risks to business and society of depleting natural capital, so they are more likely to be factored into decisions affecting land use;
- Rolling out REDD+, with safeguards, on a far larger scale;
- Mainstreaming the concept of "deforestation-free" as a critical element of sustainable supply chains and financing and ensuring it is applied in ways that protect forests while balancing the interests of all stakeholders;
- Developing forest-friendly infrastructure that mitigates social and environmental impacts without undermining local economic opportunities;
- Using landscape approaches to integrate these elements and enable solutions at an adequate scale to achieve sustainable land-use mosaics and balance trade-offs among competing land uses.

Deforestation front focus

AMAZON

The Amazon is a complex natural region, comprising an array of interdependent ecosystems. It is hugely important in terms of the ecosystem services it provides, including ecological processes, biodiversity and cultural diversity.

Since 2005, there has been an important reduction in the rate of deforestation across parts of the Amazon region, but deforestation and forest degradation continue at an alarming rate, threatening to overturn gains that have been made. The Amazon is the biggest deforestation front in the world, according to WWF projections, and interventions are urgently needed to prevent a large-scale, irreversible ecological disaster.

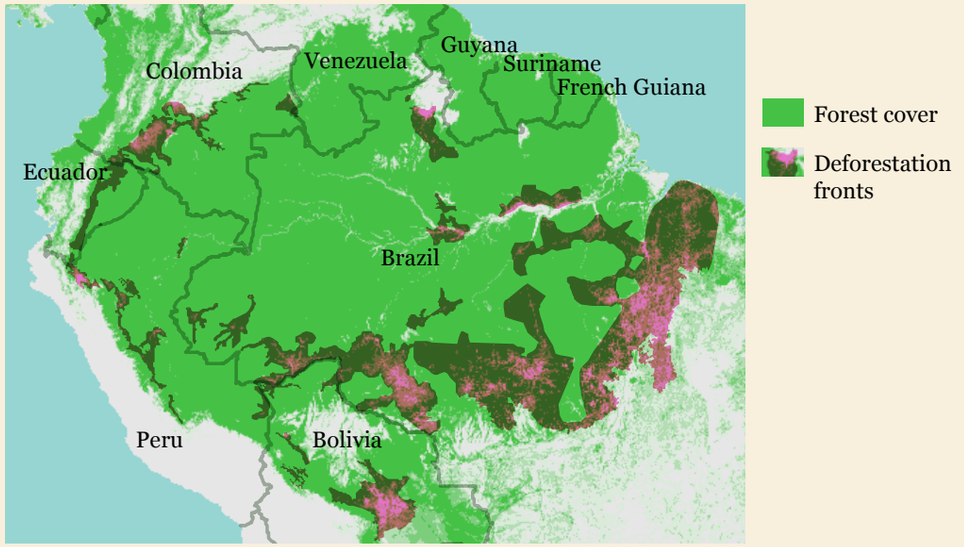
Forest losses from 2001 to 2012 averaged 1.4 million ha per year[50] for the Amazon biome, resulting in a total loss of 17.7 million ha in those 12 years. Brazil was responsible, on average, for 75 per cent of accumulated deforestation, with Brazil, Peru and Bolivia together accounting for 90 per cent.

Recent WWF estimates suggest that 27 per cent – more than a quarter – of the Amazon biome will be without trees by 2030, 13 per cent from new deforestation,[51] if the average deforestation rate for the last 10 years for each country continues. This would give a total area lost to deforestation from 2010 to 2030 of 23 million ha.[52] If construction goes ahead on planned hydroelectric dams and major new paved roads – such as the Carretera Marginal de la Selva, running from Peru through Ecuador to Colombia; the Trans-Amazon highway; the Manaus-Porto Velho "BR 319"; and the Cuiabá-Santarem "BR 163" – coupled with the new Interoceanic Highway running through Brazil, Bolivia and Peru, deforestation could double to 48 million ha between 2010 and 2030, or 100 million by 2050.[53]

The Andean-Amazon deforestation area – spanning 670 million ha[54] from Colombia to Bolivia – includes sub-fronts moving in from the southeast, Brazil and Bolivia, the Andean piedmont and from the north in Colombia and Ecuador. Deforestation has been growing particularly in the Andean-Amazon countries, namely Peru – due to expansion of palm oil, agriculture, illegal logging and informal mining – parts of Bolivia,[55] Colombia and, to a lesser degree, Venezuela, Guyana, Suriname and French Guiana.[56] Though the deforestation rate in Brazil has decreased, changes to the Forest Code in 2012 have been associated with increased deforestation, including within the Amazon biome.[57]

CREDIT: ADRIANO GAMBARINI / WWF-BRAZIL

Crops and pasture meet natural forest in Mato Grosso in the Brazilian Amazon.



Deforestation front focus

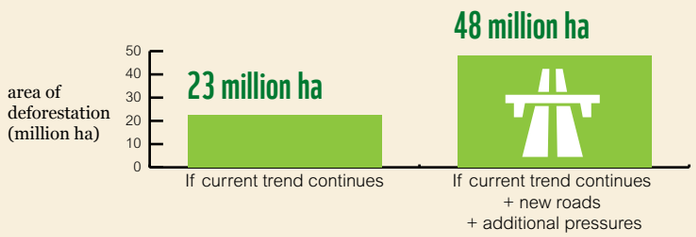
AMAZON

Brazil Amazon deforestation projections if conservation measures are not introduced
(includes deforestation in both Cerrado and Amazon biomes)

2020[58]	25%
2030[59]	31%
2050[60]	40%

Amazon key data

Countries	Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Suriname and French Guiana
Area of deforestation front	670 million ha
Deforestation, 2001-2012	17.7 million ha
Deforestation (projected), 2010-2030	23-48 million ha
Top causes	Cattle ranching, agriculture



Amazon deforestation pressures

Pasture and **cattle ranching**,[61] specifically farm gate beef and dairy, is the dominant cause in many areas[62] and is also linked to land speculation in some countries.

Expansion of **mechanized agriculture**, particularly for animal feed[63] and biofuels,[64] using soy,[65,66,67,68] oil palm[69,70,71] and also corn, is a key cause, with increased production linked to subsidized resettlements in some countries.[72] **Indirect land-use change** can be significant,[73] e.g., if soy replacing pasture[74] results in cattle rearing moving into natural forest.[75]

Small-scale agriculture is expanding in regions such as northern and eastern Bolivia,[76] Colombia, Ecuador, Peru and the Guianas, where high levels of poverty, pressure for land, unsustainable practices and problems of control are leading to an expansion.

Dams and **hydropower expansion**, including settlement around dams and associated infrastructure, is a major driver behind deforestation. The area at risk from deforestation impact occurs between 40 and 100km from hydroelectric dams.[77] There are 154 constructed dams, and another 298 either under construction or planned in the Amazon biome.[78] Dam impacts often overlap with protected areas and indigenous territories.

Roads give access to remote areas, bringing people and land speculation inwards. Mechanisms to manage or reduce the impacts of new roads are often absent or poorly implemented. The fronts showing the greatest deforestation rates are areas with more roads, showing a strong correlation between deforestation and the presence of roads and projections of new roads. Nearly 95 per cent of deforestation in Brazil Amazon was found to be within 5.5km of roads and 1km of navigable rivers.[79]

Forest fires due to poorly controlled burning for land clearance and management are a contributing factor to both deforestation and forest degradation.[80]

Road development accompanies mines, oil and gas drilling, often deepening deforestation. Mining is significant in places[81] such as Peru, where artisanal and small-scale alluvial **gold mining** has increased 400 per cent since 1999.[82]

Unsustainable legal and illegal timber trade contributes to forest degradation and can be the first stage of forest conversion [83]

Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

Deforestation front focus

ATLANTIC FOREST/GRAN CHACO

The Atlantic Forest is one of the richest rainforests in the world, with high levels of endemism and richer biodiversity per area than the Amazon.[84] However, the region also hosts 75 per cent of the Brazilian human population and remaining forest fragments are under intense pressure. The neighbouring Gran Chaco is the largest dry forest in South America, covering some 100 million ha in Argentina (62 per cent), Paraguay (25 per cent), Bolivia (12 per cent) and Brazil (1 per cent).[85] But unless policies change, both ecosystems could virtually disappear outside protected areas.

© MICHEL GUNTHER / WWF-CANON

Deforestation of the Atlantic Forest for cattle grazing. Bahía, Brazil.

