BACKGROUND PAPER

Asia-Pacific Climate Report 2025

Forests in Asia and the Pacific: Climate and Biodiversity

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Asian Development Bank

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Abbreviations

ADB	–	Asian Development Bank
CBD	–	Convention on Biological Diversity
CDM	–	Clean Development Mechanism
CO_2	–	carbon dioxide
CORSIA	–	Carbon Offsetting and Reduction Scheme for International Aviation
EFT	–	ecological fiscal transfer
EU	–	European Union
FAO	–	Food and Agriculture Organization of the United Nations
GBF	–	Kunming-Montreal Global Biodiversity Framework
GCF	–	Green Climate Fund
GDP	–	gross domestic product
ICAO	–	International Civil Aviation Organization
IMO	–	International Maritime Organization
IUCN	–	International Union for the Conservation of Nature
Lao PDR	–	Lao People's Democratic Republic
MDB	–	multilateral development bank
NTFP	–	non-timber forest product
ODA	–	overseas development assistance
PES	–	payment for ecosystem services
PRC	–	People's Republic of China
REDD+	–	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
sq km	–	square kilometer
UK	–	United Kingdom
UN	–	United Nations
UNCCD	–	United Nations Convention on Combating Desertification
UNDP	–	United Nations Development Programme
UNFCCC	–	United Nations Framework Convention on Climate Change
US	–	United States
WWF	–	World Wide Fund for Nature

Notes: In this report, "$" refers to United States dollars.
ADB recognizes "China" as the People's Republic of China and "Korea" as the Republic of Korea.

Highlights:

- ***Forests across the 46 economies of the Asia and Pacific region are vast and diverse***
    - Asia and Pacific forests span 6 million square kilometers (sq km) (4.6% of the global landmass), including 2.1 million sq km of primary forest as of 2000
    - These forests are home to 38% of the world's endemic birds, 26% of endemic mammals, 25% of endemic amphibians, and 23% of endemic reptiles
- ***Asia and Pacific forests are experiencing rapid change***
    - From 2000 to 2020, the region lost 682,000 sq km (11.4%) of forest area, including 176,000 sq km of primary forest), while 199,000 sq km (3.3%) of forest regrew
    - More than half (51%) of forest loss was caused by commodity-driven deforestation, such as land clearing for palm oil, short-rotation wood fiber, rubber, mining, and energy infrastructure, while timber harvest accounted for more than one-third (35%) of loss
    - Forest loss has consequences for climate mitigation, biodiversity conservation, clean water provision, human health, and climate adaptation and resilience
- ***Effective interventions for forest conservation have a proven track record***
    - These interventions fall into five categories: passive protection; protecting sufficient forest value; raising forest value; restricting exploitation and conversion; and shifting commodity sources
    - Brazil offers a globally significant success case, having reduced Amazon deforestation by 80% from 2004 to 2012 through a swath of policy measures
    - Other success cases include Indonesia (post-2016) and Indigenous Peoples worldwide
- ***A robust constellation of finance mechanisms and policy frameworks already exists***
    - Four main visions of Reduce Emissions from Deforestation and Forest Degradation in Developing Countries (REDD+) are (1) intergovernmental carbon markets, (2) payments for performance, (3) private voluntary carbon markets, and (4) emerging initiatives
    - Other public finance mechanisms include protected area finance, debt-for-nature swaps, bilateral aid, payments for ecosystem services (PES), and ecological fiscal transfers (EFT); private finance mechanisms include sustainable forestry, forest-compatible bioeconomy, sustainability certification, and reform of subsidies and credit
    - Global policy frameworks include the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD)'s Global Biodiversity Framework, as well as the United Nations Convention to Combat Desertification (UNCCD), International Civil Aviation Organization (ICAO), and multilateral development banks
- ***Key economic, legal, and political challenges to forest conservation remain***
- ***Recommendations for the Asian Development Bank:***
    - Deploy loans and technical expertise in support of forest conservation.
    - Help aggregate willingness-to-pay for forest services from disparate beneficiaries and channel these funds to increase revenue for forest land-use decision-makers
    - Support the emergence of a "bioeconomy" sector of industries that spur economic development and are compatible with conserved or regrowing forest

I. Introduction

The forests of the Asia and Pacific region[1] cover 6.0 million square kilometers—24% of the region's land area and 4.6% of the global landmass (GFW 2025). The fate of these forests has massive implications not only for the economies and societies of the region but also for the global climate and biodiversity.

Forests in Asia and the Pacific exhibit tremendous geographic variation. They extend in latitude from the steaming equatorial rainforests of Borneo and Sumatra to the boreal coniferous forests of Mongolia, sweeping across 10 time zones—from the deciduous forests of the Caucasus to the moist forested lagoons and atolls of Kiribati. Forests rise from the dense coastal mangroves of Thailand and Viet Nam to open montane forests of the Himalayan ranges in Nepal and Pakistan, nearing 5,000 meters in altitude.

Forests stretch from the remote wildernesses of Mongolia and Papua New Guinea to the heart of dynamic global cities like Singapore and Hong Kong, China. Some of Asia's oldest forests—such as those in Taman Negara, Peninsular Malaysia—are believed to have remained intact for more than 130 million years, while across the region new forests are being planted every day.

The Asia and Pacific region is replete with unique and exceptional forests. Around Cambodia's Tonlé Sap Lake, forests are seasonally flooded, largely under water during the wet season and reemerging in the dry season. The largest contiguous mangrove forests in the world are found in Bangladesh's Sundarbans. In the bamboo forests of East Asia, sturdy grasses grow as tall as trees.

Forests in the region are put to a vast variety of uses, including timber plantations, wildlife refuges, recreation and tourism, and sacred groves. Asia-wide,[2] forests are managed for commodity production (32%), soil and water protection (22%), biodiversity conservation (15%), social services (1%), and multiple uses (22%), among other uses (FAO 2020).

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[1] In this background paper, "Asia and the Pacific" refers to the Asian Development Bank's "Developing Asia" or "the Asia and Pacific" region, which includes 46 economies: Afghanistan; Armenia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; the People's Republic of China; the Cook Islands; Fiji; Georgia; Hong Kong, China; India; Indonesia: Kazakhstan; Kiribati; the Republic of Korea; the Kyrgyz Republic; the Lao People's Democratic Republic; Malaysia; Maldives; the Marshall Islands; the Federated States of Micronesia; Mongolia; Myanmar; Nauru; Nepal; Niue; Pakistan; Palau; Papua New Guinea; the Philippines; Samoa; Singapore; Solomon Islands; Sri Lanka; Taipei,China; Tajikistan; Thailand; Timor-Leste; Tonga; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; and Viet Nam.

[2] The geographic scope of "Asia" used in the Food and Agriculture Organization of the United Nations (FAO) statistics differs from that of the Asia and Pacific region.

More than three-quarters of forest land in Asia is publicly owned, including one-quarter that lies within protected areas. Around 12% is privately owned by individuals, and around 7% by local, tribal, and indigenous communities. The remainder is owned by businesses or is under unknown ownership (FAO 2020).

The forests of Asia and the Pacific are as diverse as the geography of the world's largest continent. The World Wide Fund for Nature (WWF) identifies 162 different forested ecoregions across the region—representing 19% of the world's terrestrial total (Olson et al. 2001). Their names evoke a dazzling diversity of ecosystems: Deccan thorn scrub forests, Luzon tropical pine forests, Chao Praya freshwater swamp forests, Sumatran montane rainforests, Admiralty Islands lowland rainforests, Brahmaputra Valley semi-evergreen forests, Timor deciduous forests, Peninsular Malaysian peat swamp forests, Eastern Himalayan subalpine conifer forests, Hainan Island monsoon rain forests, Northern Triangle temperate forests, Irrawaddy dry forests, Central Polynesian tropical moist forests, Kazakh forest steppe, Ussuri broadleaf forests, and more.

The vast diversity of forest ecosystems in Asia and the Pacific gives rise to a kaleidoscopic array of plants and animals, including some of the world's most iconic and charismatic species. Giant pandas inhabit the mountainous bamboo forests of Sichuan. Tigers still roam parts of India, the People's Republic of China (PRC), and mountainous Southeast Asia. Elusive snow leopards hide deep in the mountains of Central Asia and the Himalayas. Asian rhinos cling to existence in isolated pockets of the Himalayas and Southeast Asia. The Bornean and Sumatran forests are home to orangutans. The skies of Asia's forests are home to dozens of species of big-beaked hornbills and brightly plumed birds of paradise.

These famous species are just the tip of the iceberg of Asia and Pacific forests' floristic and faunal diversity. Species richness—defined as the number of species present in a given area—increases closer to the equator. A 10-hectare area of lowland rainforest in Borneo typically contains around 450 different species of trees (Rahayu et al. 2022), more than triple the number found in all of Europe (Slik et al. 2015). The proliferation of species in Asia's forests has been aided by the geographic isolation of ecosystems created by Asia's many water bodies—seas, channels, and rivers, and soaring mountain ranges and steep ravines. Within forests, the complex vertical structures of soil, floor, ground cover, understory, trunks, canopy, and emergent crowns provide many ecological niches allowing a wide variety of plant and animal species to flourish.

Many of the plants and animals in Asia and the Pacific live nowhere else on earth. Of the 3,297 bird species endemic to a single country, 1,324 (40%) are found in Asia and the Pacific, led by Indonesia (544 endemic species), the Philippines (260), Papua New Guinea (112), India (75), and the PRC (69) (IUCN 2025). Out of 2,804 endemic mammals, 829 (30%) are found in Asia and the Pacific, led by Indonesia (315), the Philippines (134), the PRC (94), Papua New Guinea (85), and India (55). Asia and the Pacific is home to 1,546 (27%) of the world's 5,676 endemic amphibians, led by India (304), Papua New Guinea (287), the PRC (258), Indonesia (224), and Malaysia (109); and 1,900 (29%) of the world's 6,600 endemic reptiles, led by Indonesia (346), India (309), the Philippines (257), Malaysia (158), and the PRC (145).

Tropical forests are particularly rich in life, containing 63% of mammals, 72% of birds, and 76% of amphibians, and 42% of reptiles, despite covering only 18% of Earth's land surface (Pillay et al. 2022). Of the 1,324 endemic birds in the Asia and Pacific region, 1,258 (95%) are found in forests, led by Indonesia (526), the Philippines (255), Papua New Guinea (108), Solomon Islands (68), and India (62) (IUCN 2025). Of the region's 2,804 endemic mammals, 2,079 (74%) are found in forests, with the highest numbers in Indonesia (291), the Philippines (133), Papua New Guinea (79), the PRC (52), and India (50). Among the region's 1,546 endemic amphibians, 1,437 (93%) are found in forests, led by India (289), Papua New Guinea (274), the PRC (228), Indonesia (211), and Malaysia (107). Of the 1,900 endemic reptiles in the region, 1,513 (80%) are found in forests, led by Indonesia (260), the Philippines (245), India (241), Malaysia (150), and Sri Lanka (130). Altogether, the forests of Asia and the Pacific are home to 38% of Earth's endemic birds, 26% of endemic mammals, 25% of endemic amphibians, and 23% of endemic reptiles.

The forests of the Pacific Islands in particular stand out as hotbeds of endemism. Although they cover only 0.36% of the world's land area, the forests of the 14 Pacific developing member countries (DMCs) in the Asia and Pacific region[3] are home to 276 endemic birds (8.4% of the world's 3,297 endemic birds), 103 endemic mammals (3.7% of the world's 2,804 endemic mammals), 280 endemic amphibians (4.9% of the world's 5,676 endemic amphibians), and 145 endemic reptiles (2.2% of the world's endemic reptiles) (IUCN 2025).

The forests of Asia and the Pacific are globally important for biodiversity conservation. They contain 13 of the world's 36 recognized biodiversity hotspots: the Caucasus; East Melanesian Islands; Eastern Himalaya; Indo-Burma, Bangladesh, India and Myanmar; Irano-Anatolian; Mountains of Central Asia; Mountains of Southwest China; New Caledonia; the Philippines; Polynesia-Micronesia; Sundaland, Indonesia and Nicobar Islands of India; Wallacea of Indonesia; and Western Ghats and Sri Lanka (WorldAtlas 2025). The region is also home to 2,806 (17%) of the world's 16,502 key biodiversity areas, though not all of these are located in forests (KBA 2025).

The remoteness and inaccessibility of many forested lands in Asia and the Pacific correlates with the presence and stewardship of Indigenous Peoples. Biological diversity and linguistic diversity are high in many of the same places (Gorenflo et al. 2012). It is therefore not

[3] The Cook Islands, Fiji, Kiribati, the Marshall Islands, the Federated States of Micronesia, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

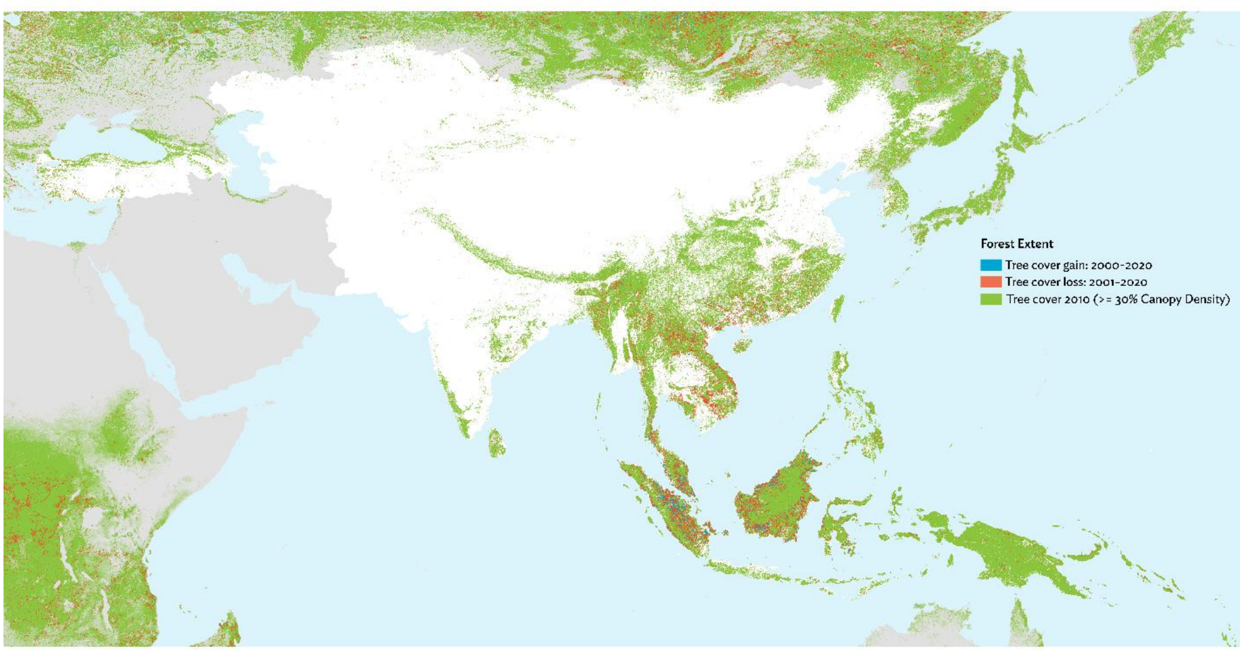
surprising that some of the most biodiverse regions—such as Yunnan and Papua New Guinea—are also home to large populations of Indigenous Peoples. While Indigenous Peoples are estimated to comprise only 8% of the population of the Asia and Pacific region (Mamo et al. 2022; World Bank 2025a), 23% of land in Asia and the Pacific is designated for or owned by Indigenous Peoples and Local Communities. This includes 97% of land in Papua New Guinea, 65% of land in Turkmenistan, 49% of land in the PRC, and 40% of land in the Kyrgyz Republic, according to the Rights and Resources Institute (RRI 2015). The proportion of forested land designated for or owned by Indigenous Peoples and Local Communities is likely higher.

1. Current State and Trends

Forest cover, loss, and gain

As of 2000, forests in Asia and the Pacific covered approximately 6.0 million square kilometers (sq km) (24% of the region's land area) (GFW 2025) (Figure 1). The largest forest areas were in the PRC (1.6 million sq km), Indonesia (1.6 million sq km), Papua New Guinea (430,000 sq km), Myanmar (430,000 sq km), and India (390,000 sq km).

Figure 1: Forest Extent (green), Loss (pink), and Gain (blue) Across Asia and the Pacific, 2000–2020



Note: Areas in white represent ADB Developing Member Economies
Source: GFW (2025).

Of this total forest area, 2.1 million sq km was *primary* forest in 2000—areas that had never been cleared (GFW 2025). Primary forests are especially significant for biodiversity habitat because of their ecosystem complexity and ecological niches that have matured over centuries or millennia. The largest primary forest areas were in Indonesia (940,000 sq km), Papua New Guinea (330,000 sq km), Malaysia (160,000 sq km), Myanmar (140,000 sq km), and India (100,000 sq km).

From 2000 to 2020, the region lost 682,000 sq km of forest—equivalent to 11.4% of its total forest area and 16.6% of global forest loss during that period (GFW 2025) (Figure 1). The greatest losses occurred in Indonesia (270,000 sq km), the PRC (103,000 sq km), Malaysia (84,000 sq km), Myanmar (40,000 sq km), and the Lao People's Democratic Republic (Lao PDR) (37,000 sq km).

Of the forest that was lost from 2000 to 2020, 176,000 sq km (25.8%) was primary forest. This represents 8.4% of the 2.1 million sq km of primary forest in Asia and the Pacific in 2000. The greatest primary forest loss was in Indonesia (97,000 sq km), followed by Malaysia (27,000 sq km), Cambodia (13,000 sq km), the Lao PDR (8,600 sq km), and Papua New Guinea (7,800 sq km).

Concurrently, 199,000 sq km (3.3%) of forest area regrew—15.2% of global forest gain during that period (GFW 2025) (Figure 1). However, much of the forests that regrew from 2000 to 2020 consisted of secondary natural forests, plantations, agroforests, and swidden agricultural areas, which are qualitatively different from primary forests. Plantation monocultures are less rich in biodiversity and provide fewer ecosystem services than natural forests (Hua et al. 2022). Even when natural forests are allowed to regrow after being cleared, it can take decades for them to regain their lost carbon stocks, and biodiversity may not return to levels comparable to the initial state for an even longer period. The greatest forest gain occurred in the PRC (67,000 sq km), followed by Indonesia (49,000 sq km), India (19,000 sq km), Thailand (18,000 sq km), and Malaysia (10,000 sq km).

Forests generate wealth and employment, including through the timber industry. Forestry rents across Asia and the Pacific were estimated at $34.5 billion in 2021, equivalent to 0.14% of gross domestic product (GDP) (World Bank 2025a). Meanwhile the Food and Agriculture Organization of the United Nations (FAO) estimates that approximately 9 million people in Asia[4] were employed in forestry and logging in 2020, though not all of this activity is sustainable (FAO 2020). Forests also produce non-timber forest products (NTFPs), which are widely used for food, medicine, energy, income, and other purposes. Globally, NTFPs

[4] NB: The FAO definition of Asia differs from that used by ADB for Asia and the Pacific.

are used by an estimated 5.8 billion people (FAO 2024) and generated approximately $88 billion in annual income in 2011 (FAO 2014).

Causes of forest loss

The direct causes of forest loss across Asia and the Pacific from 2001 to 2015 have been categorized using remote sensing (Curtis et al. 2018). More than half (51%) of forest loss was attributed to commodity-driven deforestation, including land clearing for palm oil, short-rotation wood fiber, rubber, mining, and energy infrastructure. More than one-third (35%) was caused by forestry activities, specifically the timber harvest of natural or plantation forests. Shifting agriculture, in which forest is cleared for agriculture and later allowed to fallow with forest regrowth, contributed 12%. Only a small proportion of deforestation was directly caused by wildfire (1.6%) or urbanization (0.3%), though it is important to note that fires—often human-set—were widely used as a method of land clearing. Similar analyses conducted for individual countries indicate that, for example, in Indonesia from 2001 to 2016, deforestation was primarily followed by oil palm plantations (23%), grassland/shrubland (20%), small-scale agriculture (15%), timber plantations (14%), large-scale plantations (7%), small-scale mixed plantations (7%), secondary forests (6%), logging roads (4%), mining (2%), fish ponds (1%), and other uses (2%).

Beneath these direct, or proximate, causes of deforestation lie *underlying* drivers of deforestation, which may be demographic, economic, technological, institutional, or cultural (Geist and Lambin 2002). Hundreds of studies conducted over recent decades have compared spatial patterns of deforestation with maps of proximate and underlying driver variables to analyze which factors accelerate deforestation or slow forest loss (Busch and Ferretti Gallon 2022). Meta-studies have synthesized these findings, revealing strong agreement on the factors that accelerate or slow deforestation (Figure 2).

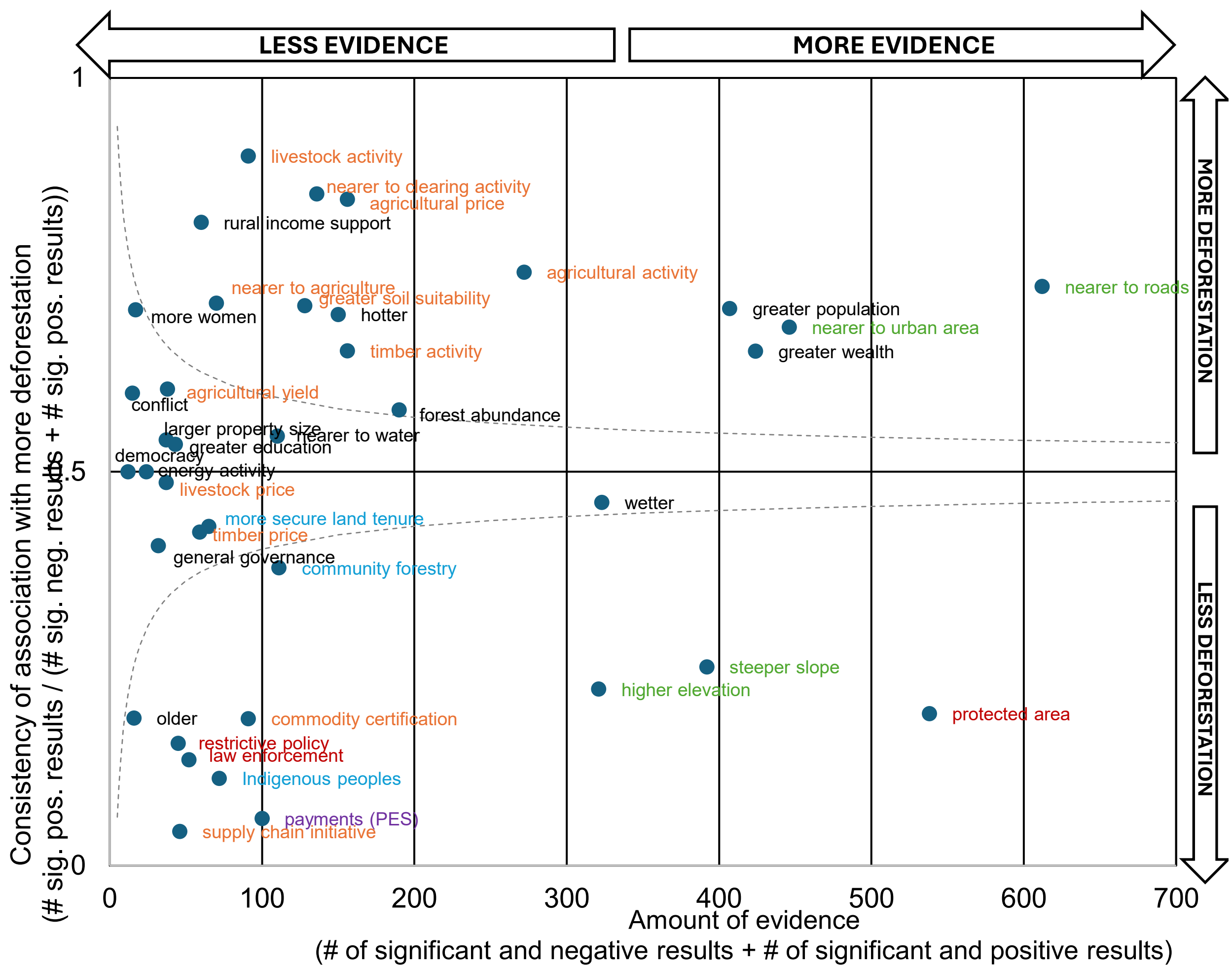
Figure 2: Agreement on Drivers of Deforestation Across Review Studies

		DEGRAD.		DEFORESTATION															REFOR.	
		Busch and Ferretti-Gallon 2021 (R)	Burivalova et al 2019	Busch and Ferretti-Gallon 2021 (R)	Busch and Ferretti-Gallon 2021 (S)	Börner et al 2020	Scullion et al 2019	Burivalova et al 2019	Börner and West 2018	Min-Venditti et al (2017)	Busch and Ferretti-Gallon 2017 (R0	Busch and Ferretti-Gallon 2017 (S)	Pfaff et al 2013	Angelsen and Rudel 2013	Rudel et al 2009	Chomitz 2007	Geist and Lambin 2002	Angelsen and Kaimowitz 1999	Busch and Ferretti-Gallon 2021 (R)	Borda Niño 2019
Built infra-structure	nearer to roads			+	+						+	+	+	+	+	+	+	+	~	+
	nearer to urban area			+	+						+	+				+	+	+	-	-
	nearer to cleared land			+	+						+	~					+	+		
	nearer to infrastructure						+													
Market commodities	agricultural activity			+	+		+				+	+	+		+	+	+	+		
	higher agricultural price			+	+		+				+	~		+		+	+	+		
	nearer to agriculture			+	+						+	+					+	+		
	timber activity			+	~		+		~		~	~	+		+	~	+	~		
	higher timber price			~	~		+				~	~		~		~	+	~		
	mining activity						+													
	livestock activity			+	+		+													
	higher livestock price			~	~		+			+										
	energy activity			~	~															
	greater agricultural yield			~	~															
	supply chain initiative			-	~															
	commodity certification		-	-	~	~		~												
Demographics and socioeconomics	greater population	+		+	+		+				+	+			+	+	+	+	-	
	larger property size			~	~						~	~			+	~		~		
	older population			-	~						~	~								
	greater education			~	~						~	~	-							
	greater poverty			-	-		+				-	-				~	+	~	~	
	more Indigenous peoples			-	-	-					-	~				-				
	more women			~	~															
Land management and institutions	more secure land tenure			~	~	~			~	~	~	~	~	~		~	~	~		
	community forestry		-	-	~			-		-	~	~		-		~				
	law enforcement			-	~		-		-		-	~				-				
	protected area			-	-	-	-	-	-	-	-	-	-	-	-	~				+
	decentralization					-			~											
	more democratic			~	~															
	stronger governance			~	~	-	-													
	conflict			~	~															
Policy	rural income support			+	~					+	+	+				+	+			
	payments (PES)			-	-	-		-	-	-	-	~	~	-		~				
	restrictive policy			-	-				-	~										
Biophysical characteristics	greater soil suitability			+	+						+	+					+	+		-
	nearer to water			~	~						~	~						+		+
	wetter			~	~						-	~								-
	higher elevation			-	-						-	-			-	-	-		~	+
	steeper slope			-	-						-	-			-	-	-		+	+
	fire						+													
	hotter			+	~															
	forest abundance			+	~															+

Notes: + denotes positive association with forest degradation, deforestation, or reforestation; ~ denotes no association or mixed or ambiguous association; - denotes negative association. Green denotes more forests; gray denotes neutral to forests; red denotes less forests. Driver variables in blue are new to Busch and Ferretti-Gallon (2022) compared to Busch and Ferretti-Gallon (2017).
Source: Busch and Ferretti-Gallon (2022).

Deforestation is consistently associated with greater accessibility (i.e., as influenced by natural features such as slope and elevation, as well as built infrastructure like roads, cities, and cleared areas), according to a comprehensive meta-analysis (Figure 3) (Busch and Ferretti Gallon 2022). It is also associated with higher economic returns from agriculture, livestock, and timber. Higher rates of deforestation are associated with greater population and greater wealth, while lower rates are associated with the presence of Indigenous Peoples. As discussed in more detail below, deforestation can be reduced through policies that directly influence allowable land-use activities, such as the establishment of protected areas, enforcement of forest laws, payments for ecosystem services, community forest management, and certification of sustainable commodities. However, policies and institutions that primarily seek other objectives—such as democracy, general governance, conflict abatement, and land tenure security—are generally not associated with reduced deforestation.

Figure 3: Drivers of Deforestation



Notes: Colors signify variables associated with five categories of interventions for conserving forests: 1) passive protection (green); 2) protecting sufficient forest value (blue); 3) raising forest value (purple); 4) restricting exploitation and conversion (red); 5) shifting commodity sources (orange).
Source: Busch and Ferretti-Gallon (2022).

In contrast, greater reforestation is typically associated with steeper slopes, increased distance from cities, and lower population density. However, natural forest regrowth and the establishment of commercial plantations follow different patterns. Natural forest regrowth is more likely to occur in remote and economically marginal lands, while commercial plantations are more likely to be established in accessible high-suitability lands (Busch and Ferretti-Gallon 2022).

Consequences of forest loss

The clearing and burning of forests released carbon dioxide into the atmosphere, contributing to global climate change. The forests of Asia and the Pacific contained approximately 62.2 billion tons of aboveground carbon in 2000—representing 21% of the global total. The greatest amounts of aboveground forest carbon were found in Indonesia (20.3 billion tons), followed by the PRC (10.5 billion tons), Papua New Guinea (6.4 billion tons), Myanmar (4.9 billion tons), and India (4.2 billion tons) (GFW 2025).

The loss of aboveground carbon represents only a fraction of the total carbon flux from forests to the atmosphere resulting from deforestation. Forest carbon stored in belowground biomass and in soil, particularly in peatlands and mangroves, is emitted as well. The potential for Asia and Pacific forests to contribute to climate mitigation—through avoided deforestation, afforestation/reforestation, forest management, avoided peat degradation, peat restoration, avoided mangrove conversion, and mangrove restoration—is discussed and quantified in a companion brief (Busch 2025).

The clearing and burning of forests in Asia and the Pacific emitted an estimated 42.2 billion tons of carbon dioxide (CO_2) from 2001 to 2020—accounting for 24% of the global emissions from forest loss over that period.[5] The highest emissions of carbon dioxide from aboveground carbon came from Indonesia (20.3 billion tons), followed by Malaysia (4.9 billion tons), the PRC (4.6 billion tons), Myanmar (2.1 billion tons), and Viet Nam (2.1 billion tons). Note that one ton of solid carbon is equivalent to 3.67 tons of carbon dioxide in the atmosphere.