Ironically, Gran Chaco has suffered partly as a result of tighter controls to protect remaining fragments of Atlantic Forest – a classic example of "leakage" and the reason WWF has combined these two distinct ecosystems as a single deforestation front.

In the Gran Chaco biome in particular, deforestation rates are exceptionally high. A recent study of deforestation dynamics in the biome found that 11.7 million ha (7.9 million ha in Argentina, 3.3 million ha in Paraguay, and 0.5 million ha in Bolivia) were converted between 1976 and 2011. The study concluded that 23 per cent of the Gran Chaco biome had been lost in Argentina, 19 per cent in Paraguay and 3.5 per cent in Bolivia.[86]

The Atlantic Forest is now confined to only 11.7 per cent (16.3 million ha) of its original extent in Brazil, 24.9 per cent (1.2 million ha) in Paraguay,[87] and 38.7 per cent (1 million ha) in northern Argentina.[88] This is mainly due to agricultural expansion during the colonial period, industrialization and urban development. Although 9 per cent of the region's territories are covered by protected areas, over two-thirds are under sustainable use, which usually means farmland and does not necessarily protect forest. Just 2.5 per cent (3.3 million ha) is in national parks where use is more restricted, including 700 mainly small strictly protected areas[89] (1.6 per cent). Atlantic Forest continues to be converted. In Brazil, losses over the previous few years have been around 20,000 ha per year, and WWF projects losses to 2030 could be around 425,105 ha. In Argentina, deforestation rates in the biome averaged 5,485 ha a year from 2006 to 2011.

Based on current and recent rates of forest loss, WWF estimates deforestation to equal 10 million ha between 2010 and 2030 for the Atlantic Forest and Gran Chaco. Solutions to address deforestation will require interventions at the regional level; tackling one deforestation issue without considering the wider regional and global context can simply result in the problem being shifted somewhere else.

Restoration efforts are also under way, at least in the Brazilian Atlantic Forest. In 2009, these were integrated into the Atlantic Forest Restoration Pact, when more than 160 institutions – including WWF, the government and universities – set a target to restore 15 million ha of degraded lands by 2050; 60,000 ha are already under restoration in more than 80 projects covering several states. The Brazilian government also created a Rural Environmental Registration* requirement for rural properties that encourages restoration in compliance with the National Forest Code.

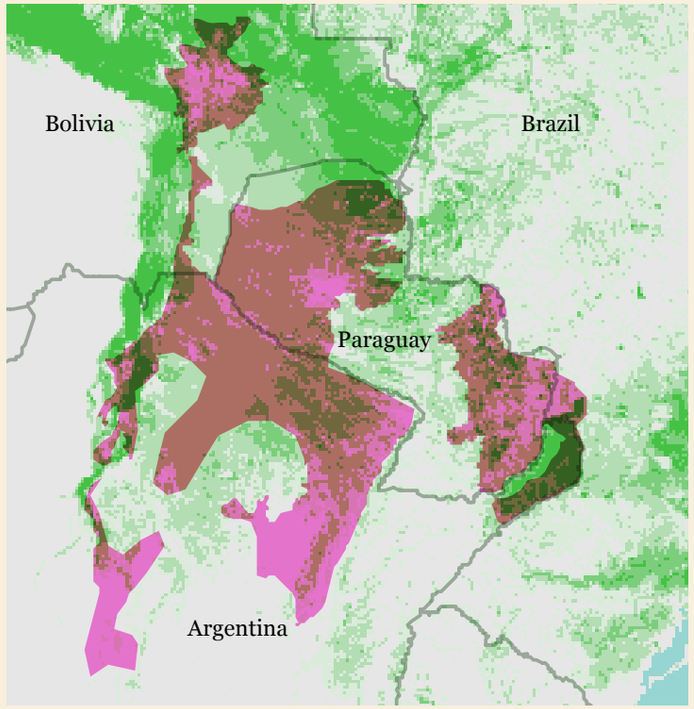
*Rural Environmental Registry is an online system through which rural property owners must register their land. CAR is a federal system, but states are responsible for implementation. CAR is configured to use high-resolution satellite images that are then registered by the property owner and contain all of the relevant information for compliance with the law, including the location of Areas of Permanent Protection and Legal Reserves.

Deforestation front focus

ATLANTIC FOREST/GRAN CHACO

Atlantic Forest/Gran Chaco key data

Countries	Argentina, Bolivia (for Chaco), Brazil and Paraguay
Deforestation (projected), 2010-2030	10 million ha
Top causes	Agriculture, livestock, infrastructure



Forest cover Deforestation fronts

Atlantic Forest/Gran Chaco deforestation pressures

	Agricultural expansion, particularly for **soy**[90] but also maize, sunflower, wheat, rice and oats is the main driver of deforestation in Argentina and Paraguay.[91,92] Resistance to forest clearing has sometimes been violently suppressed, including suppression of land protests related to soy.[93]
	Clearance for **pasture**, including **overgrazing**, causes further impacts on forest cover.[94]
	Roads and **pipelines**[95] threaten to increase forest loss.
	Fire and a consequent increase in **invasive species**[96] is a key contributor.
	Firewood collection and **charcoal production** are sources of both forest clearance and degradation, particularly in Gran Chaco.[97]
	Logging, including illegal operations, continues in both regions.[98]
	Pulpwood plantations continue to be linked to conversion in the west Argentinean Chaco.[99]
	Mining is increasing, for example in the Bolivian Chaco.[100]
	Proposed dams and associated infrastructure are a potential cause of future forest loss.

Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

Deforestation front focus

BORNEO

A century ago, most of Borneo was covered in forest. The island has since undergone a massive transformation as coastal lowland forests have been cleared, converted to other land uses or degraded. The rate of deforestation and degradation has accelerated, with 30 per cent of Borneo's forests lost in the last four decades.

Twenty million ha were lost between 1985 and 1997.[101] Deforestation has continued since 2000,[102] particularly in Central Kalimantan,[103] West Kalimantan and Sarawak.[104] Between 2003 and 2008, a further 5.8 million ha were deforested[105] in Borneo as a whole. By 2010, 53 per cent of the island's original forest remained, of which about half was thought to be "intact," some 21 million ha; 42 per cent of this intact forest is slated to be logged and 16 per cent further converted into timber plantations.[106,107]

A recent analysis for one area of West Kalimantan projecting business-as-usual scenarios found that by 2030, the area of forest likely to be cleared for oil palm would reduce the remaining natural forest cover to 4 per cent.[108] Other projections suggest that 45 per cent of Kalimantan peat swamp forest in Indonesia could be lost by 2030;[109] in Malaysian Borneo, most new plantations are expected in Sarawak.[110] Although the Indonesian government has decreed[111] that Indonesia's Kalimantan provinces should remain 45 per cent forested, this is not reflected in district and provincial development plans, nor in the numerous, often overlapping permits granted for mining and agriculture.

Industrial conversion of forests into palm oil, timber and pulpwood plantations is the main cause of deforestation. Other pressures include conversion for small-scale agriculture, fires, illegal logging, and new roads and dams. In Indonesia, in particular, these pressures are exacerbated by weak governance. Permits purporting to allow land conversion are often in conflict with sectoral regulations, spatial plans, community land claims and permits granted in other sectors.

If current deforestation rates continue unabated, 21.5 million ha will be lost between 2007 and 2020, reducing remaining forest cover to just 24 per cent of the island.[112] Recent private sector commitments to halt deforestation and government policy changes suggest a slowdown in these rates is probable. For example, through the "Heart of Borneo" declaration, the governments of Brunei Darussalam, Indonesia and Malaysia have committed to manage and conserve forest resources in the inland portion of the island where most forest cover is retained.[113] Proposed measures to back this declaration could reduce deforestation rates significantly. Accordingly, WWF projects forest loss of 22 million hectares for the period 2010 to 2030 in Borneo.

© ALAIN COMPOST / WWF-CANON

Cleaning forest fire for palm oil plantation Central Kalimantan, Indonesia.

© ALAIN COMPOST / WWF-CANON

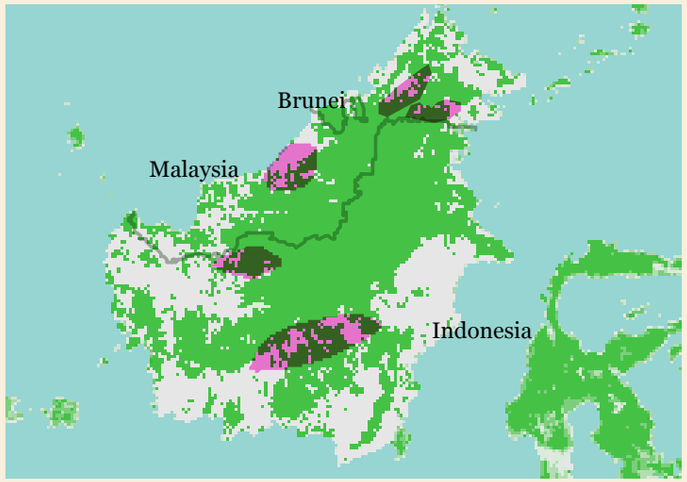
Burning palm-oil plantation. Palangkaraya, Central Kalimantan, Indonesia.

Deforestation front focus

BORNEO

Borneo key data

Countries	Indonesia (Kalimantan), Malaysia (Sabah, Sarawak) and Brunei
Deforestation, 2003-2008	5.8 million ha
Deforestation (projected), 2010-2030:	22 million ha
Top causes	Conversion for palm oil, unsustainable logging



Forest cover Deforestation fronts

Table symbols

- Primary cause of forest loss and/or severe degradation
- Important secondary cause of forest loss and/or severe degradation
- Less important cause of forest loss and/or severe degradation

Borneo deforestation pressures

Conversion for **palm oil** plantations is the largest cause of deforestation across all regions of Borneo.[114,115,116] Palm oil plantations cover 11.7 million ha in the Indonesian part of Borneo alone,[117] with significant increases in the last decade.[118] The profits from logging and conversion to palm oil plantation greatly exceed foreseeable revenues from carbon markets and other payment for ecosystem services (PES) schemes,[119] creating additional challenges for forest conservation. Most new plantations are expected to be in Sarawak.[120]

Uncontrolled small-scale conversion is also a significant pressure, including within some protected forests.[121]

Repeated cycles of **unsustainable, often illegal, logging** result in severe forest degradation, [122] and forests that have been logged over and abandoned are vulnerable to encroachment and conversion to other land uses.[123]

Indonesia's two biggest **paper** players have pledged near zero deforestation;[124,125] however, third parties continue to clear forests set aside for conservation in the concessions of these companies, and their suppliers continue to clear forests not designated for protection due to flawed conservation and social value assessments.[126,127] The future impacts of the sector on Borneo's forests remain uncertain due to the gap between plantation wood supply and planned milling capacity, and government plans in Indonesia to allocate more forested land for pulpwood plantation development.

Fire is used to **clear land**, but often spreads to burn out of control on drained, or temporarily dry, peatlands[128] – around 1 million ha were drained for Indonesia's failed mega rice project and large areas have been drained for plantations. Also at risk are forests made drier and more flammable due to El Niño events or because of large canopy gaps resulting from poor logging practices and encroachment. Fire impacts have been greatest in West Kalimantan, Central Kalimantan and Sabah, and burnt tracts of forest are often not given the opportunity to recover.[129]

Mining, for **coal**, **gold** and other **minerals**, is significant in some areas and, if economic development plans are realized, is set to be a very important direct or indirect cause of forest loss in some parts of the island. Large mining companies are at least willing to "minimize" the environmental impacts of their mining activities, while small-scale mining appears to be completely ignorant about this.

Dam building is increasing, including on the territories of indigenous peoples.[130]

Road development is an important contributory cause, with 95 per cent of deforestation in Borneo occurring within 5km of the forest edge.[131] Malaysian Borneo contains 364,000km of roads in forests.[132] New roads make previously remote forest areas accessible to settlers, illegal logging and land claims.

Deforestation front focus

CERRADO

The richest savannah in the world, the Cerrado high plateau of Brazil and Bolivia is not nearly as recognized as the Amazon, but it is under just as much threat. The rate of vegetation conversion in the Cerrado far exceeds that of the Amazon, with native habitats and rich biodiversity being destroyed faster than the neighbouring rainforest.

The Cerrado encompasses the area west of the Brazilian Highlands to Santa Cruz, Bolivia. The Brazilian portion originally covered 200 million ha,[133] but half of it has already been converted to agriculture.[134] The remainder is severely fragmented,[135] with few contiguous areas over 1,000 ha.[136] In the Bolivian portion, deforestation statistics specific to the Cerrado biome are not readily available. However, studies on Eastern Bolivia highlight significant recent deforestation correlated with suitability of land for mechanized agriculture, including proximity to roads and markets.[137]

In Brazil, between 2002 and 2010, almost 10 million ha – 4.9 per cent of the original Cerrado area[138] – were cleared. If the current rate of loss continues, WWF estimates that much of the Cerrado's natural savannah, woodland and forest outside protected areas, totalling 15 million ha, will disappear by 2030.[139,140] The Brazilian government is reported to have policies that 35 per cent of the forest should remain as permanent forest estate[141] but even if the government's aim for retaining natural ecosystems is achieved, an additional 11.2 million ha of the Cerrado will be converted over the next few years.

The Cerrado has fewer protected areas than other Brazilian ecosystems – 8.9 per cent in total with just 2.9 per cent under strict protection. Landowners are, by law, supposed to keep 20-35 per cent of land under native vegetation (including as legal reserves), depending on location.[142] But these laws are not rigorously enforced.[143]

© ZIG KOCH / WWF

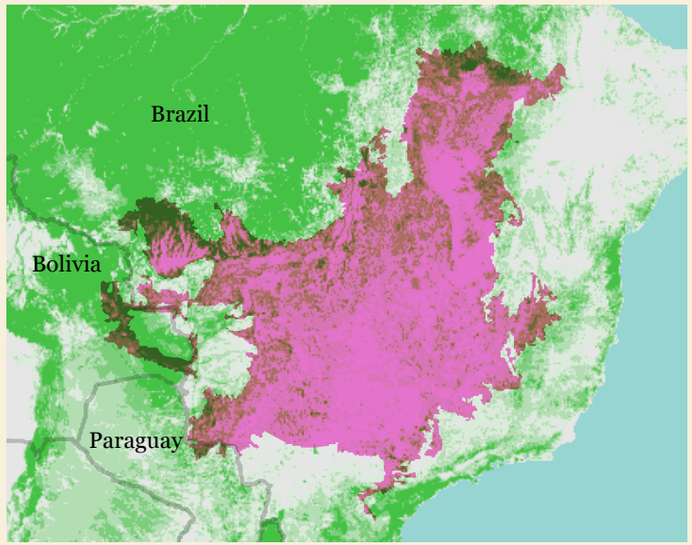
Aerial view of Cerrado savannah, Juruena National Park, Brazil.

Deforestation front focus

CERRADO

Cerrado key data

Countries	Brazil, Bolivia
Ratio of protected areas	8.9% (2.9% under strict protection)
Deforestation (projected), 2010-2030	15 million ha
Top causes	Conversion to soy plantations, cattle ranching



Forest cover Deforestation fronts

Cerrado deforestation pressures

Cattle ranching[144] is one of the main causes of conversion, totaling 60 million ha to date.

Conversion of forest to **soy plantations** for food, animal feed and biofuels[145] – totalling 12-14 million ha[146] – has now overtaken cattle ranching as the primary cause of forest loss.[147] Brazil is the world's second largest producer of soybean, and with half of it coming from the Cerrado, it is now probably the main cause of conversion.[148] **Sugar** and **grain** production are contributing causes.

WWF's research suggests that the root cause of agricultural expansion into the Brazilian Cerrado was a need for foreign exchange, related to a balance-of-payment deficit and the debt crisis. This was exacerbated by a high international price for soybean, political influence of large landowners and the transfer of the national capital to Brasilia, which brought pressure to develop the region.[149] This led to a range of pressures, including **road building** from the 1950s onwards,[150] **development policies** focused on agricultural expansion and the growing market for **soy**.[151]

Dams and **hydropower expansion**, including settlement around dams and associated infrastructure, is linked to forest loss.

Road development and in-migration associated with mining is a cause of deforestation in some areas.

Degradation is caused by cutting trees for fuelwood and charcoal, mostly for **industrial uses**.[152]

Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

Deforestation front focus

CHOCÓ-DARIÉN

The tropical rainforests of the Chocó-Darién run along South America's northwestern Pacific coast from northwestern Ecuador through Colombia, connecting to eastern Panama. These are among the most biologically diverse regions in the world, boasting more than 8,000 plant species, close to 600 bird species and the highest rainfall levels on Earth.