At the same time, forest regrowth across the region removed an estimated 47.2 billion tons of carbon dioxide from the atmosphere—equivalent to 16% of the global CO_2 removals from forest regrowth over the same period.[6] The greatest CO_2 removals occurred in the PRC (14.6

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[5] Author's calculations based on Global Forest Watch 2023 Statistics Summary v30102024. https://www.globalforestwatch.org/dashboards/global/ (accessed April 2025).

[6] Footnote 5.

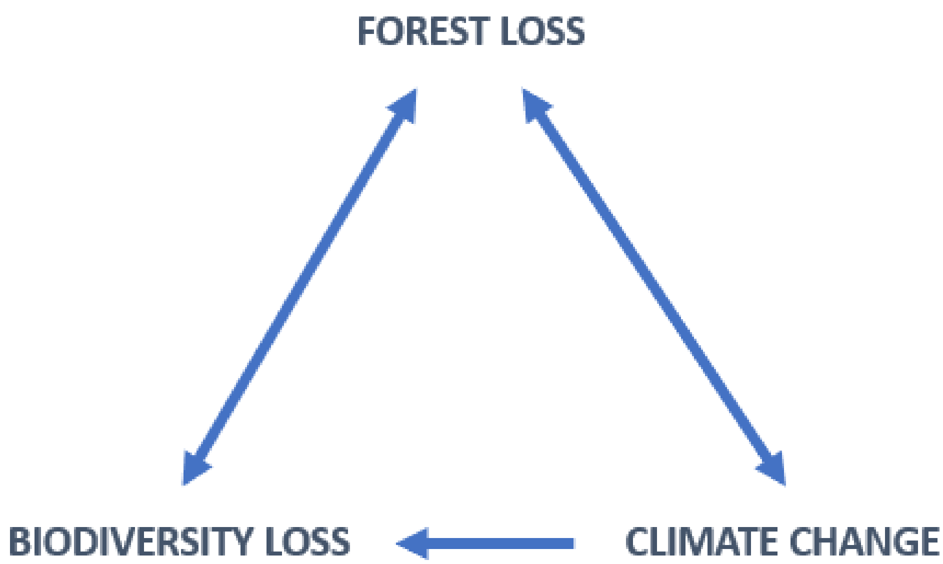
billion tons), followed by Indonesia (12.3 billion tons), India (2.8 billion tons), Myanmar (2.5 billion tons), and Viet Nam (2.4 billion tons).

Biodiversity loss is another globally significant consequence of deforestation. Forests are home to 78% of bird species, 68% of mammals, and 80% of amphibians, along with countless other species of animals and plants. When forests are cleared, these species lose their habitats. Additionally, when forests are degraded, animals and plants are imperiled through hunting and habitat degradation as well. Deforestation also contributes to climate change, which further endangers plants and animals.

The highest number of endangered or critically endangered forest bird species in the Asia and Pacific region is found in Indonesia (74), followed by the Philippines (34), Malaysia (26), Thailand (25), Myanmar (23), and the PRC (23), out of a global total of 473 (IUCN 2025). The highest number of endangered or critically endangered forest mammal species is also found in Indonesia (96), followed by India (44), Viet Nam (42), the PRC (37), and Malaysia (36), out of a global total of 626. For amphibian species, India has the most endangered or critically endangered (88), followed by the PRC (80), Sri Lanka (53), Viet Nam (48), and Malaysia (27), out of a global total of 1,868. Finally, Sri Lanka has the highest number of endangered or critically endangered reptile species in the Asia and Pacific region (83), followed by India (53), New Caledonia (49), Indonesia (38), and Viet Nam (36), out of a global total of 878.

Forest loss, biodiversity loss, and climate change are interlinked (Figure 4). As stated above, forest loss contributes to climate change when the carbon stored in tree trunks, limbs, roots, and soil is oxidized and released into the atmosphere. Forest loss also drives biodiversity loss through the elimination of habitat and reduction of connectivity, while forest degradation accelerates biodiversity loss through the hunting and ecosystem degradation that accompanies it. However, these pressures operate in reverse as well. Climate change results in forest loss as hotter, and in some cases drier and more fire-prone, conditions become prevalent (Khaine and Woo 2014). Biodiversity loss can lead to forest loss when seed-dispersing species and pollinators are eliminated through defaunation (de Paula Mateus et al. 2018). Furthermore, climate change drives biodiversity loss as rising temperatures and altered precipitation patterns shift suitable habitat ranges beyond the capacity of species to migrate or create novel ecosystems altogether (Bellard et al. 2012).

Figure 4: Interlinkages Between Forest Loss, Biodiversity Loss, and Climate Change

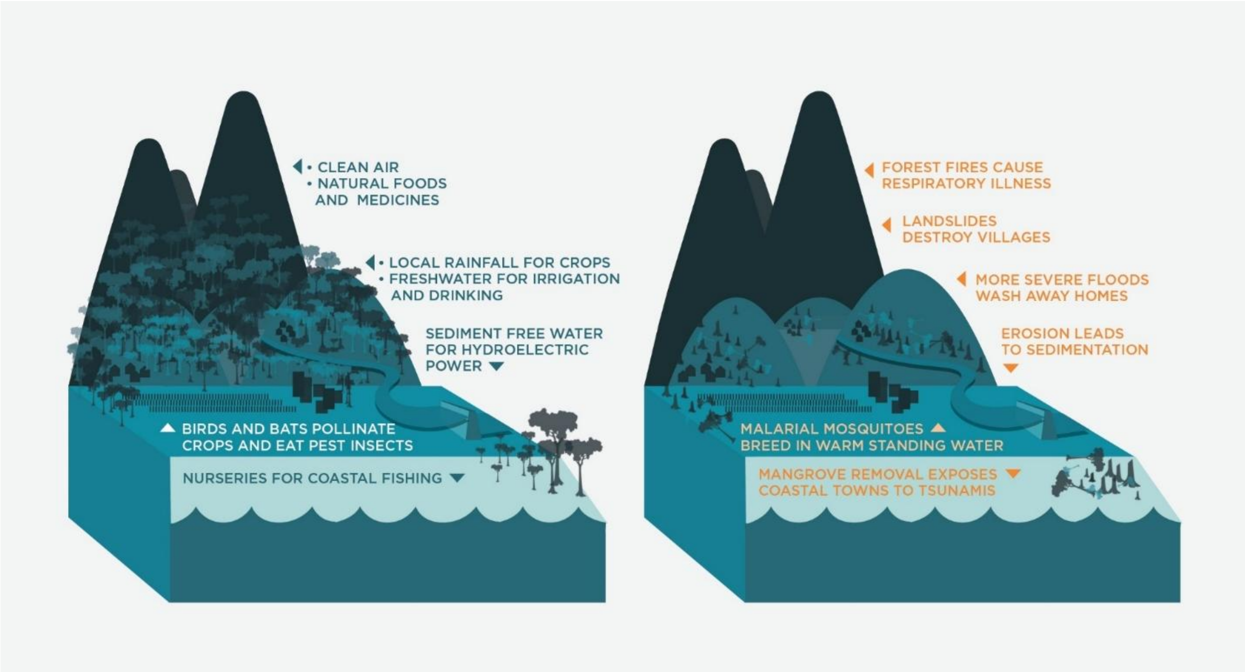


Source: Author.

Conserving forests (i.e., avoiding deforestation), is generally beneficial for both climate and biodiversity. However, the forests one might aim to conserve for climate protection may not necessarily be the same as those chosen for biodiversity conservation (Smith et al. 2021). Similarly, reforestation is generally positive for climate and biodiversity compared to other land uses, such as agriculture. However, the type of reforestation undertaken makes a difference for biodiversity; for instance, regrowing natural forests supports much more diversity than plantation monocultures (Hua et al. 2022).

In addition to climate and biodiversity, forests support other Sustainable Development Goals (Le et al. 2025), such as clean water provision (Figure 5). Forests provide clean water by trapping sediment as water flows overland and filtering out pollutants from groundwater and surface water. They also help ensure more reliable water provision by retaining water during the wet season and releasing it during the dry season (Seymour and Busch 2016).

Figure 5: Ecosystem Services Provided by Forests, and Damages from Deforestation



Source: Seymour and Busch (2016).

Clean water from forested watersheds enhances the functioning of hydroelectric dams downstream. In the Asia and Pacific region, 16% of electricity is generated by hydroelectric dams, including nearly 100% in Nepal, 60% in Cambodia, more than 30% in Viet Nam, Sri Lanka, and Pakistan, and more than 10% in Armenia, the PRC, the Philippines, and India, in 2014 (World Bank 2025a). However, when reservoirs behind dams fill with sediment due to erosion, their generation capacity declines, necessitating costly repairs and dredging. Forests help mitigate this erosion that causes sedimentation. Consequently, dams like the PRC's Three Gorges have invested in reforestation of their upstream watersheds (Teng et al. 2019).

Forest loss also undermines health and safety. Forests offer natural protection against deadly storms, floods, and mudslides (Seymour and Busch 2016), as well as droughts and desertification (Kulik et al. 2023). Coastal mangrove forests protect inland inhabitants from tsunamis and strong wave surges (Marois and Mitch 2015). People living near healthy forests enjoy cleaner air, while fires used to clear forests can severely degrade air quality for those downwind. Air pollution from forest fires can travel hundreds of kilometers across international borders, resulting in health and economic damages in affected nations (Sheldon and Sankaran 2017). Additionally, the clean water provided by forests leads to cleaner water for drinking, bathing, and cooking, contributing to better health.

Deforestation can also increase the prevalence of infectious diseases. Studies have shown that deforestation raises malaria rates in Asia (Vythilingam and Kumar Jeyaprakasam 2024) and Latin America (Colonia et al. 2024), although this phenomenon has not been observed in Africa (Bauhoff and Busch 2020). Furthermore, deforestation has facilitated the spillover of zoonotic diseases to humans, including henipaviruses, Hendra virus, and Nipah virus (White and Nazgour 2020).

Forests also provide critical services related to climate resilience and adaptation. As mentioned, terrestrial forests reduce the risk of landslides and floods, while mangrove forests offer protection against storms, sea-level rise, and coastal erosion. Forests also provide a local cooling effect (Li et al. 2015), which is increasingly valuable as global temperatures rise.

2. Solutions and Best Practices

Criteria to measure success

In discussing solutions and best practices for forests, it is helpful to define criteria for measuring success. The most direct indicator is forest cover—that is, the area of land that meets a biophysical land cover definition of forest. Forest cover is by far the easiest indicator to detect and measure via satellite, despite the definitional differences regarding what constitutes a forest.

Forests' contribution to addressing climate change can be assessed through carbon stock. Aboveground carbon stock, which is the amount of carbon contained in the biomass of tree trunks, limbs, branches, and leaves, can be measured using on-the-ground field measurements combined with allometric equations, then extrapolated using spatial variables collected by satellites. Belowground carbon stock can be estimated by multiplying aboveground carbon stock by ecosystem-specific "root-shoot ratios" (Mokany et al. 2006). Carbon in forest soil can be measured and extrapolated based on soil type. Multiple research teams have produced comprehensive maps of forest carbon (e.g., Dubayah et al. 2023) and forest carbon fluxes (e.g., Harris et al. 2021).

Measuring the contribution of forests to addressing biodiversity loss is significantly more complicated. Several metrics of success for biodiversity exist, including *species richness* (the number of species of a particular taxonomic group in an area), *range size rarity* (where species with small ranges are weighted more heavily), *endemism* (the number of species that live only in a specific location), and *endangered status* (which assesses the risk of extinction faced by species, ranging from least concern to critically endangered, as compiled by the International Union for the Conservation of Nature [IUCN]). There is no consensus on which of these metrics is the "right" one for evaluating biodiversity, and many of these metrics are not precisely mapped or frequently updated.

The condition of forests in the Asia and Pacific region can also be assessed through other indicators, including biodiversity intactness (De Palma et al. 2021), forest fragmentation (Reddy et al. 2013), human pressure (Geldmann et al. 2014), intact forest landscapes (Potapov et al. 2017), and institution-specific designations, such as critical forest biomes (GEF 2024).

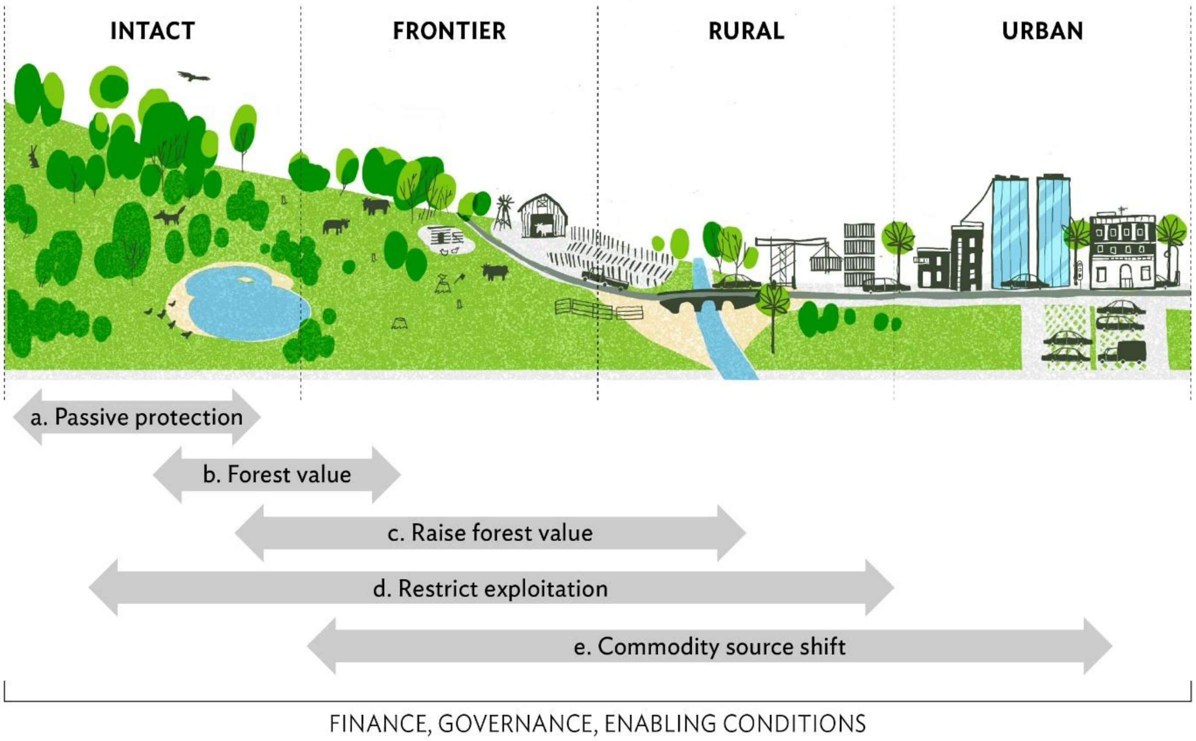
In addition to their biophysical qualities, forests can be measured based on their contributions to the measured economy. Criteria can include forest income, forest rents, product value, livelihoods, and contribution to GDP. The value of forests extends beyond the measured economy to encompass a wide range of unmeasured goods and services. A meta-analysis of 25 forest services estimated mean total values of $1,747 per hectare per year for tropical rainforests and $561 per hectare per year for tropical dry forests, though with wide variation (Taye et al. 2021). The natural capital value of forests in producing continued flows of ecosystem services is the subject of national initiatives aimed at creating natural capital accounts (Fenichel 2025).