The Chocó-Darién extends over 16.9 million ha, with forest cover maintained in about two-thirds of the region (12.5 million ha remains under forest cover). Scenario-based analyses demonstrate that forest loss over the next 30-40 years could reach more than 3 million ha based on current pressures, with more optimistic scenarios estimating potential loss of just over 1.5 million ha.[153] This corresponds to 18 per cent and 9 per cent of the ecoregion, respectively, potentially leaving less than half of the ecoregion under forest cover. Agriculture, roads and electricity grid infrastructure (power lines), mining and oil exploration are the largest drivers of the projected forest loss.[154]

Deforestation in the Ecuadorian Chocó has been most significant while forest clearance is now gathering pace in Panama and Colombia. Ecuador has lost most original forest[155] and, following intense clearing,[156] has just 2 per cent of its coastal forest remaining.[157] In Colombia, deforestation is occurring in the Pacific lowlands, and is associated with mining, infrastructure development and agricultural expansion.[158,159] At the national level, the colonization frontline in Colombia was advancing at around 0.84km/year[160] and from 2002 to 2007, 91,756 ha was lost in national parks.[161] In Panama, the deforestation from 1992 to 2008 was 881,226 ha. In some cases in the Darien and Panama provinces (the regions with the highest land use dynamics[162]), forests were replaced by teak plantations.[163] Some areas remain relatively pristine and protected areas provide some protection,[164] but the situation is changing due partly to pressures from mining and growing interest in agro-industry development.

Based on current and recent loss, WWF estimates deforestation will be 3 million ha in the Chocó-Darién as a whole by 2030. Projections in Colombia are that by 2030, national deforestation will equal 3.4 million ha[165] including in biodiversity hotspots in Quibdó-Tribugá and Patía-Mira regions.[166]

© PABLO CORRAL / WWF

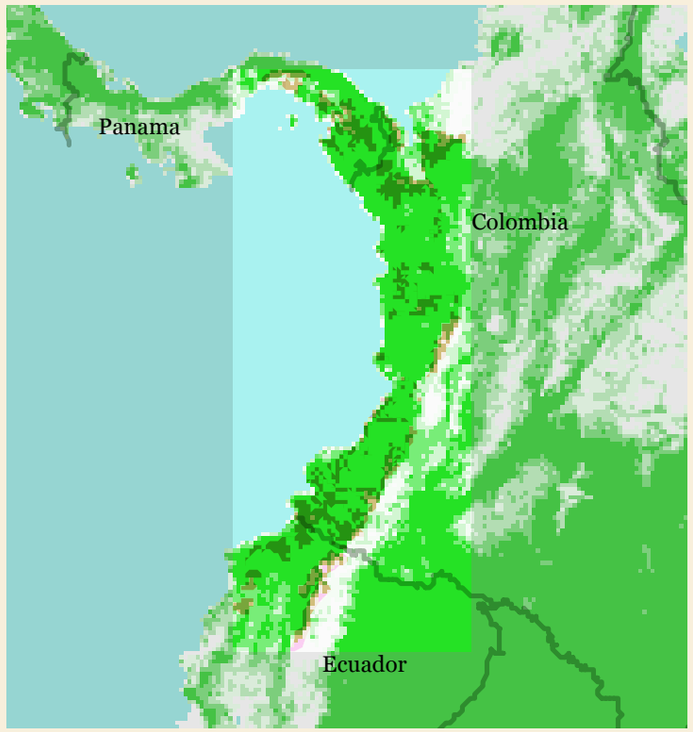
Indigenous communities like this Awa man depend on the forests of Chocó-Darién for their livelihoods, but are threatened by development of infrastructure and extractive industries.

Deforestation front focus

CHOCÓ-DARIÉN

Chocó-Darién key data

Countries	Colombia, Ecuador and Panama
Deforestation (projected), 2010-2030	3 million ha
Top causes	Mining, infrastructure, agriculture



Forest cover Deforestation fronts

Chocó-Darién deforestation pressures

	Agriculture, including **coca production**,[167] and colonization is estimated to cause 90 per cent of deforestation in Ecuador and Colombia and is a major cause of forest loss in Panama.
	Expansion of **cattle ranching** is a significant cause.
	Mining is a contributor to deforestation, particularly in Colombia[168] and Ecuador;[169] there were 564 mining contracts awarded in Colombia from 1990 to 2011; 1,092 in Ecuador (1992-2011), including 140 active affecting over 100,000 ha; and 42 in Panama. Colombia also has 20 oil blocks over 12.2 million ha, including 17 in reserved areas.[170]
	Timber demand often fuels unsustainable logging.[171]
	Analysis in the Ecuadorian Chocó found that population density, costs of travelling and distance to rivers are significantly related to forest loss.[172,173] **Road construction** and proximity to roads was found to be the largest single factor in deforestation.[174] Colombia has 18 road projects in the region, Ecuador has 9 and Panama is planning a major connecting road.[175]
OTHER	**Population growth**, **land scarcity** and **poverty** are all critical underlying causes,[176] coupled with armed conflict and narcotic production.[177]

Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

Deforestation front focus

CONGO BASIN

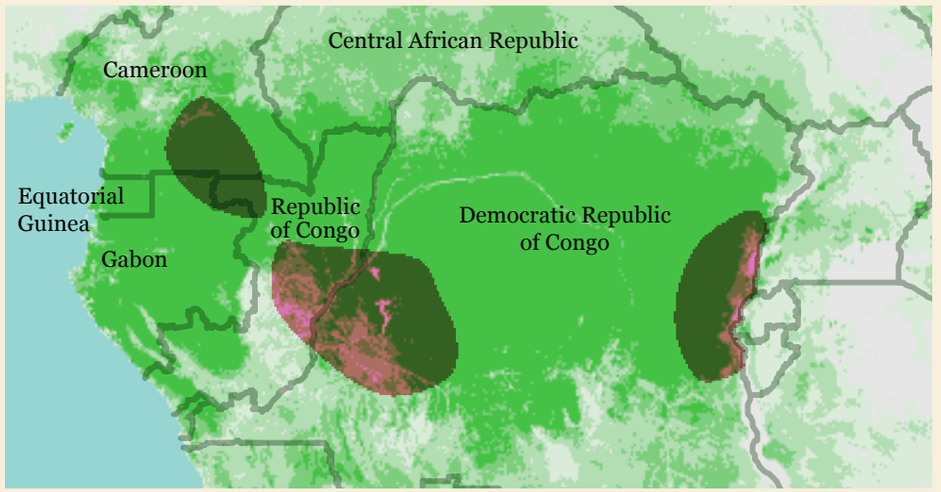
The Congo Basin* contains 20 per cent of the world's tropical forests[178] – some 301 million ha[179] – and makes up one of the most important wilderness areas left on Earth. A mosaic of rivers, forests, savannahs, swamps and flooded forests, the Congo Basin forests span six countries – Cameroon, Central African Republic, Democratic Republic of Congo (DRC), Republic of the Congo, Equatorial Guinea and Gabon – and are home to species such as mountain and lowland gorillas, bonobos, okapis, chimpanzees and elephants.

Change is coming to the Congo Basin, but sporadically, influenced by politics and economics in individual countries. In this region, deforestation is less a *front* than many individual *incursions*, and has proceeded more slowly than in other fronts. Losses were estimated as 0.19 per cent from 1990 to 2000, and 0.14 per cent from 2000 to 2010, with forest decreasing everywhere.[180] Deforestation rates are thus historically low, but some estimates show degradation is an increasing problem and is generally under-reported.[181,182] DRC has the highest deforestation, 6-7 million ha since 2000,[183] followed by Cameroon[184] and Equatorial Guinea.[185]

Drawing on published analysis,[186] WWF estimates that a minimum of 12 million ha are likely to be lost by 2030, with forests retreating to a core and contiguous forest fragmenting into three areas: one between Gabon, Cameroon and the Republic of Congo, and one each in eastern and western DRC. However, volatile politics and nervous investors make future projections difficult. A series of national and regional conflicts have resulted in many refugees,[187] which can increase or decrease overall rates of forest loss. Moreover, population in Congo Basin countries is expected to double between 2000 and 2030, leading to 170 million people concentrated mainly in urban areas (70 per cent of the population in Gabon and Congo are urban-dwellers), making forests close to large cities particularly at threat.[188]

* "Congo Basin" is used not as a hydrological definition but to describe the lowland dense humid forests of Central Africa.