The following sections use forest cover as the standard criterion for measuring forest conservation success, while acknowledging that a wide variation of other metrics exist. These include measures that can be used to compare the value of a forest to alternative land uses at the same site, to forests elsewhere, or to the condition of the same forest at another point in time. Forest cover serves as a crude proxy for the existence of these other values.

Effective interventions

As mentioned earlier, the proximate causes of forest loss include increased accessibility, higher economic returns from alternative land uses, and demographic change. A longstanding truism in the forest conservation community is that the way to protect forests is to make them “worth more alive than dead.” But how can this be achieved? There are numerous examples of effective interventions supported by evidence (Busch and Ferretti-Gallon 2022) that have been implemented. These interventions can be grouped into five categories: passive protection; protecting sufficient forest value; raising forest value; restricting exploitation and conversion; and shifting commodity sources. Each of these is underpinned by finance, governance, and enabling conditions, which are discussed in later sections.

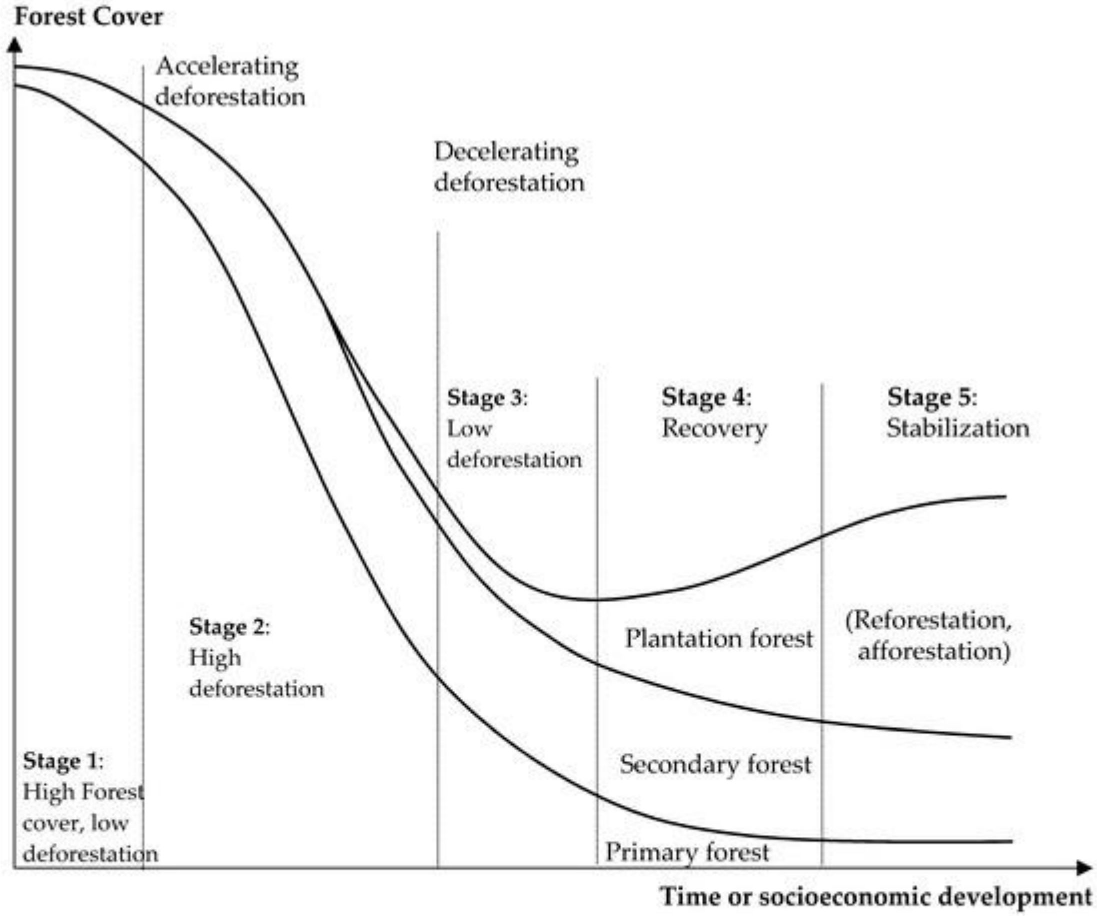
Figure 6: Effective Interventions for Forest Conservation, by Remoteness



Source: Author.

The appropriateness of different interventions varies by geography. Imagine a stylized geographic transect running from the most remote, inaccessible region of a country to its urban capital (Figure 6). Along this transect, dense forests are first chipped away by frontier activities (mining, logging, small-scale agriculture) and then transformed into a mosaic of trees and agricultural land. This transition continues to remnant forests within larger-scale agricultural areas and denser populations, ultimately reaching the urban outskirts with few, if any, remaining forests. This simplified representation of forests across a country aligns with the "forest transition curve" (Mather 1992) and the radial theory of economic geography (von Thunen 1826), as illustrated in Figure 7.

Figure 7: Forest Transition Curve



Source: Michinaka (2018).

At the far left of Figure 6 are dense, intact forests that have been conserved through *passive protection*. Their remoteness and inaccessibility have prevented most economic activities and denser settlement that lead to deforestation elsewhere. Examples include the remote roadless areas of the Amazon Basin, the island of Papua, and the high mountainous terrains of the Andes and Himalayas. Due to their vast and costly distance from markets, such forests can be viewed in economic terms, as “not worth much dead.”

Moving to the right in Figure 6 are areas that are heavily forested but inhabited. In many cases, the economic values these forests provide to local communities are sufficient to deter economic development based on conversion. In these situations, the forests are “already worth more alive than dead,” at least to their current inhabitants. Effective interventions focus on protecting the rights of these forest-dependent communities, which include Indigenous territories and communities around the world, rubber tappers in Brazil, and community forestry arrangements in Nepal and beyond. These interventions may also involve eco-tourism centered on national parks or other protected areas, as well as multiple-use extractive reserves. Paradoxically, they can sometimes include logging operations, where sustainable timber harvests provide an economic counterweight to agricultural conversion. However, logging roads and forest degradation often lead to clearing for other land uses.

Continuing to the right in Figure 6, forests at the agricultural frontier are undergoing clearing and conversion to other land uses, such as croplands or pasture. Here, interventions aim to tip the economic scales to make forests more valuable than alternative land uses. This entails adding value to forests to "make them worth more alive than dead." Payments for ecosystem services have been in place in Costa Rica for nearly 30 years (Arriagada et al. 2015). This model has been adapted for use in Mexico, Viet Nam, Brazil, and other countries (Salzman et al. 2018).

An alternative approach to forest conservation involves restricting exploitation and conversion. These measures eliminate or reduce the economic value of clearing forests through regulation, making forests' "value when dead unrealizable." Such interventions include the enforcement of forest laws in Brazil (Assuncao et al. 2013), moratoria on logging and land conversion in the PRC (Durst et al. 2001) and Indonesia (Busch et al. 2015), and the establishment of protected area networks in every country worldwide (Shah et al 2021). These restrictive measures can be applied across a wide range of geographic settings (Figure 6). Additionally, the restrictive land uses imposed by governments can be paired with economic compensation for local citizens who lose economic opportunities, as seen in Costa Rica and the PRC.

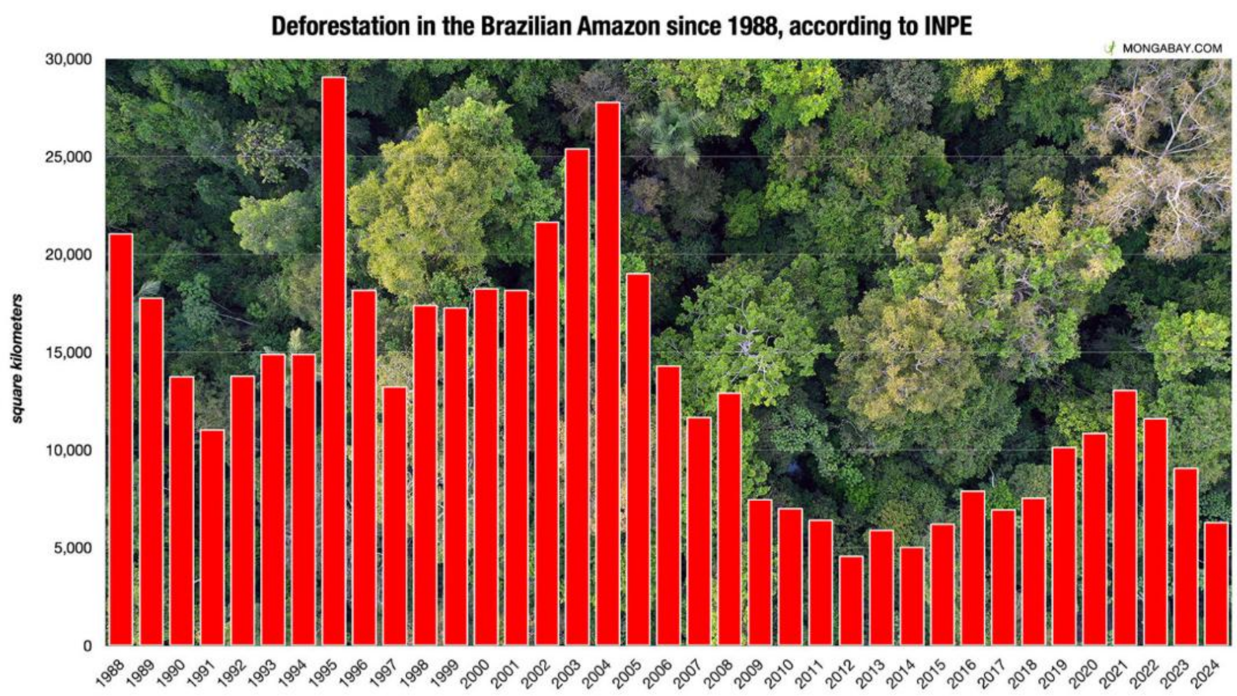
At the end of the spatial continuum are areas dominated by large-scale agriculture, which have often replaced forests (Figure 6). In these regions, including the frontier, forest conservation can be achieved by promoting agricultural practices that do not replace forests. This can be accomplished through commodity certification (e.g., via the Roundtable on Sustainable Palm Oil or Forest Stewardship Council), price premiums, preferential access to agricultural credit (as in Brazil and Colombia), and public or private supply chain initiatives that avoid purchasing commodities grown on recently deforested land. The underlying logic is to decrease demand for products that make land "worth more than dead forests."

Success cases

Brazil was once the most public face of tropical deforestation. The country, which had the world's largest area of tropical forest—approximately 5.0 million sq km as of 2010 (GFW 2025)—also experienced the highest rate of deforestation by area, felling between 10,000 and 30,000 sq km of Amazon forest annually between 1988 and 2004 (Figure 8). However, in 2005, the Government of Brazil initiated and strongly backed a multipronged effort to reduce deforestation—the Action Plan to Prevent and Control Deforestation in the Brazilian Amazon

(PPCDAm). This effort led to an 80% decrease in deforestation from 2004 to 2012, dropping from a high of 28,000 sq km in 2004 to just 4,600 square kilometers in 2012 (Figure 8).

Figure 8: Annual Brazilian Amazon Deforestation, 1988–2024



Source: Mongabay.com based on data from INPE Brazil.

The policy mix employed by the Government of Brazil included interventions across all five categories of effective forest conservation described earlier. To ensure ongoing passive protection across large swaths of the remote Amazon, the government minimized the construction of new roads into remote forested areas. Law enforcement along existing roads was strengthened, and paving projects were delayed (Nepstad et al. 2014).

Additionally, Brazil established a many new protected areas, adding 640,000 sq km between 2003 and 2008. Some of these areas protected remote wildernesses, while others focused on protecting communities of forest-dwelling people. Brazil designated many Indigenous Peoples' reserves under collective tenure, granting communities the right to exclude outsiders while promoting sustainable management (Boucher 2014). It also designated extractive reserves, which enabled rubber tappers to maintain their livelihoods without disruption.

At the forest frontier, where forests and agricultural economies often clashed, Brazil implemented initiatives to enhance the value of preserving forest land. The Bolsa Floresta program made monthly payments to hundreds of families in exchange for keeping forests standing. Brazil's Amazon Fund further supported various forest conservation programs throughout the region.

A key component of Brazil's policy mix was the restriction of exploitation of forest on private lands. The Forest Code had long prohibited private landowners from clearing more than 20% of their property. However, this law was challenging to enforce and frequently violated. In 2004, Brazil introduced a satellite-based monitoring system called DETER, which allowed authorities to detect deforestation within 2 weeks of occurrence. This enabled them to identify and penalize landowners who engaged in illegal deforestation. Federal prosecutors initiated high-profile lawsuits against powerful property owners.

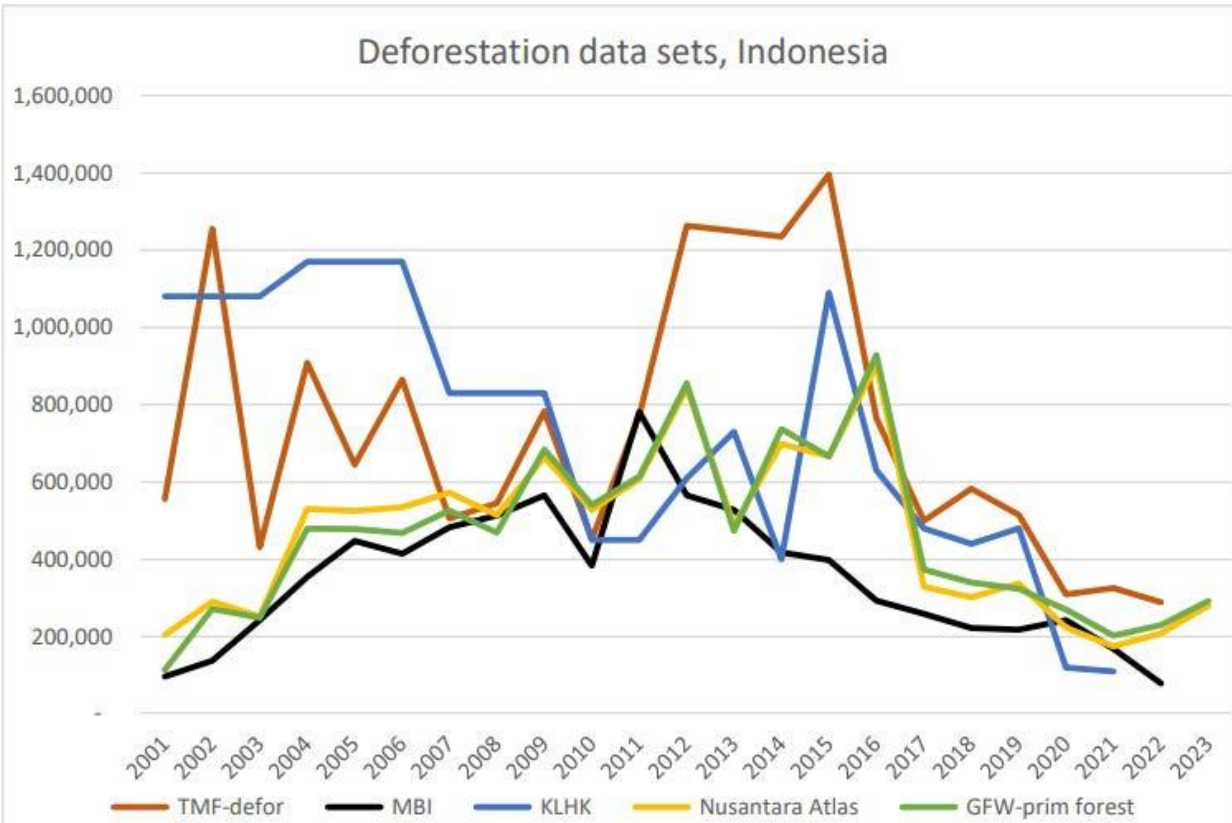
Brazil directly confronted the agricultural industries responsible for much of the deforestation in the Amazon—cattle and soy. In 2008, the government began "blacklisting" municipalities with high deforestation rates, cutting off their access to subsidized agricultural credit and increasing monitoring and fines. In 2006, soy traders ceased buying soy grown on recently deforested land, leading soy growers to voluntarily declare a moratorium on deforestation. Although soy expansion continued to boom, it no longer came at the expense of the Amazon forest. In 2009, the beef and leather industry followed suit, with meat packers voluntarily agreeing to buy cattle only from non-blacklisted jurisdictions. Beef production also continued to rise.