African forest elephant; Dzanga-Sangha Special Reserve, Central African Republic



Deforestation front focus

CONGO BASIN

Congo Basin key data

Countries	Cameroon, Central African Republic, DRC, Republic of Congo, Gabon
Countries with most deforestation	DRC, Cameroon, Equatorial Guinea
Deforestation (projected), 2010-2030	12 million ha
Top causes	Small-scale agriculture, fuelwood

© MICHEL GUNTHER / WWF

View of Minkébé Forest, Gabon

Congo Basin deforestation pressures

This is the leading cause of deforestation in the region, caused mainly by **shifting cultivation**; some of the forest returns during fallow periods make overall deforestation estimates hard to calculate.[189]

Fuelwood comprises an estimated 90 per cent of timber harvest[190] in the Congo Basin.

Large **agricultural plantation development** is likely to become more important, including for **palm oil;** 1.6 million ha of projects have been announced since 2009,[191] with four companies currently trying to secure 180,000 ha for palm oil in southern Cameroon[192] and large projects planned in DRC, including a Chinese company (ZTE) seeking 1 million ha for oil palm development.[193] **Rubber** and **soy** are also gaining importance.

Much of the **timber industry** is inefficient[194] and some probably unsustainable.[195] Illegal logging is suspected to be widespread,[196] accounting for up to half the timber extraction, mainly going to China[197] but some to the EU despite the existence of controls.[198] If the region experiences significant economic growth, the domestic market could also put pressure onto forest resources.

Large-scale mining, mainly by Chinese and Australian companies,[199] and **artisanal mining**[200] are both important. The latter is often in protected areas.[201] Mining permits sometimes overlap with conservation areas. [202] For example, over 120 exploration permits have been issued in Cameroon in the last two years[203] with overlapping conservation and mining permits,[204] and the nature of operations in DRC has also caused concern.[205]

Population increase and **infrastructure development** are important secondary causes of deforestation. Rising population is leading to expansion of urban areas, and threatening forests close to large cities and in other development areas. Realization of currently planned and funded transport infrastructure in the region is projected to increase deforestation by up to three times.[206]

Cattle may become more significant if the climate becomes drier as projected, although ranching is currently constrained by tsetse fly.

Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

Deforestation front focus

EAST AFRICA

Eastern Africa has a diversity of forest types – vast open miombo woodlands, remnant coastal forests and unique mountain forest in the Eastern Arc. The deforestation threat extends to all forest types.

Remote sensing analysis found forest losses from 2000 to 2012 were concentrated in Mozambique (2,155,200 ha), Tanzania (1,990,300 ha) and Zambia (1,316,300 ha),[207] although precise figures are hard to calculate in this region.[208] Underlying drivers were population growth,[209] poverty,[210] perverse economic incentives,[211] weak institutions, environmental degradation[212] and climate change.[213]

The inland miombo woodlands are located mainly in the Zambesian Regional Centre of endemism with 8,500 floral species – 54 per cent of which are endemic – and no less than 20 biodiversity hotspots. It currently covers 380 million ha and is the dominant forest type of the region.[214,215] The miombo is home to more than 40 national parks, with protected areas covering 22 per cent of the region. When effective, these are vital in reducing the rate of deforestation. However, a combination of deforestation, release of soil carbon[216] and climate change could create a "tipping point" of degradation for miombo.[217]

The coastal forests of Tanzania and Kenya have been reduced to 10 per cent of their original area;[218] the whole biome is now thought to cover 625,000 ha – 58,700 ha in Kenya, 62,900 ha in Tanzania and 477,800 ha in Mozambique.[219] Protected areas exist but demonstrate varying levels of effectiveness.[220] The Eastern Arc forests have also undergone major conversion, with Tanzania losing close to 80 per cent;[221] current total estimates are that little more than 500,000 ha remain.[222]

In addition to outright land conversion, the region's forests are under pressure from over-harvesting for timber and fuelwood. Much of the logging is illegal – whether for precious timber destined for Asian markets[223] or to make charcoal for local use.[224] Overharvesting by licensed operators is also a problem due to poor enforcement of regulations.

Across Africa, oil, gas and mining projects are driving investment in new and improved infrastructure. "Development corridors" are intended to leverage this to spur local development through small to medium enterprises in industries such as agribusiness and tourism.[225] Forests within these development corridors are vulnerable to loss or severe degradation through conversion to agriculture or colonization by settlers seeking employment and other economic opportunities. The East African deforestation front thus extends inland from the coast into miombo woodlands along the following development corridors:

JOHN KABUBU / WWF-COASTAL EAST AFRICA

A forest cleared for farming and charcoal production in Rufiji, Tanzania

- Mtwara (Malawi, Mozambique, Tanzania, Zambia)
- Nacala (Malawi, Mozambique, Zambia)
- Beira (Mozambique, Zimbabwe)
- Limpopo (Mozambique, Zimbabwe).

Zambia and northwest Zimbabwe are in the centre of the miombo, but have road and rail connectivity to the west and east coasts. Zambia plans to leverage its central location to become the region's logistical hub for freight (e.g. through the Chipata-Mchinji railway link to the Nacala corridor). Zimbabwe is also experiencing rapid growth in transport links (e.g. Victoria Falls and Kariba airports), settlement and other infrastructure (e.g. hydropower in the Batoka gorge). Transportation infrastructure is likely to compound the levels of deforestation in the miombo woodlands of both countries through increased accessibility, new settlements, conversion to agricultural land and related edge effects in forested areas.

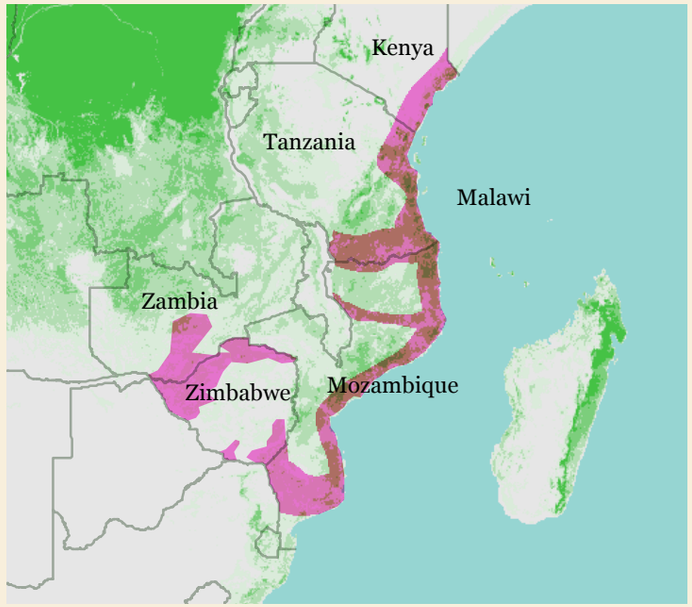
WWF projects potential forest loss in the East Africa region of up to 12 million ha between 2010 and 2030, which is echoed by other researchers,[226] but impacts will vary by country and forest type. Projections are based on continuation of recent trends in coastal areas, particularly in Mozambique, and accelerated rates of loss further inland, associated with infrastructure and development corridors extending into miombo woodlands.

Deforestation front focus

EAST AFRICA

East Africa key data

Countries	Kenya, Malawi, Mozambique, Tanzania, Zambia, Zimbabwe
Dominant forest type	Miombo (380 million ha)
Deforestation, 2000-2012	Around 6 million ha
Deforestation (projected), 2010-2030	12 million ha
Countries with most deforestation	Mozambique, Tanzania, Zambia
Top causes	Crop and livestock expansion



Forest cover Deforestation fronts

East Africa deforestation pressures

In development corridors and areas of high population density, **small-scale agriculture** and **in-migration** are a major cause of deforestation.[227,228,229] Out-grower schemes for cotton, tobacco[230] and other cash crops are creating and expanding farming blocks in Zambia and Zimbabwe.

Livestock expansion is a leading cause of deforestation.[231]

Uncontrolled fires have been identified by stakeholders as a major issue in the miombo,[232] with larger, more intense fires associated with human activity.