The trends in deforestation in the Brazilian Amazon since 2012 further underscore the effectiveness of the policy mix outlined above. From 2013 to 2021, successive federal governments relaxed—and later abandoned—many of the restrictive polices, resulting in a tripling of the annual deforestation rate (Figure 8). Beginning in 2022, however, these policies were strengthened again. Since then, deforestation has fallen by more than half over the past 3 years (Figure 8). Commodity prices also played a role in influencing deforestation rates, alongside the effectiveness of policies (Assuncao et al. 2015).

Another globally significant success story is Indonesia, which is home to the world's third-largest area of tropical forest—approximately 158 million sq km as of 2010, following Brazil and the Democratic Republic of Congo (GFW 2025). Until 2016, Indonesia had the second-highest rate of tropical deforestation after Brazil, and in 2009, it had the highest (GFW 2025). The primary drivers of deforestation were the expansion of oil palm plantations, used for palm oil production, and short-rotation plantations such as eucalyptus and acacia, which are grown for pulp and paper products. Deforestation peaked at 2.4 million ha in 2016 (GFW 2025), coinciding with a severe El Niño event that made the climate particularly hot and dry. The unhealthy smoke from human-set forest fires drifted from villages in Kalimantan all the way to Singapore and Malaysia, making international headlines (Sheldon and Sankaran 2017).

Indonesia launched its own program to reduce deforestation, and the results have been successful. Depending on the data source and the forest definition used, deforestation has declined by between 40% and 90% (Angelsen et al. 2025) (Figure 9). Researchers attribute this decline to a combination of factors, including public policies such as a 2011 moratorium on new permits to clear primary forests and peatlands; reforms related to fire management and peatland protection; private sector actions, including commodity certification and corporate pledges; civil society pressure to hold government and companies accountable; relatively stable commodity prices; and the increasing scarcity of remaining accessible forest (Angelsen et al. 2025).

Figure 9: Annual Indonesia Deforestation, 2000–2024



Source: Angelsen et al. (2025) based on various data sets.

Although not a single country, forest stewardship by Indigenous Peoples worldwide has been an enormous success story. Indigenous Peoples often live in and manage forest areas that far exceed their numbers. In Brazil, for instance, Indigenous Peoples make up approximately 0.83% of the population (IBGE 2023) but manage 14% of the national land area and 23% of the Brazilian Amazon (PIB 2018). Deforestation rates in Indigenous territories are significantly lower than in surrounding areas—even after accounting for the lower economic potential of the lands (Busch and Ferretti-Gallon 2022).

Numerous other examples of successful forest management exist. The PRC increased its forest area by 440,000 sq km from 2000 to 2016 through large-scale reforestation programs and logging bans (Guo et al. 2022). Costa Rica successfully reversed massive forest loss through protection policies and payments for ecosystem services (Sanchez-Azofeifa 2013). The Republic of Korea increased its forest biomass more than sixfold between 1960 and 2000 (Choi et al. 2002). Countries with "high forest, low deforestation" rates, such as Guyana, Suriname, and Gabon, have resisted economic pressures to retain forest cover across more than 90% of their territories (da Fonseca et al. 2007).

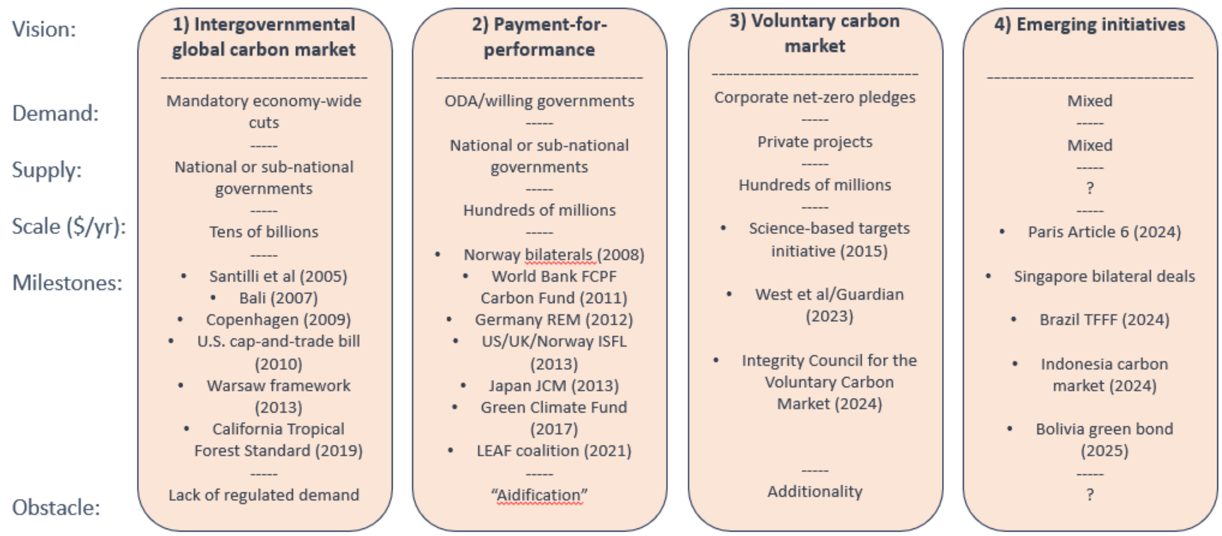
3. Financing Mechanisms for Ecosystem Conservation

The five strategies outlined above for conserving forest ecosystems—(i) passive protection, (ii) protecting forest value, (iii) increasing forest value, (iv) restricting exploitation and conversion, and (v) shifting agricultural sourcing—incur costs. These may include budgetary expenses associated with forest conservation programs or administrative overhead. They also have opportunity costs from forgone economic activities related to forest exploitation or conversion to more profitable land uses. Various financing sources can support forest conservation activities or compensate for opportunity costs.

Reducing Emissions from Deforestation and Forest Degradation in Developing Countries

The central idea of Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD+) is that payments will be made to forest countries or communities based on the amount of carbon their forests prevent from entering the atmosphere by not being cleared or remove from the atmosphere through regrowth. Different venues have conceived varying visions of who pays, who receives payments, how these payments are made, and the rules and formulas governing them. Four main visions of REDD+ can be identified: (1) REDD+ as an intergovernmental global carbon market; (2) REDD+ as intergovernmental performance-based payments; (3) REDD+ as private voluntary carbon markets; and (4) emerging initiatives (Figure 10).

Figure 10: The Rise, Fall, and Resilience of Alternative Visions of Reducing Emissions from Deforestation and Forest Degradation (REDD+)



JCM = joint crediting mechanism, LEAF = Lowering Emissions by Accelerating Forest Finance, TFFF = Tropical Forests Forever Facility, UK = United Kingdom, US = United States.

Source: Author.

The original vision of REDD+ as an intergovernmental global carbon market within the framework of the United Nations Framework Convention on Climate Change (UNFCCC) began in 2005 with an influential proposal (Santilli et al. 2005), supported politically by Brazil and advanced by the Coalition for Rainforest Nations, led by Costa Rica and Papua New Guinea. Negotiations on REDD+ rules (e.g., monitoring, reference levels, social and environmental safeguards, benefit sharing) began in Bali in 2007 and concluded in Warsaw in 2013.

It was hoped that an international intergovernmental carbon market, driven by demand from regulated companies looking to meet compliance obligations partly through REDD+ offsets, could generate financing for forest conservation on a scale of tens of billions of dollars annually. However, these hopes were dashed in 2009 with the collapse of international climate negotiations in Copenhagen and the subsequent failure of a cap-and-trade bill in the United States (US) Senate the following year. The California Air Resources Board opened the door to intergovernmental offsets between states and provinces when it endorsed a California Tropical Forest Standard in 2019. However, significant domestic political opposition hindered this initiative's advancement. The lack of growth in compliance markets with an appetite for international offsets remains a significant obstacle to this vision of REDD+. Current demand for offsets through regulated compliance markets falls far short of plausible supply.

A second vision of REDD+ proposed intergovernmental payments for performance, wherein governments of relatively wealthy countries would compensate governments of forest countries based on the carbon value of their forest conservation efforts. This vision was never entirely distinct from the first. Initially, intergovernmental performance-based payments were viewed as a bridge to, and later as a substitute for, an intergovernmental global carbon market.

Led by bilateral agreements between Norway and Brazil (2008), Guyana (2009), and Indonesia (2010), this concept expanded to include bilateral payments from Germany, the United Kingdom (UK), and the US, to Peru, Colombia, Ecuador, Liberia, Gabon, and others. Multilateral payment-for-performance systems were initiated through the World Bank's 11-member Forest Carbon Partnership Facility Carbon Fund (2011) and the Green Climate Fund (2017). Variations on this theme included Japan's Joint Crediting Mechanism, which allowed for private offset projects in 2013, and the formation of a consortium of private buyers for jurisdictional-level actions through the Lowering Emissions by Accelerating Forest Finance (LEAF) coalition in 2021.

Hundreds of millions of dollars flow through these agreements each year. However, this system has not evolved and, in many cases, has run its course without renewal. The primary obstacle has been termed "aidification" (Seymour and Angelsen 2012). Securing public funds for overseas development assistance (ODA) is challenging, even in the best of times, and is subject to capricious swings in financial levels and donor priorities. This instability does not provide a solid, long-term foundation for payments for emission reductions, unlike an intergovernmental carbon market.

Bemoaning the slow pace and stringent rules of government-led carbon markets, private sector entrepreneurs have created a parallel system of REDD+ through voluntary carbon markets. In this vision of REDD+, voluntary private buyers (e.g., companies seeking to fulfill net-zero carbon emissions pledges) purchase forest carbon credits from voluntary private sellers (e.g., carbon project proponents in forest countries). These transactions adhere to rules established by private standards bodies (e.g., Verra, Gold Standard, Plan Vivo) and are verified by private oversight companies.

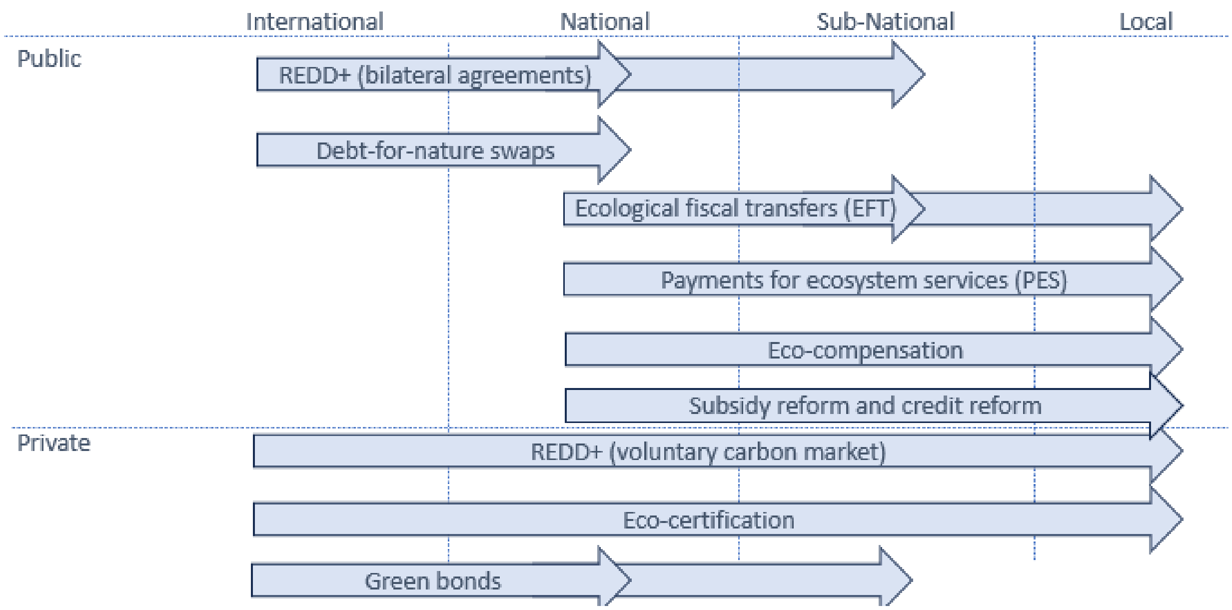
Voluntary markets for forest carbon offsets peaked at hundreds of millions of dollars annually with the confluence of numerous large companies' net-zero pledges following the Science-Based Targets Initiative (2015). This boom was followed by a bust after revelations published in *Science* (West et al. 2023) and later in *The Guardian* (Greenfield 2023) indicating that the credits claimed by private forest carbon projects far exceeded independent estimates of the carbon they effectively kept out of the atmosphere ("additionality"). In response, the private carbon market has launched initiatives to improve and identify offsets that are “high integrity.” However, the challenge remains that carbon market buyers and sellers may selectively choose which set of rules to follow from a range of options, presumably to their own advantage rather than that of the climate.

As the visions of REDD+ described above have struggled and persisted in their own ways, emerging initiatives continue to develop. Provisions of UNFCCC Paris Agreement Article 6, which detail how countries can meet their climate pledges through international cooperation, were finalized in Baku in 2024 (UNFCCC 2025a). Since the adoption of Article 6, 63 Parties to the UNFCCC have signed 98 bilateral agreements (A6IP 2025). For example, Singapore has initiated offset agreements with Peru, Papua New Guinea, Ghana, and Nepal that include emission reductions from forests (Begum 2025). Switzerland has concluded Article 6 agreements with Peru, Ghana, Thailand, and Chile (Dupraz-Dobias 2025). Indonesia has announced intentions to significantly scale up international forest carbon market sales (Sulaiman and Suroyo 2024), while Bolivia aims to sell $5 billion in forest carbon credits (Reuters 2024). Brazil has mooted a “tropical forests forever facility,” asking developed countries to leverage their favorable credit ratings to borrow private capital, reinvest it in developing country growth funds, and distribute the expected returns that remain after paying back creditors to fund forest conservation (Gov.br 2024). It remains to be seen which, if any, of these initiatives will succeed.

Other public finance

In addition to REDD+, there are various other sources of public finance for forest conservation, ranging from international governments to national, subnational, or local entities, and from national governments to subnational or local entities (Figure 11).

Figure 11: Scale of Sources and Destinations of Finance for Ecosystem Conservation



REDD+ = Reducing Emissions from Deforestation and Forest Degradation in Developing Countries.
Source: Author.

Global spending on national protected area systems is estimated at $24.3 billion per year (Waldron et al. 2020). Apart from the domestic spending by national governments, international funding for protected areas comes from multilateral funders, such as the Global Environment Facility; bilateral funders, including the US, France, and Germany; and international nongovernment organizations like WWF and Conservation International. These funds support the administrative and budgetary costs of maintaining protected areas. In many cases, they also provide compensation and investment in communities surrounding protected areas that forgo extractive economic activities in favor of tourism and resource management.

Debt-for-nature swaps have proliferated since the first one occurred in 1987, when Bolivian debt to the US was acquired at a discount and paid off by Conservation International in exchange for the establishment and management of new protected areas (FAO 1996). Since then, there have been more than 140 debt-for-nature swaps (US State Department 2024) involving more than $6 billion, with the majority occurring since 2021 (Reuters 2025). For debtor nations, these swaps can reduce debt burdens, improve sovereign credit ratings, and create new streams of financing for nature; however, they may be too small to substantially alleviate debt burdens and may fail to address the root causes of environmental degradation (Nedopil and Sun 2025). According to the International Institute for Environment and Development, debt-for-nature swaps have the potential to unlock more than $100 billion for action on climate change and biodiversity loss (IIED 2024).

Bilateral and multilateral aid from many donor nations has supported forest activities related to conservation, climate change, and biodiversity. Forestry-marked ODA grew slowly from 1995 to2016, increasing from around $400 million in 1995 to $600 million in 2016, which represented a decline from around 0.33% to 0.18% of total ODA. Subsequently, forestry-marked ODA grew more rapidly, reaching nearly $1.6 billion in 2021 (nearly 0.40% of total ODA). Nearly 80% of bilateral assistance for forests came from four countries: Germany, Japan, the UK, and France. Meanwhile, more than half of forest-marked ODA was spent through multilateral financing bodies such as the World Bank, Green Climate Fund, and Global Environment Facility. Other donors with bilateral forest spending included Belgium, Canada, Denmark, Finland, the Netherlands, Norway, Spain, the Republic of Korea, Sweden, Switzerland, and the US (Zabel 2023). In 2025, the US eliminated its agency for international development (Daniel 2025), while the UK and other donors reallocated ODA toward military spending (Loft et al. 2025).

Payments for ecosystem services (PES) provide funding to landholders based on their monitored success in achieving ecological targets, such as the area of forest loss avoided, or the area of forest restored. Costa Rica began trialing PES in 1997 and, by 2019, had distributed more than $500 million to 18,000 families (UNFCCC 2023). The concept has since spread to more than 60 countries. Globally, an estimated $36 billion–$42 billion per year flows through more than 550 PES programs in more than 60 countries as of 2018 (Salzman et al. 2018).

Ecological fiscal transfers (EFT) are transfers of public revenue between governments within a country based on ecological indicators (Busch et al. 2021). They provide a portion of annual operating funding to subnational governments in Brazil, Portugal, France, India, the PRC, Indonesia, and Malaysia, without relying on legislative appropriations. Indian states receive more than $10 billion annually in transfers based on their forest cover. Municipalities in the state of Pará in Brazil receive funding based on their success in reducing deforestation. EFT in Indonesia and Malaysia include indicators for forests and biodiversity.

Other private finance

Private finance for forest conservation or restoration generally expects the likelihood of a return on investment. Various activities can provide such returns, with the most straightforward being timber harvests. However, as mentioned earlier, timber harvesting is often unsustainable, as logging roads and camps pave the way for more extensive exploitation and conversion of forests. On the other hand, sustainable forest management has the potential to be profitable, as cyclical timber production can support biodiversity while preventing conversion to agricultural land use, which typically offers fewer climate and biodiversity benefits. Investment in sustainable plantation forestry has been launched by asset managers through vehicles such as the Tropical Asia Forest Fund 2 (GFI 2025a).

Private investment can also help build industries that rely on forest goods and services beyond timber. These include nature-based tourism, shade-grown coffee and other crops, non-timber forest products, and the development of pharmaceuticals and innovative materials derived from forest plants and animals. Private capital can invest in activities that are likely to generate carbon credits, whether through public initiatives (e.g., Bolivia's bond issue mentioned above) or private efforts (e.g., voluntary carbon markets or nascent biodiversity markets).

Hundreds of eco-labels vouch for the sustainable production of a wide variety of products, from dolphin-safe tuna to organic agricultural products. Several prominent eco-labels assist private commodity producers in demonstrating forest-friendly practices, ideally allowing them to sell their products at a higher market premium. The Forest Stewardship Council label showcases environmentally responsible practices in timber production. The Roundtable on Sustainable Palm Oil establishes standards for palm oil, a major driver of deforestation in Southeast Asia, while the Roundtable on Responsible Soy sets similar standards for soy production, a significant contributor to deforestation in Latin America. These market-based initiatives complement, or may aim to preempt, public restrictions on the import of commodities produced on recently deforested land, such as the contentious European Union (EU) Deforestation Regulation, which has faced challenges from several commodity-exporting countries through the World Trade Organization (Brack 2024).

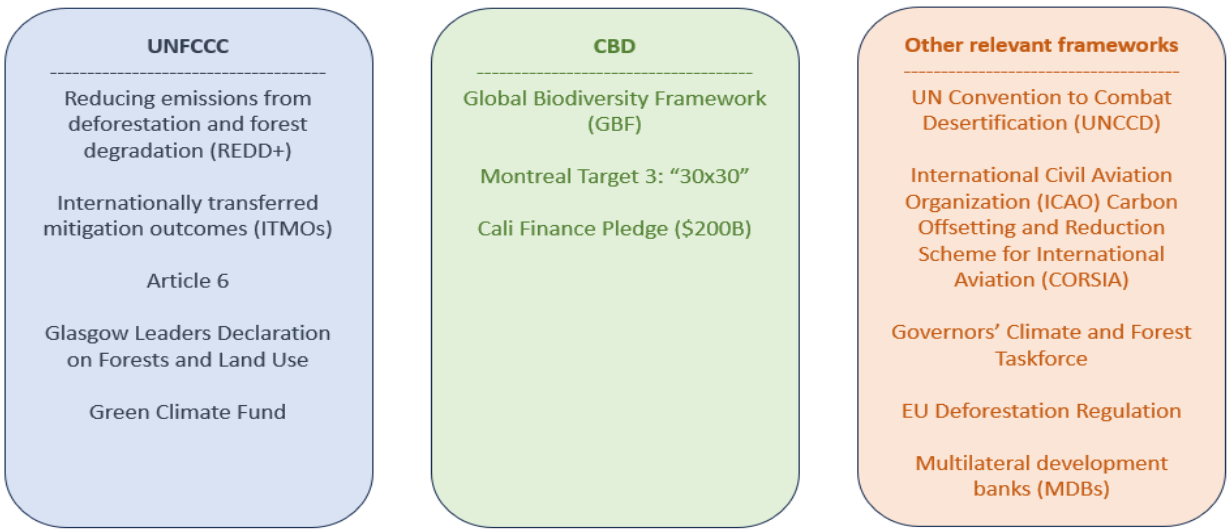
The size of public and private investment in forests pales in comparison to the investment and public subsidies received by agriculture. Therefore, it is important to consider not just investing *in* nature but also investing *for* nature (Zadek 2025). This means that, in addition to directing financial flows toward forest conservation, financial flows for other economic activities are also being reformed and revised in ways that help reduce forest loss or encourage regrowth. As noted above, Brazil has reformed its rural credit system to restrict subsidized credit to municipalities with low deforestation rates. Colombia is piloting the provision of favorable agricultural credit terms to farmers who engage in reforestation on their properties (BIOFIN 2025).

4. Global and Regional Policy Frameworks

Countries can and do undertake various forest policies domestically. Many of the most successful forest conservation programs have been national and unilateral. As mentioned earlier, Brazil's PPCDAm stands out as a flagship example of forest conservation success. Other success stories, such as Indonesia's moratorium on permits for forest clearing, the PRC's logging ban, and Costa Rica's PES program, have also been strongly national in character and implementation.

Even so, there are compelling reasons for countries to participate in multilateral fora to advance forest conservation. These reasons may include attracting investment by soliciting larger scales of public or private finance from external capital than would be available domestically; increasing attention by leveraging the media coverage afforded by global summits to announce plans or highlight achievements; leveraging successful efforts through diplomacy to encourage actions by other countries; sharing knowledge by accessing scientific expertise on best practices and communicating lessons learned; and coordinating with other nations on global, regional, and transboundary issues involving forest management and harmonizing rules. For these reasons, most countries choose to engage in global and regional policy frameworks for forests (Figure 12).

Figure 12: Relevant Global and Regional Frameworks of Policy and Governance



CBD = Convention on Biological Diversity, EU = European Union, UN = United Nations, UNFCCC = United Nations Framework Convention on Climate Change.
Source: Author.

The largest and most influential global policy framework involving forests is the UNFCCC. Since 1992, the UNFCCC has met annually to negotiate a global response to climate change. The 2015 Paris Agreement remains the high-water mark of these negotiations, with all Parties agreeing to periodically submit "nationally determined contributions"—national pledges outlining their goals for climate mitigation, adaptation, and finance. The UNFCCC also conducts periodic "stock-takes" to assess collective progress toward global goals. In principle, this ratcheting mechanism encourages countries to strengthen their commitments over time. The UNFCCC's principal mechanism related to forests is REDD+, as previously described. The finalization of Article 6 rules in Baku in 2024—concerning international carbon trading—may enable certain elements of REDD+ to become operational.

Additionally, there are other aspects of the UNFCCC that have implications for forests. Before REDD+ and Article 6, the primary financial mechanism for climate mitigation from forests within the UNFCCC was the Clean Development Mechanism (CDM)'s credit program for afforestation/reforestation. Since the first afforestation/reforestation project was approved through the CDM for reforestation aimed at watershed management in the PRC's Pearl River Basin, 67 afforestation/reforestation projects have been approved, with 27 located in the Asia and Pacific region (UNFCCC 2025b). Ironically, the CDM allowed for credits for reforestation but none for avoided deforestation. This created a paradox where projects could generate carbon credits by reforesting one site, gradually removing carbon from the atmosphere, but could not receive credits for preventing the deforestation of a neighboring site, which would have a much larger and quicker carbon impact.

The UNFCCC also hosts its own multilateral finance institution—the Green Climate Fund (GCF). The GCF is unique in its exclusive focus on climate mitigation and adaptation, with its governing board composed equally of representatives from Annex I countries (i.e., "developed" countries as of 1992) and non-Annex I countries. Since its establishment in 2010, the GCF has approved 86 projects related to forests and land use out of a total of 314 projects. It has provided $615 million in financing for 18 projects that include forests in their titles. Of these projects, 16 focused on mitigation or were crosscutting between mitigation and adaptation; and 4 were in the Asia and Pacific region (GCF 2025).

Outside of official negotiations and institutions, the UNFCCC meetings serve as a venue for international coordination among like-minded members. At the 2021 summit, leaders from 144 countries signed the Glasgow Leaders' Declaration on Forests and Land Use (National Archives 2023), pledging to collectively halt and reverse forest loss by 2030. The goals of this declaration are carried forward through the Forest Climate Leaders Partnership.

The Convention on Biological Diversity (CBD), created in 1992, aims to conserve global biological diversity, use its components sustainably, and share the benefits of genetic resources fairly and equitably. In 2022, the CBD adopted the Kunming–Montreal Global Biodiversity Framework (GBF), with the ambitious goal of achieving "a world living in harmony with nature by 2050" (CBD 2025). Like the Paris Climate Agreement, the Framework is structured around countries setting and communicating their own commitments, with periodic global stock-takes to assess collective progress toward meeting its 23 global targets.

A centerpiece of the GBF is Target 3, which aims to conserve 30% of Earth's land, waters, and seas by 2030. This target encompasses not only conventional protected areas but also "other effective area-based conservation measures" and recognizes the rights of Indigenous Peoples and local communities to their traditional territories. GBF Target 3 builds on Aichi Target 11, agreed upon in 2010, which aimed to protect at least 17% of terrestrial and inland waters and 10% of coastal and marine areas. This target has been met on land but not yet in ocean (Protected Planet 2024).

Many of the other targets outlined in the GBF also have implications for forests. These include planning and managing all areas to reduce biodiversity loss (Target 1); restoring 30% of all degraded ecosystems (Target 2); halting species extinction (Target 4); ensuring the sustainable harvesting and trade of wild species (Target 5); minimizing the impacts of climate change on biodiversity (Target 8); managing wild species sustainably (Target 9); managing forestry sustainably for biodiversity (Target 10); restoring, maintaining, and enhancing ecosystem services (Target 11); increasing access to urban nature (Target 12); ensuring fair and equitable benefit-sharing of genetic resources (Target 13); and reforming harmful subsidies (Target 18).

The GBF calls on countries to increase their biodiversity financing to $200 billion per year from all sources (Target 19). This includes raising ODA and other international financial resources from developed countries to $30 billion by 2030, significantly enhancing domestic resource mobilization, and leveraging private finance. It encourages innovative financing such as PES, green bonds, biodiversity credits (Wunder et al. 2025), and benefit-sharing mechanisms, all with environmental and social safeguards. This commitment will be partially operationalized through the Cali Fund for the Fair and Equitable Sharing of Benefits, hosted in partnership with the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). The Cali Fund aims to mobilize new funding streams for biodiversity action and allocate 50% of resources to Indigenous Peoples and local communities.

The United Nations Convention on Combating Desertification (UNCCD) was the third convention established at the 1992 Rio de Janeiro Earth Summit, alongside the UNFCCC and CBD. It aims to combat land degradation, desertification, and drought through national action plans and international partnerships. For example, the UNCCD supports the African Union-led Great Green Wall initiative, which seeks to reverse erosion, degradation, and desertification by restoring hundreds of millions of hectares of degraded land across the Sahel region.

Other United Nations (UN) agencies also administer programs related to international forest conservation and restoration. UNEP and the Food and Agriculture Organization of the United Nations (FAO) lead the UN Decade on Restoration, which aims to prevent, halt, and reverse deforestation on every continent. This initiative is complemented by intergovernmental efforts such as the Bonn Challenge, where more than 60 countries have pledged to restore more than 350 million hectares of degraded and deforestation land, as well as the Global Mangrove Alliance, which seeks to expand global mangrove cover by 20% by 2030. Additionally, private forest restoration initiatives like Trillion Trees contribute to these efforts. The UN Department of Economic and Social Affairs hosts the UN Forum on Forests, which promotes the management, conservation, and sustainable development of all types of forests.

The International Civil Aviation Organization (ICAO) is responsible for managing greenhouse gas emissions from international flights. These emissions are not solely the responsibility of individual countries, like those that account for the majority of emissions negotiated under the UNFCCC. ICAO links to forests through its emissions trading system, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which covers emissions from international flights. CORSIA allows offsets from various sources, including efforts to reduce deforestation and restore forests (ICAO 2025). Similarly, the International Maritime Organization (IMO) governs emissions from international shipping, which also fall outside the auspices of the UNFCCC. The IMO plans to implement a carbon-trading system in 2028; however, there is currently no indication that it will include offsets from forests or other sources (IMO 2025).