Charcoal use is increasing,[233] most commonly near roads[234] and cities.[235] Much of it involves illegal logging.[236]

Unsustainable commercial logging, often illegal, is causing severe degradation to forests in the region.[237]

Infrastructure development is significant, including new roads, rail links and dams, some of which are funded by China.[238]

Large-scale mining and related infrastructure development as well as in-migration are increasing and contributing significantly to deforestation,[239] for example the mining projects at Lumwana and Kalumbila by Barrick Gold and First Quantum in northwest Zambia.

A growth in **plantation** and **biofuel** crops, as well as **pulp**[240] and **bioenergy**[241] **plantations**, is also occurring.

Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

Deforestation front focus

EASTERN AUSTRALIA

Australia is the only place on Earth where all three major divisions of mammals are present: the egg-laying monotremes (platypus and echidna); the marsupials; and the placental mammals. At least 130,000 species of native animals and plants, nearly 8 per cent of all life on Earth, are found in Australia.[242]

Of the 1,250 plant and 390 animal species listed as threatened by the Australian government (excluding extinct and marine species), 964 plant species (77 per cent) and 286 animal species (73 per cent) have deforestation and resulting fragmentation or degradation of their habitats listed as threats.[243]

The forests and woodlands of eastern Australia comprise the six WWF terrestrial ecoregions within the Australian states of New South Wales (NSW) and Queensland: *Queensland tropical rain forests, Eastern Australia temperate forests*, *Brigalow tropical savannah, Eastern Australia mulga shrublands, Southeast Australia temperate forests* and *Southeast Australia temperate savannahs* (see map).

At least 10 per cent of native Australian terrestrial species are endemic to this region, and 24 per cent have the majority of known records in this region.[244]

One of the symbols of Australia, the koala, although not confined to this front, was recently listed vulnerable to extinction due to deforestation in Queensland and NSW and consequent fragmentation.[245]

Two of the ecoregions, *Queensland tropical rainforests* and *Eastern Australian temperate forests*, comprise the *Forests of Eastern Australia* global biodiversity hotspot.[246] About 70 per cent of this hotspot is cleared or disturbed and only 18 per cent protected.

Deforestation in the northern ecoregions[247] is a substantial contributor of sediment pollution affecting the Great Barrier Reef. Soil surface rainfall runoff is shown to increase between 40 and 100 per cent due to deforestation in this area.[248] Beyond the short-term effect of deforestation on soil erosion, using the cleared land for livestock and crops means a continual flow of sediment, nutrient and agri-chemical pollution to the Reef.[249]

Until the enactment of new laws in NSW and Queensland in 2005, land clearing was rampant. At its peak in Queensland in 1999, nearly half a million hectares were cleared per year. In 1990, emissions from deforestation were 25 per cent of Australia's total greenhouse gas emissions. By 2012 this had sunk to 6 per cent, although total emissions remained much the same.[250]

Despite a major reduction in deforestation rates in Australia due to such laws, recent and projected weakening of key legislation in the frontline states of Queensland and NSW threatens a resurgence in deforestation.

Queensland saw a pronounced fall in clearing rates following a ban in 2006 on large-scale deforestation for agriculture, but a change in laws has led to a resurgence of clearing, both legal and newly legalized. There's no reliable information yet as to whether there was a shift back toward clearing of primary forest. However, WWF expects such a shift to occur because the 2006 ban on large-scale clearing of primary forests was partly removed in 2013.

In NSW, rates of deforestation are much lower than in Queensland, around 50-100,000 ha per annum, including both primary and secondary forest. Large-scale deforestation for agriculture was heavily restricted in 2005. Although new approvals have contracted dramatically, actual deforestation has been slow to respond due to exemptions and ongoing clearing under earlier approvals.[251] Of immediate concern in NSW is that what gains have been made are under threat of being lost due to a current proposal to repeal the deforestation laws and replace them with weaker substitutes.[252]

Deforestation across the entire front ranges from over 3 million ha of all forests lost from 2010 to 2030 to 3 million ha of primary forests in addition to over 3 million ha of secondary forests cleared by 2030. These projections depend on whether Queensland and NSW decide to change their land clearing laws. WWF conservatively has not included, in clearing of secondary forests, any reclearing of forests cleared within the same time period. Permanent offsets for reforestation were also excluded where known (NSW only).

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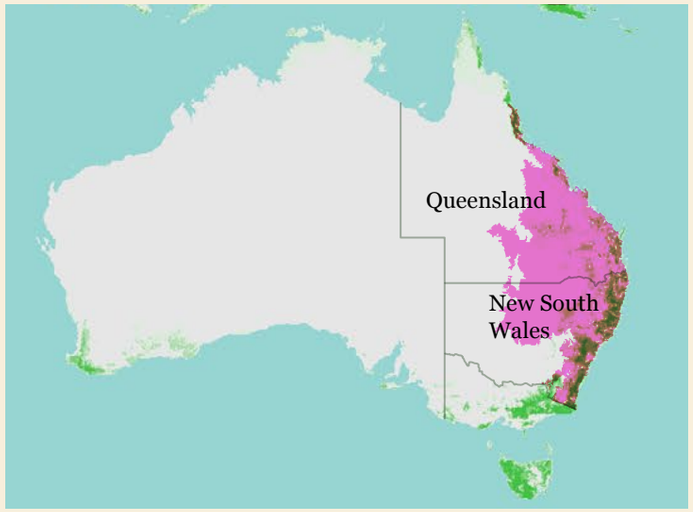
The Cathedral Fig Tree, a massive green fig tree (*Ficus virens*) in the Daintree Rainforest on the Atherton Tablelands, Queensland, Australia.

Deforestation front focus

EASTERN AUSTRALIA

THEO ALLOFS / GETTY IMAGES

Koalas were recently listed vulnerable to extinction due to deforestation.



Forest cover Deforestation fronts

Eastern Australia deforestation pressures

	Pasture creation for livestock is the dominant driver, accounting for 88 per cent of clearing of both primary and secondary forests and woodlands. In Queensland, mature mulga forest is bulldozed to feed stock directly on the foliage, while opening up land for pasture. This exemption continued despite the 2006 ban on broadscale clearing in that state.
	Forestry and **conversion to plantations** is a significant driver in New South Wales Eastern Temperate Forests, but relatively minor in Queensland.
	Cropping is a relatively minor component but dominates in some key areas, and is greater in NSW than in Queensland.
	Mining is a minor component overall, but open cut **coal mines** are significant in some portions of the central Brigalow Savannah and in the Eastern Temperate Forests.

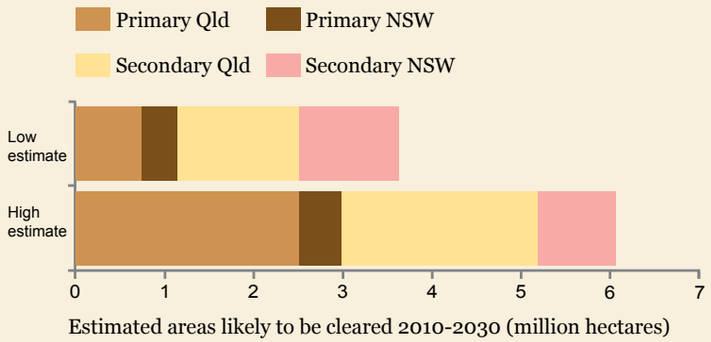
Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

Eastern Australia key data

States	New South Wales (NSW), Queensland
Type of forests most at risk	Sub-humid eucalypt and acacia forests and woodlands
Key species affected	Tree-dependent birds, koalas, possums and gliders
Deforestation (projected), 2010-2030	3-6 million ha
Main driver	Pasture for livestock



Estimated areas likely to be cleared 2010-2030 (million hectares)

Deforestation front focus

GREATER MEKONG

Tigers, elephants, saolas, Mekong Irrawaddy dolphins, and thousands of other lesser-known but equally threatened species form a complex web of life in the Greater Mekong. The region encompasses the countries of Cambodia, Lao PDR, Myanmar, Thailand and Vietnam. The economies in the region are booming, but with this comes the complex task of balancing legitimate needs for development while safeguarding forest ecosystems and ecosystem services.

© WWF-CAMBODIA

Rubber plantation after deforestation, Eastern Plain Landscape, Cambodia

Before the 1970s, most of the Greater Mekong was highly forested. However, today most of the region's natural forests have been reduced, severely fragmented or degraded,[253,254] including from the impacts of wars.[255] Only about half of the Greater Mekong land area is currently forested, with only 13 per cent of primary forests remaining.[256] This, alongside poaching and wildlife trade, is creating a biodiversity crisis.[257] Primary forest has virtually disappeared in Vietnam, is extremely low in Cambodia, and scarce in Lao PDR, Myanmar and Thailand.[258] Natural regeneration[259] and plantation establishment in China[260] and Vietnam[261] has recovered some area under trees, but not natural forest.

Between 1973 and 2009 forests in the Greater Mekong declined by almost a third: 43 per cent in Vietnam and Thailand; 24 per cent in Lao PDR and Myanmar; and 22 per cent in Cambodia. Intact forest area was reduced from 70 to 20 per cent of the region,[262] leaving around 98 million ha of forest.[263] Mangroves have been severely affected,[264] partly by wartime defoliants,[265] with the Lower Mekong countries losing an estimated 222,650 ha between 1980 and 2005. Illegal logging, including in protected areas, is a major problem in Cambodia,[266] Myanmar[267] and Lao PDR,[268] but prevalent throughout the region.[269]

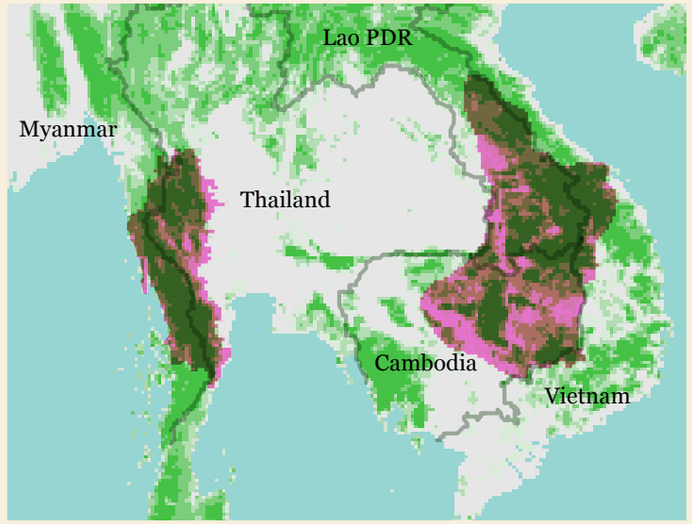
WWF projects further losses of 15-30 million ha by 2030, with only 14 per cent of remaining forest consisting of core, intact areas.[270] Losses are likely to remain highest in Cambodia, Lao PDR and Myanmar, where 2010-2020 deforestation is projected at 4.8 million ha.[271] A critical cause amplifying deforestation pressures is weak governance, anarchic development and economic dependence on natural resources.[272]

Deforestation front focus

GREATER MEKONG

Greater Mekong key data

Countries	Cambodia, Lao PDR, Myanmar, Thailand, Vietnam
Countries with highest deforestation currently	Cambodia, Lao PDR, Myanmar
Deforestation, 1973-2009 (excluding China)	49 million ha
Deforestation (projected), 2010-2030	15-30 million ha
Top causes	Crop plantations, agriculture, unsustainable and illegal logging



Forest cover Deforestation fronts

Greater Mekong deforestation pressures

Conversion of forest for **crop plantations** and **agriculture**, namely **sugar**, **rice**, **rubber**[273] and **biofuels**[274], is a key cause of deforestation in the region. In Myanmar alone, over 2 million ha of forest have been allocated to agriculture;[275] between 2011 and 2013, 1.15 million ha of primary forest was cleared each year for timber production and conversion to agriculture.[276]

Rapid development of roads and infrastructure leads to **new settlements** that encroach on forest for small-scale agriculture development.

Legal and policy restrictions on logging in Vietnam, China and Thailand, coupled with **growing demand**,[277] are driving unsustainable[278] and **illegal**[279] **logging** for export and indirect land-use change in Cambodia, Lao PDR and Myanmar.[280] Illegal logging, including within protected areas, is prevalent throughout the reg[i]on.[281]

Establishment of **tree plantations** (acacia, eucalyptus), many of which are still small scale,[282] is a growing threat, particularly in Vietnam and Lao PDR, where it is supported by government incentives.

Fast economic growth in the Mekong region is translated on the ground into rapid and often anarchic development of **roads and infrastructure**.

Dam development has a relatively small impact on total forest cover, but can be an important factor in fragmentation and loss of connectivity,[283] and is a factor in forest loss in Thailand.[284]

Wood energy and charcoal consumption is stable and even growing in some countries, accelerating forest degradation.

OTHER

Mangroves are replaced with **shrimp farms** and **rice production**.

Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

Deforestation front focus

NEW GUINEA

New Guinea and the islands around it span two countries. The eastern portion comprises the country of Papua New Guinea (PNG), while the western part forms the Indonesian provinces of Papua and West Papua. A treasure trove of biological and cultural diversity, New Guinea and its neighbouring islands are home to the largest remaining tracts of tropical forest in the Asia-Pacific region and more than one in six of the world's language groups.

© BRENT STIRTON / GETTY IMAGES

Pukapuki man in a traditional dug-out canoe. Papua New Guinea

Land use is shaped by two very different economic systems – the first involves most of the rural population and centres on traditional subsistence gardening, hunting and gathering; while the second is focused on industrial, export-oriented resource extraction and plantations.

The New Guinea region retains significant forest cover (some 82 million ha), but faces a growing deforestation threat. According to data from Global Forest Watch, the region lost around 1 million ha of forest from 2001 to 2012 (the Indonesia provinces of Papua and West Papua lost 373,000 ha, while PNG lost 630,000 ha).[285] The rate of forest loss could surge, however, if current proposals for agricultural development are realized. According to a 2010 plan, the government of PNG expects to see substantial growth in its four major export crops (palm oil, coffee, cocoa and copra) by the year 2030, with an expansion in plantations of 5–6 per cent annually.[286] Special Agricultural Business Licences (SABLs) have been granted for over 5 million ha of customary land.[287]

Large-scale agricultural developments are also proposed in the Indonesian provinces of Papua and West Papua. For example, the Merauke Integrated Food and Energy Estate concept, launched in 2010 by the Indonesian government, aims to transform 1.2 million ha of forest land in West Papua province into large-scale agribusiness estates.[288] The future of this proposal is uncertain. As of March 2015, the Merauke district government had zoned only 258,000 ha for agricultural development, and while over 850,000 ha of palm oil and sugarcane permits had been granted, most were inactive.[289] A study of various government planning and investment maps for Papua province in 2009 found up to 2.8 million ha were proposed for plantation development.[290]

In both PNG and Indonesia, much uncertainty remains over the extent to which the proposals will become reality. They are the subject of various official inquiries and legal challenges, and their commercial viability is questionable. With many of PNG's SABLs, for example, there is mounting evidence that they are merely ploys to gain permits to clear-fell timber, with the leaseholders having little capacity or interest in developing the cleared land for agriculture.[291,292] In Indonesia, allocation of new concessions for logging or conversion of native forests is under a moratorium, which will expire in 2015. The moratorium maps indicate that over 600,000 ha of forest in the province of Papua alone would be vulnerable to potential clearance for tree plantation if the moratorium is allowed to expire.[293]

Studies have also identified commercial logging and expanding subsistence agriculture as major causes of deforestation and forest degradation.[294] However, there is debate about the extent to which these activities cause outright forest loss, due to the many variables affecting regeneration dynamics after forests are degraded by logging or cleared for shifting cultivation.[295,296]

WWF projects that the New Guinea region could lose up to 7 million ha of forest between 2010 and 2030. This is based on the following assumptions: (a) some, but by no means all, current land clearing proposals are realized; (b) the total land area cultivated for subsistence agriculture continues to expand gradually due to population pressures and other causes; and (c) loss of a portion of the forests in timber concessions continues due to encroachment, fire and illegal logging, mainly after the cessation of commercial logging operations.

Deforestation front focus

NEW GUINEA

New Guinea key data

Countries	Papua New Guinea, Indonesia
Deforestation, 2001-2012	1 million ha
Deforestation (projected), 2010-2030	7 million ha
Top causes	Agriculture, clear-fell timber harvesting

Forest cover Deforestation fronts

New Guinea deforestation pressures

Under various project proposals and plans, up to 10 million ha of currently forested land is slated for **agricultural development**, but many of these are unlikely to proceed due to legal challenges, operational risks and lack of commercial viability.

Due to rising populations, a gradual expansion of the total area under **subsistence agriculture**, including **slash and burn**, is likely to result in future forest loss.