Multilateral development banks (MDBs) provide grants and loans related to forests while also facilitating knowledge sharing and convening expertise. The Global Environment Facility serves as an agent for the three Rio conventions (UNFCCC, CBD, UNCCD). Additionally, the Green Climate Fund is a specialized MDB for climate under the UNFCCC that supports forests. The World Bank, the Asian Development Bank, Inter-American Development Bank, African Development Bank, and other MDBs include forest-related projects in their portfolios. At UNFCCC COP 28 in 2023, 10 MDBs jointly committed to boosting action on climate and development (ADB 2023).

Other international institutions are also concerned with forest conservation and restoration. The Governors' Climate and Forest Taskforce is a collaboration of 45 states and provinces that together encompass more than one-third of the world's tropical forest area (GCF Task Force 2025). The International Tropical Timber Organization promotes sustainable use, management, trade, legality, and capacity building in tropical forestry. The International Union of Forest Research Organizations is a global network of scientists and science organizations studying forests and fostering international cooperation in forest research. It includes institutions such as the Center for International Forestry Research and the World Agroforestry Center.

5. Challenges and Barriers to Implementation

Economic challenges

Of the various challenges and barriers faced by forest conservation and restoration, economic issues are at the forefront. As mentioned earlier, it is often the case that "forests are worth less alive than dead." For instance, a land user at the forest frontier in a country in Asia and the Pacific may choose between maintaining the land in its forested state or burning and clearing it to make way for an oil palm, rubber, or short-cycle pulp and paper plantation. Conversely, in the context of reforestation, a land user might decide between keeping the land as an oil palm plantation or replanting it as a forest. In either case, land users are likely to weigh the costs and benefits of forests versus plantations and, if they are acting according to economic theory, choose the land use they expect to yield the higher net benefits. This often leads to the preference for agricultural plantations over forests, resulting in a steady conversion of forested land to agriculture.

It is important to understand that the answer to the *individual* question of which land use provides a greater flow of net benefits to the land user often differs from the answer to the *social* question of which land use offers greater net benefits to society as a whole. Forests provide many social benefits—such as carbon, biodiversity, clean water, clean air, and protection from natural disasters—that are enjoyed by society but not accounted for by the land use decision-maker. In other words, forests generate positive externalities.

Furthermore, there are salient differences between the private benefits of agriculture and the social benefits of forests. The private benefits derived from clearing forests for crops are tangible, concentrated among the individuals or companies using the land, and easily monetizable through the sale of crops in well-functioning global markets. These benefits are often subsidized as well. In contrast, the social benefits of maintaining forests for their ecosystem services are diffused, accruing to many people locally (e.g., storm protection), regionally (e.g., clean air and water), or globally (e.g., climate and biodiversity). These social benefits are intangible and difficult to monetize, often omitted from conventional macroeconomic calculations of GDP due to their off-the-books nature and the challenges in measuring them.

Efforts are underway to address these economic challenges and barriers. For example, REDD+ seeks to consolidate the willingness-to-pay for environmental services among multiple beneficiaries, offering monetary compensation to land users for maintaining forests instead of clearing them (Seymour and Busch 2016). PES programs apply a similar approach across a broader set of ecosystem services (Salzman et al. 2018). In the PRC, “horizontal” EFT enables downstream provinces to pay upstream provinces based on the quality of water flowing down the river, creating a monetary incentive for upstream provinces to enhance water quality (ADB 2016). In California and the US West, “forest resilience bonds” aggregate the willingness to pay from urban utilities, insurance companies, and municipalities in exchange for managing nearby forests to reduce fire risk and improve water quality (GFI 2025b). Initiatives aimed at improving Natural Capital Accounting can help quantify the economic value of the ecosystem services provided by forests, paving the way for monetization and protective policies (World Bank 2025b).

Legal challenges

Forest conservation and restoration also encounter numerous legal challenges. Forests are frequently located in remote areas where governance is weak and the rule of law is not consistently applied. This allows for the illegal production and trade of timber, wildlife, and narcotics to operate more freely than in more densely populated areas. According to

Interpol, illegal logging and the illicit timber trade account for 15%–30% of all timber traded globally (Interpol 2025).

Land tenure in forested areas is often unclear or overlapping. Questions regarding who holds rights to use a particular area of land are frequently contested, and land claims may be unrecorded or recorded inconsistently by different ministries. This presents a barrier to various forms of forest conservation, including payments from environmental markets such as REDD+. Brazil is attempting to clean up rural land tenure through its Rural Environmental Registry (CAR) (Lopes et al. 2023). Indonesia has made efforts to clarify land rights through its One Map Project (World Bank 2018).

Additionally, land clearance as a means of obtaining legal land rights poses an obstacle to conservation. In many countries, clearing forests is a necessary step for land users to prove "productive use" as a way of obtaining legal title to the land. Maintaining or replanting forests does not provide similar proof of productive use (Araujo et al. 2009). In other countries, forest ministries have exclusive authority to grant land concessions or ownership, which can lead to rent-seeking behavior (e.g., Burgess et al. 2012).

Indigenous Peoples often act as strong guardians of forests, as previously mentioned. However, their territorial claims are often not legally secured, and their ability to contest territorial infiltration is limited. Indigenous territories have demonstrated lower rates of deforestation across the tropics when compared to similar matched lands (Sze et al. 2022).

Political challenges

Partly due to economic and legal imbalances in favor of forest conversion over conservation, political support for forests is often limited. Agriculture holds a privileged position in many countries, as rural communities depend on food production for livelihoods and subsistence. Even in urban areas, concerns over rising food prices make agriculture a political "third rail." As a result, politicians are more likely inclined to subsidize agriculture than to restrict it in ways that protect forest.

By contrast, it is often more difficult to form winning political coalitions in support of forest conservation, and these coalitions tend to be politically weaker. Indigenous Peoples and other forest-dependent communities are often remote from capitals and in many countries face social marginalization and stigmatization. Support for biodiversity, carbon sequestration, and the other ecosystem services provided by forests is widespread but shallow, and difficult to aggregate into winning electoral issues or legislative backing. Politicians who enact forest conservation policies typically do so as part of a broader platform rather than as a central focus of their campaigns. Still, it can happen: Luiz Inácio Lula da Silva prominently featured Amazon conservation in his campaign for a second presidential term and subsequent governing agenda (Villegas and Kaplan 2022).

International coordination challenges

Conserving and restoring forests at a scale that is meaningful for addressing global climate change and biodiversity loss necessitates international coordination, which brings additional challenges. The most significant forest loss is occurring in tropical countries, while the greatest willingness to pay for climate change and biodiversity conservation is in developed countries. This imbalance motivates the concept of international financial transfers. However, establishing rules for such transfers has proven time-consuming. Negotiating the REDD+ framework through the UNFCCC took 7 years, from its introduction in Bali in 2007 to its conclusion in Warsaw in 2014. Negotiating the rules for Article 6 took an additional 9 years, from Paris in 2015 to Baku in 2024. Then, moving public funds has proven challenging due to “aidification,” as previously described.

Reductions in deforestation in one country can potentially lead to increased deforestation elsewhere due to “leakage,” where deforestation shifts to countries or regions with less stringent forest protection policies (Atmadja and Verchot 2012). This can occur through the global trade of commodities linked to deforestation, as production is displaced. International leakage is more likely to undermine conservation goals based on area rather than forest attributes such as carbon, as deforestation may move from high-carbon areas (such as the Amazon) to lower-carbon areas (such as the Cerrado, or the US Midwest) (Villoria et al. 2022). Achieving international harmonization on deforestation policy can help diminish such leakage.

Knowledge gaps and technological challenges

Until recently, spatial data on forest cover change was expensive and scarce. However, this changed in 2013 with the publication of a global, annual, high-resolution data set on forest cover loss (Hansen et al. 2013). Since then, data sets on forest cover loss and gain have proliferated and continued to improve in spatial resolution (e.g., Sentinel, Planet), frequency, accuracy, cost, and number of providers. High-frequency data on forest cover loss can identify deforestation within days of its occurrence (e.g., DETER in Brazil), enabling real-time enforcement of forest laws. Rapid advancements are being made in land-use detection, carbon stock monitoring (e.g., GEDI), and even forest biodiversity.

Thus, science and technology are not as significant a barrier to forest conservation and restoration as they are to other aspects of climate change mitigation. What is most needed is not technological breakthroughs, but rather policy reforms. This is not to say that there are not areas where technological advances are useful. For example, reforestation can be facilitated by drone dispersal (Marzuki et al. 2021). Natural capital accounting initiatives are helping to make the flow of ecosystem services provided by forests and other natural capital more visible to policymakers (Fenichel 2025).

Increasing agricultural yields can ease tension between food production and land expansion. In principle, growing more food per hectare should mean that fewer hectares are required for food production, thus reducing agricultural expansion at the expense of forests (the Borlaug Hypothesis). However, greater food production per hectare also raises the economic returns to farmland, making it more valuable than forests and spurring further conversion (Jevons Paradox). Whether yield increases will lead to less deforestation or more is the subject of empirical analysis (e.g., Pelletier et al. 2020), and so far, the results appear to be a wash (Busch and Ferretti-Gallon 2022). To ensure that forest conservation and increased food production occur together as a result of yield increases, these increases should be paired with direct forest conservation measures.

6. Policy Recommendations and Way Forward

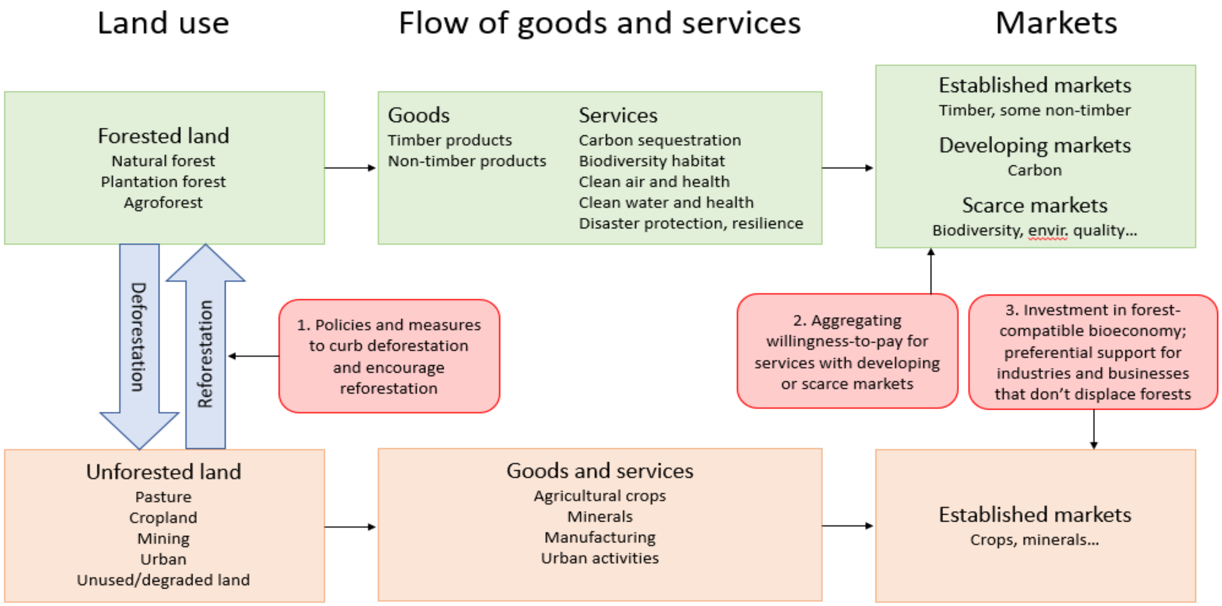
Across the Asia and Pacific region, forests are being lost far more rapidly than they are regrowing, leading to severe consequences for climate change and biodiversity. However, large-scale success in reducing deforestation is achievable, as demonstrated by the experiences of Brazil and Indonesia. Deforestation can even be reversed, as shown by the PRC and Costa Rica.

The most successful measures for reducing deforestation have been restrictive. In Brazil, these measures included establishing protected areas, Indigenous reserves, enforcing forest laws, and imposing credit restrictions on high-deforesting municipalities. In Indonesia, a moratorium on converting forests to oil palm and short-rotation wood fiber species was implemented.

However, restrictive measures alone shift the opportunity costs of conservation onto rural land users, who are compelled to forgo economic development opportunities based on expanding agriculture and pasture at the expense of forests. Thus, for long-term sustainability, there is a political economy mandate to provide positive incentives that alleviate costs for rural land users. Examples include payments for ecosystem services (PES) in Costa Rica, eco-compensation in the PRC, and ecological fiscal transfers (EFT) for forests in India.

The Asian Development Bank (ADB), in its role as a public sector lender, can significantly contribute to accelerating forest conservation and restoration across the 46 economies of the Asia and Pacific region. Here are three potential ways it can assist (Figure 13).

Figure 13: Proposed Development Bank Actions to Support Forest Conservation



Source: Author.

First, ADB can provide national governments with loans, grants, and technical expertise to support public policies and private initiatives aimed at reducing deforestation and increasing reforestation. These policies could be restrictive, such as establishing protected areas, Indigenous reserves, and enforcing forest laws, or they could be positive, such as implementing payments for ecosystem services, ecological fiscal transfers, or investing in reforestation programs.

Second, ADB can help aggregate willingness to pay for the conservation of forests and their services across disparate beneficiaries, channeling this into increased revenue for land-use decision-makers. For instance, Californian "forest resilience bonds" consolidate willingness to pay from urban utilities, insurance companies, and municipalities in exchange for managing nearby forests to reduce fire risk and improve water quality (GFI 2025b). Another example is the PRC's "horizontal" EFT, where downstream provinces pay upstream provinces for river water quality, financially supported by the central government (ADB 2016). Additionally, reforestation initiatives around the world aim to improve water quality for urban drinking water and hydroelectric dams (Teng et al. 2019).

Third, ADB can support the development of a "bioeconomy" sector that fosters economic development enterprises compatible with conserved or regrowing forests. This sector extends beyond the production and sale of carbon credits and can include nature-based tourism, shade-grown coffee and other crops, non-timber forest products, and the development of pharmaceuticals and innovative materials derived from the properties of forest plants and animals.

References

A6IP. 2025. Current Developments in Bilateral Cooperation and Article 6.4 Mechanism.

Asian Development Bank (ADB). 2016. Toward a National Eco-compensation Regulation in the People's Republic of China.

ADB. 2023. COP28 Multilateral Development Banks (MDB) Joint Statement.

Angelsen, A. et al. 2025. Explaining the Recent Reduction of Indonesia's Deforestation. Centre for Land Tenure Studies Report 01/25. Norwegian University of Life Sciences (MBNU).

Araujo, C. et al. 2009. Property Rights and Deforestation in the Brazilian Amazon. *Ecological Economics*. 68 (8-9). pp. 2461–2468.

Arriagada, R. A. et al. 2015. Do Payments Pay Off? Evidence from Participation in Costa Rica's PES Program. PLOS One 10(8). e0136809.

Assuncao, J. et al. 2013. DETERring Deforestation in the Brazilian Amazon: Environmental Monitoring and Law Enforcement. Climate Policy Institute.

Assuncao. J. et al. 2015. Deforestation Slowdown in the Brazilian Amazon: Prices or Policies? *Environment and Development Economics*. 20 (6). pp. 697–722.

Atmadja, S. and L. Verchot 2012. A Review of the State of Research, Policies and Strategies in Addressing Leakage from Reducing Emissions from Deforestation and Forest Degradation (REDD+). *Mitigation and Adaptation Strategies for Global Change*. 17. pp. 311–336.