Most **timber harvesting** permits authorize selective logging only so do not result in large areas of outright forest loss. However, based on historical trends, a significant portion of the forests in timber concessions is likely to be later converted to subsistence agriculture or degraded beyond the point of recovery by **illegal logging or fire**.

While there are no pulp mills, **acacia plantations** in the Indonesian portion supply woodchips for export mainly to China, to meet growing demand from expanding pulp and paper mills.[297] Potential future expansion of **pulp plantations** could lead to forest conversion.

Heavily degraded forests are often drier and more vulnerable to **permanent fire damage** than healthy closed-canopy forests.

Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

Deforestation front focus

SUMATRA

The Indonesian island of Sumatra is the sixth largest island in the world and holds some of the richest and most diverse tropical forests on the planet. They provide livelihoods to millions of people and give shelter to critically endangered species such as the Sumatran rhino, elephant, orang-utan and tiger.

Sumatra, especially Riau province,[298] has become the centre of Indonesia's paper and palm oil production.[299] Vast stretches of acacia and oil palm monocultures have replaced natural forests and some of the world's largest pulp mills and palm oil refineries line the rivers and coasts. Riau province alone hosts over 200 crude palm oil extraction mills.[300]

Sumatra's ecosystems are not well represented in its protected area system.[301] Most parks and reserves straddle the island's mountain ridge, few cover its vast low-lying areas and peat swamps. From 1985, as the palm and paper sectors took hold, Sumatra suffered large-scale deforestation and many of its ecosystems became critically endangered.[302, 303] By 2014, Sumatra had lost 13.9 million ha (55 per cent) of its natural forests. Only 11.5 million ha of natural forest remained in severely fragmented blocks, covering 26 per cent of the island.[304] Protected areas, especially those recognized at the national level, have proven more resistant to deforestation than other areas though even they are being cleared for agricultural plantations.[305,306,307]

In Sumatra, outright deforestation was often preceded by industrial selective logging followed by illegal logging. From there deforestation has usually progressed along two paths: (1) a government declaration that the area is degraded, the rezoning of the area for conversion into pulpwood or palm oil plantations, and clearing of remaining forest for plantation development; or (2) settlement of an area by migrants, and deforestation for small-scale agriculture, oil palm and rubber plantations.

While some arms of the government have developed plans to stabilize and even reverse forest loss,[308,309] the status of these plans remains unclear and the desired impact has not materialized. All of Sumatra's remaining forests are in great danger of deforestation if business as usual continues and lack of governance prevails. Elevation and soil type are no deterrents. The last forests to go will be the protected areas with the steepest slopes.

© WWF-GERMANY/M. RADDAY

Palm oil plantation. Tesso Nilo, Riau province, Sumatra.

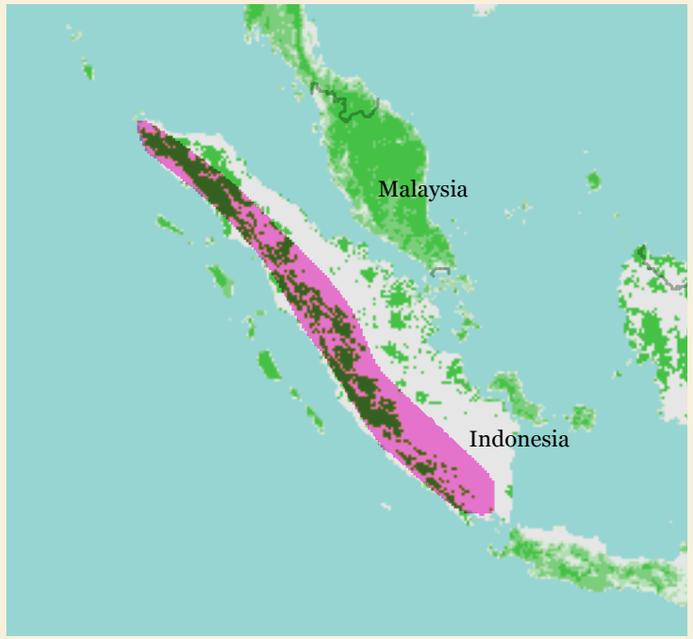
Based on WWF data,[310] Sumatra lost 1.7 million ha of natural forest between 2008 and 2014. The deforestation rate outside protected areas was 2.9 per cent per year, mainly for pulp and palm oil production in Riau and Jambi provinces. Inside protected areas, it was 0.4 per cent. Assuming similar future rates of deforestation, WWF projects up to 5 million ha of deforestation between 2020 and 2030.

Deforestation front focus

SUMATRA

Sumatra key data

Countries	Indonesia
Deforestation, 1985-2014	13.9 million ha natural forest loss (55% loss)
Deforestation (projected), 2010-2030	5 million ha
Top causes	Small-scale agriculture, infrastructure development



Forest cover Deforestation fronts

Sumatra deforestation pressures

Palm oil from small producers is driving deforestation even into protected forests and national parks.[311,312]

Road construction has been linked to deforestation[313,314] and its impact will accelerate as the Trans-Sumatra toll road is realized[315] and if a new bridge connects the island to mainland Malaysia.[316]

Licensed **selective logging** has all but ceased; less than 10 per cent of the permits remain active. Encroachment and illegal logging in retired logging concessions are rampant. Most have been rezoned for legal deforestation for pulpwood or palm oil plantation development.[317]

Indonesia's two biggest **paper** players have pledged near zero deforestation,[318,319] though third parties continue to clear forests set aside for conservation in the concessions of these companies, and their suppliers continue to clear forests not designated for protection due to flawed conservation and social value assessments.[320,321] The future impacts of the sector on Sumatra's forests remain uncertain due to the gap between plantation wood supply and existing and planned milling capacity, and government plans to allocate more forested land for wood supply and plantation development.

Fires are often set to clear land for small-scale agriculture operations and to clear logging debris, but are also often found in large commercial concessions.[322] When these fires "escape" they can severely degrade nearby natural forests and drained peatlands.

Large palm oil producers such as Asian Agri, Golden Agri Resources, Musim Mas and Wilmar have recently pledged to halt forest conversion and pursue Roundtable on Sustainable Palm Oil certification. However, these voluntary commitments are at odds with policies of some government agencies that support further expansion of agriculture into forest areas. Furthermore, many palm oil mills continue to accept palm oil bunches from smallholders who have acquired land through illegal forest conversion.

Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

GLOSSARY, NOTES AND ACRONYMS

Biodiversity: a shortened form of biological diversity, describing variation within and between species and at ecosystem level.

Deforestation: Conversion of forest to another land use or long-term reduction of tree canopy cover. This *includes* conversion of natural forest to tree plantations, agriculture, pasture, water reservoirs and urban areas; but *excludes* logging areas, where the forest is expected to regenerate naturally or with the aid of silvicultural measures.

Degradation: Changes within the forests that negatively affect the structure or function of the stand or site, and thereby lower the capacity to supply products and/or ecosystem services.

Living Forests Model: developed for WWF by the International Institute for Applied Systems Analysis (IIASA[323]) the model draws on G4M and GLOBIOM models[324] to show geographically explicit land-use change under different scenarios. The G4M model projects future deforestation and land-use change by extrapolating from historical trends and taking into account future projections for population, GDP and infrastructure. GLOBIOM is an economic model that allocates land and resources optimally based on projected commodity and ecosystem service demands under future GDP, population and policy scenarios.

Protected area: a clearly defined geographical space that is recognized, dedicated and managed through legal or other effective means in order to achieve the long-term conservation of nature with associated ecosystem services and cultural values.[325]

Zero Net Deforestation and Forest Degradation (ZNDD): WWF defines ZNDD as ***no net forest loss through deforestation and no net decline in forest quality through degradation***. ZNDD provides some flexibility: it is not quite the same as no forest clearing anywhere, under any circumstances. For instance, it recognizes people's right to clear some forests for agriculture, or the value in occasionally "trading off" degraded forests to free up other land to restore important biological corridors, provided that biodiversity values and net quantity and quality of forests are maintained. In advocating ZNDD by 2020, WWF stresses that: (a) most natural forest should be retained — the annual rate of loss of natural or semi-natural forests should be reduced to near zero; and (b) any gross loss or degradation of pristine natural forests would need to be offset by an equivalent area of socially and environmentally sound forest restoration. In this accounting, plantations are not equated with natural forests as many values are diminished when a plantation replaces a natural forest.

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