Bauhoff, S. and J. Busch 2020. Does Deforestation Increase Malaria Prevalence? Evidence from Satellite Data and Health Surveys. *World Development*. 127. 104734.

Begum, S. 2025. Singapore Inks Carbon Trading Agreement with Peru. *The Straits Times*.

Bellard, C. et al. 2012. Impacts of Climate Change on the Future of Biodiversity. *Ecology Letters*. 15 (4). pp. 365–377.

BIOFIN. 2025. Colombia Leads the Way in Greening Agricultural Finance to Protect Biodiversity. The Biodiversity Finance Initiative, United Nations Development Programme.

Boucher, D. 2014. How Brazil Has Dramatically Reduced Tropical Deforestation. *Solutions*. 5 (2). pp. 66–75.

Brack, D. 2024. Does the EU Deforestation Regulation Comply with WTO requirements? *Forest Trends*.

Burgess, R. et al. 2012. The Political Economy of Deforestation in the Tropics. *Quarterly Journal of Economics*. 127 (4). pp. 1707–1754.

Busch, J. 2025. Climate Mitigation Potential of Asia-Pacific Forests. ADB.

Busch, J. et al. 2015. Reductions in Emissions from Deforestation from Indonesia's Moratorium on New Oil Palm, Timber, and Logging Concessions. *Proceedings of the National Academy of Sciences of the United States of America*. 112 (5). pp. 1328–1333.

Busch, J. et al. 2021. A Global Review of Ecological Fiscal Transfers. *Nature Sustainability*. 4. pp. 756–765.

Busch, J. and K. Ferretti Gallon. 2022. What Drives Deforestation, Reforestation, and Forest Degradation? An Updated Meta-Analysis. *Review of Environmental Economics and Policy*. 17 (2). pp. 217–250.

Choi, S. et al. 2002. Large Rate of Uptake of Atmospheric Carbon Dioxide by Planted Forest Biomass in Korea. *Global Biogeochemical Cycles*. 16 (4). pp. 361–365.

Colonia, C. B. et al. 2024. Malaria, Relationship with Climatic Variables and Deforestation in Colombia, Latin America and the Caribbean from 2000 to 2020: A Systematic Review. *Malaria Journal*. 23 (347).

Convention on Biological Diversity (CBD). 2025. Global Biodiversity Framework. Curtis, P.G. et al. 2018. Classifying Drivers of Global Forest Loss. *Science*. 361 (6407). pp. 1108–1111.

da Fonseca, G. A. B. et al. 2007. No Forest Left Behind. *PLoS Biology*. 5 (8). pp. 1645–1646.

Daniel, A. 2025. Farewell to USAID: Reflections on the Agency that President Trump Dismantled. Goats and Soda, National Public Radio.

De Palma, A. et al. 2021. Annual Changes in the Biodiversity Intactness Index in Tropical and Subtropical Forest Biomes, 2001–2012. *Scientific Reports*. 11. 20249.

de Paula Mateus, D. et al. 2018. Defaunation Impacts on Seed Survival and Its Effect on the Biomass of Future Tropical Forests. *Oikos*. 127 (10).1. pp. 526–1538.

Dubayah, R. et al. 2023. GEDI L4B Gridded Aboveground Biomass Density, Version 2.1. ORNL DAAC.

Dupraz-Dobias, P. 2025 What Do New Rules on Carbon Offsets Mean for Dealmaker Switzerland? Swissinfo.ch.

Durst, P. B. et al. 2001. Forests Out of Bounds: Impacts and Effectiveness of Logging Bans in Natural Forests in Asia-Pacific. Food and Agricultural Organization of the United Nations (FAO).

FAO. 1996. Debt-for-Nature Swaps: A Decade of Experience and New Directions for the Future. FAO.

FAO. 2014. State of World's Forests 2014.

FAO. 2020. Global Forest Resources Assessment 2020.

FAO. 2024. The State of the World's Forests 2024.

Fenichel, E. 2025. Natural Capital Accounting Background Paper. ADB.

GCF Task Force. 2025. Who We Are. Governors' Climate and Forest Task Force.

Geist, H. J. and E. Lambin. 2002. Proximate Causes and Underlying Driving Forces of Tropical Deforestation: Tropical Forests Are Disappearing as the Result of Many Pressures, Both Local and Regional, Acting in Various Combinations in Different Geographical Locations. *BioScience*. 52 (2). pp. 143–150.

Geldmann, J. et al. 2014. Mapping Change in Human Pressure Globally on Land and Within Protected Areas. *Conservation Biology*. 28 (6). pp. 1604–1616.

Global Environment Facility (GEF). 2024. GEF Strategy on Forests: Preserving Forests, for the Future of Nature and People.

Global Forest Watch (GFW). 2025. Global Forest Watch 2023 Statistics Summary v30102024. World Resources Institute. (accessed April 2025).

Gorenflo, L. et al. 2012. Co-occurrence of Linguistic and Biological Diversity in Biodiversity Hotspots and High Biodiversity Wilderness Areas. *Proceedings of the National Academy of Sciences of the United States of America*. 109 (21). pp. 8032–8037.

Gov.br. 2024. At COP16, Five Countries Commit to Tropical Forest Finance Facility.

Green Climate Fund (GCF). 2025. Open Data Library: Funded Activities.

Green Finance Institute (GFI). 2025a. Tropical Asia Forest Fund 2.

GFI. 2025b. Forest Resilience Bond.

Greenfield, P. 2023. Revealed: More than 90% of Rainforest Carbon Offsets by Biggest Certifier Are Worthless, Analysis Shows. *The Guardian*. 18 January.

Guo, J. et al. 2022. Forest Cover Change in China from 2000 to 2016. *International Journal of Remote Sensing*. 43 (2). pp. 593–606.

Hansen, M. et al. 2013. High-Resolution Global Maps of 21st-Century Forest Cover Change. *Science*. 342 (6160). pp. 850–853.

Harris, N. et al. 2021. Global Maps of Twenty-First Century Forest Carbon Fluxes. *Nature Climate Change*. 11. pp. 234–240.

Hua, F. et al. 2022. The Biodiversity and Ecosystem Service Contributions and Trade-offs of Forest Restoration Approaches. *Science*. 376. pp. 839–844.

IBGE. 2023. 2022 Census: Brazil Has 1.7 Million Indigenous Persons and More Than Half of Them Live in the Legal Amazon. Brazilian Institute of Geography and Statistics.

International Civil Aviation Organization (ICAO). 2025. Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

International Institute for Environment and Development (IIED). 2024. Debt Swaps Could Release $100 Billion for Climate Action.

International Maritime Organization (IMO). 2025. IMO Approves Net-Zero Regulations for Global Shipping.

International Union for the Conservation of Nature (IUCN). 2025. Red List. (accessed July 2025).

Interpol. 2025. Forestry Crime

Key Biodiversity Areas (KBA). 2025. Key Biodiversity Areas. (accessed April 2025).

Khaine, I. and S. Y. Woo. 2014. An Overview of the Interrelationship Between Climate Change and Forests. *Forest Science and Technology*. 11. pp. 11–18.

Kulik, K. N. et al. 2023. The Role of Protective Afforestation in Drought and Desertification Control in Agro-Landscapes. *Systematic Study of Arid Territories*. 13. pp. 1–10.

Lan, L. N. et al. 2025. Harnessing Forests to Achieve the SDGs in Asia and the Pacific. ADB Policy Brief. Asian Development Bank.

Latona, D. and V. Furness. 2025. Spain and World Bank in Push for Wider Use of 'Debt Swaps.' *Reuters*.

Li, Y. et al. 2015. Local Cooling and Warming Effects of Forests Based on Satellite Observations. *Nature Communications*. 6. 6603.

Loft, P. et al. 2025. UK Aid: Reducing Spending to 0.3% of GNI by 2027/28. House of Commons Library, UK Parliament.

Lopes, C. L. et al. 2023. Where Does Brazil Stand with the Implementation of the Forest Code? A Snapshot of CAR and PRA in Brazilian States – 2023 Edition. Climate Policy Initiative

Mamo, D. et al. 2022. The Indigenous World 2022: 36th Edition. (accessed July 2025).

Marois, D. E. and W. J. Mitch. 2015. Coastal Protection from Tsunamis and Cyclones Provided by Mangrove Wetlands – A Review. *International Journal of Biodiversity Science, Ecosystem Services & Management*. 11 (1). pp. 71–83.

Marzuki, O. F. et al. 2021. The Mechanism of Drone Seeding Technology: A Review. *Malaysian Forester*. 84 (2). pp. 349–358.

Mather, A. S. 1992. The Forest Transition. *Area*. 24 (4). pp.367–379.

Michinaka, T. 2018. Approximating Forest Resource Dynamics in Peninsular Malaysia Using Parametric and Nonparametric Models, and Its Implications for Establishing Forest Reference (Emission) Levels under REDD+. *Land*. 7 (2). pp. 70.

Mokany, K. et al. 2006. Critical Analysis of Root: Shoot Ratios in Terrestrial Biomes. *Global Change Biology*. 12 (1). pp. 84–96.

Mongabay. 2025. Indonesia’s Deforestation Claims Under Scrutiny Over ‘Cherry-Picked’ Data.

National Archives. 2023. Glasgow Leaders’ Declaration on Forests and Land Use.

Nedopil, C. and T. Sun. 2025. Current Perspectives on Debt-for-Nature Swaps: Moving from Exploratory to Empirical Research. *Current Opinion in Environmental Sustainability*. 74. 101538.

Nepstad, D. et al. 2014. Slowing Amazon Deforestation Through Public Policy and Interventions in Beef and Soy Supply Chains. *Science*. 344 (6188). pp. 1118–23.

Olson, D. M. et al. 2001. Terrestrial Ecoregions of the World: A New Map of Life on Earth. *Bioscience*. 51 (11). pp. 933–938.

Pelletier, J. et al. 2020. Does Smallholder Maize Intensification Reduce Deforestation? Evidence from Zambia. *Global Environmental Change*. 63. 102127.

PIB. 2018. Location and Extension of Indigenous Lands. Povos Indigenas no Brazil.

Pillay, R. et al. 2022. Tropical Forests Are Home to Over Half of the World's Vertebrate Species. *Frontiers in Ecology and Environment*. 20 (1). pp. 10-15. doi: 10.1002/fee.2420.

Potapov, P. et al. 2017. The Last Frontiers of Wilderness: Tracking Loss of Intact Forest Landscapes from 2000 to 2013. *Science Advances*. 3 (1).

Protected Planet. 2024. United Nations Environment Programme.

Rahayu, S. et al. 2022. Functional Trait Profiles and Diversity of Trees Regenerating in Disturbed Tropical Forests and Agroforests in Indonesia.” *Forest Ecosystems*. 9. 1000030.

Reddy, C. S. et al. 2013. National Assessment of Forest Fragmentation in India: Landscape Indices as Measures of the Effects of Fragmentation and Forest Cover Change. *Ecological Engineering*. pp. 453–464.

Reuters. 2024. Bolivia to Sell $5 Bln in Carbon Credits to Stem Rampant Forest Loss.

Rights and Resources Initiative (RRI). 2015. Who Owns the World’s Land? A Global Baseline of Formally Recognized Indigenous and Community Land Rights.

Salzman, J. et al. 2018. The Global Status and Trends of Payments for Ecosystem Services. *Nature Sustainability*. 1 (3). pp. 136–144.

Sanchez-Azofeifa, A. 2013. Analysis of the Forest Cover of Costa Rica Between 1960 and 2013.

Santilli, M. et al. 2005. Tropical Deforestation and the Kyoto Protocol. *Climatic Change*. 71. pp. 267–276.

Seymour, F. and A. Angelsen. 2012. Summary and Conclusions: REDD+ Without Regret. In A. Angelsen, ed. *Analysing REDD+: Challenges and Choices*. Center for International Forestry Research.

Seymour, F. and J. Busch. 2016. Why Forests? Why Now? The Science, Economics, and Politics of Tropical Forests and Climate Change. Center for Global Development.

Shah, P. et al. 2021. What Determines the Effectiveness of National Protected Area Networks? *Environmental Research Letters*. 7. 074017.

Sheldon, T. L. and C. Sankaran. 2017. The Impact of Indonesian Forest Fires on Singaporean Pollution and Health. *American Economic Review*. 107 (5). pp. 526–529.

Slik, J. W. F. et al. 2015. An Estimate of the Number of Tropical Tree Species. *Proceedings of the National Academy of Sciences*. 112. (24). pp. 7472–77.

Smith, P. et al. 2021. How Do We Best Synergize Climate Mitigation Actions to Co-benefit Biodiversity? *Global Change Biology*. 28 (8). pp. 2555–2577.

Sulaiman, S. and G. Suroyo. 2024. Exclusive: Indonesia's Prabowo Plans $65 Bln Green Fund from Selling Carbon Credits. *Reuters*.

Sze, J. S. et al. 2022. Reduced Deforestation and Degradation in Indigenous Lands Pan-Tropically. *Nature Sustainability*. 5. pp. 123–130.

Taye, F. A. et al. 2021. The Economic Values of Global Forest Ecosystem Services: A Meta-Analysis. *Ecological Economics*. 189. 107145.

Teng, M. et al. 2019. Impacts of Forest Restoration on Soil Erosion in the Three Gorges Reservoir Area, China. *Science of the Total Environment*. 697. 134164.

United Nations Framework Convention on Climate Change (UNFCCC). 2023. Payments for Environmental Services Program | Costa Rica.

UNFCCC. 2025a. Article 6 of the Paris Agreement.

UNFCCC. 2025b. CDM Project Activity Search.

United States (US) State Department. 2024. Debt-for-Nature Swaps Could Help Protect Economies and Ecosystems.

Villoria, N. et al. 2022. Leakage Does Not Fully Offset Soy Supply-Chain Efforts to Reduce Deforestation in Brazil. *Nature Communications*. 13. 5476.

von Thunen, J. H. 1826. *The Isolated State*.

Vythilingam, I. and N. K. Jeyaprakasam. 2024. Deforestation and Non-human Primate Malarias Will Be a Threat to Malaria Elimination in the Future: Insights from Southeast Asia. *Acta Tropica*. 257. 107280.

Villegas, P. and S. Kaplan. Lula Vowed to Safeguard the Amazon. After Bolsonaro, It Won't Be Easy.

Waldron et al. 2020. Protecting 30% of the Planet for Nature: Costs, Benefits and Economic Implications.

West, T. A. P. et al. 2023. Action Needed to Make Carbon Offsets from Forest Conservation Work for Climate Change Mitigation. *Science*. 381 (6660). pp. 873–877.

White, R. J. and O. Nazgour. 2020. Emerging Zoonotic Diseases Originating in Mammals: A Systematic Review of Effects of Anthropogenic Land-Use Change. *Mammal Review*. 50 (4). pp. 336–352.

WorldAtlas. 2025. What Is a Biodiversity Hotspot? (accessed April 2025).

World Bank. 2018. Indonesia - Program to Accelerate Agrarian Reform (One Map Project).

World Bank. 2025a. World Bank Development Indicators.

World Bank. 2025b. Natural Capital.

Wunder, S. et al. 2025. Biodiversity Credits: An Overview of the Current State, Future Opportunities, and Potential Pitfalls. *Business Strategy and the Environment*. 0. pp. 1–30.

Zabel, A. 2023. Study on the Existing Resources for Forests. Section D: Global Forest Financing Facilitation Network.

Zadek, S. 2025. Nature Finance Background Paper. ADB.