



Rainforest Foundation
Norway

State of the tropical rainforest

*The complete overview of the tropical rainforest,
past and present.*

Deforestation 2019

35 523 km²

(Larger than the Netherlands)



Rainforest Foundation Norway is one of the world's leading organisations in the field of rights-based rainforest protection. We are working for a world where the environment is protected and human rights are fulfilled.

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Cover photo: Alexis Huguet/Rainforest Foundation Norway

Introduction

This report is the first in the world of its kind. Granted, there has been scattered research on the state and extension of the tropical rainforest. However, that research has often applied varying methodologies and they are not always comparable, nor do they necessarily present the latest data or use the same reference year. This has made it impossible to monitor the global state and historical development of the tropical rainforest in an easy and reliable manner.

Why is this important? Simply put because the tropical rainforest is arguably the most important terrestrial ecosystem on the planet.

It provides a wide range of invaluable ecosystem services for all life on Earth. Yet available data on the state of this particular tropical forest type has been surprisingly inadequate. Along with a scarcity of global biome specific forest data, misconceptions about tropical rainforests flourish. This confuses the public discourse on tropical rainforest, and at worst it could mislead policy makers and policy influencers about the true state of this unique ecosystem.

The world cannot afford that. We need the debate over how to save the rest of the tropical rainforests to be founded on reliable data on the condition of these forests. "One third" is a key takeaway from this report:

- One third of the original tropical rainforest is gone.
- One third of the original tropical rainforest is degraded.
- One third of the original tropical rainforest is still intact.

There are both positive and alarming angles to take from these simple facts. It's positive that we have not cleared half of the world's tropical rainforest, a common statement found on various credible web sites. It's alarming that only one third is left intact given that degraded forests often struggle to sustain themselves.

This report is the first complete overview of the state of the world's tropical rainforest at present and in a historical perspective. It aims to fill a critical knowledge gap in the effort to preserve these invaluable forests for future generations. 🌿



Original

Tropical rainforest cover
(all forest intact)¹
14 580 513 km²



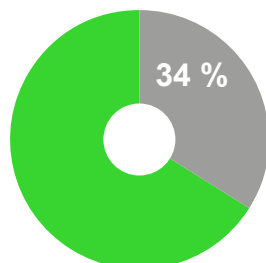
2019

Tropical rainforest cover
9 538 022 km²

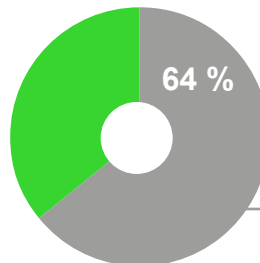


2016

Intact tropical rainforest
5 247 415 km²

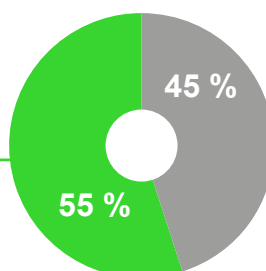


Total deforestation
5 042 491 km²



Total deforestation and degradation
9 333 098 km²

Intact tropical rainforest
5 247 415 km²



Degraded tropical rainforest
4 290 607 km²

Current rainforest cover (2019)

¹All figures are referring to canopy cover of 30 % or more. See method chapter at page 22 for more details.

The tropical rainforest



Photo: Thomas Marent

The tropical rainforest is a unique ecosystem in particularly three significant ways:

- It covers only 6,5 % of the Earth's terrestrial surface, yet holds more than half of the world's biological diversity.² No other ecosystem on Earth can match the biological diversity of this forest.
- It stores more carbon in live biomass than any other ecosystem on the planet.³ Thus, stopping the deforestation and degradation of tropical rainforests is key to be able to slow the human caused warming of Earth's oceans and atmosphere.
- It cools the air and creates evaporation more effectively than open water. It creates what has been termed the "biotic pump", which secures rainfall thousands of kilometres inland from the oceans⁴. It affects precipitation patterns all over the world⁵.

Defining tropical rainforests

Precipitation

There is no straightforward definition of a tropical rainforest. In terms of precipitation, some can receive more than 9 meters of rainfall annually, with little seasonal differences, like the Choco-Darién rainforest along the northern Pacific coast of South America⁶. The forests in the tropics that receive more than 2,5 meters of rainfall per year with little seasonal variations are growing in a climate

that deterministically supports rainforests. This means that the climate is the main driving force of the kind of ecosystem that develops. In such a climatological climax for a tropical rainforest, no other ecosystem will naturally grow⁷. This kind of rainforest climate is mainly found in interior parts of the Amazon and in Southeast Asia.

Other tropical rainforests can receive as little as 1,5 meters of rainfall a year, with a dry season that can last 3-5 months. The drier months are not rain free, but they receive significantly less rainfall than other months. These are tropical semi-evergreen rainforests, where some trees can shed the leaves during a short period of the dry season to conserve energy. This is a climate zone that also supports savannas. In this climate zone, the establishment of fire prone grasses strongly determines the establishment of a forest or savanna environment. Light-dependant fire prone grasses sustain the regular fires of the savannas. In contrast to savannas, rainforests do not consist of fire adapted plants and trees. Due to the lack of sufficient sunlight, the closed canopy of a rainforest does not allow for fire prone grasses to grow⁸. The forest also holds moisture well, so when the fires of the savannas reach the edge of intact rainforests, they die out.

This can create sharp borders between rainforest and savanna, with no transitional ecosystem between them. These are called forest-savanna mosaics and cover large areas of especially Amazonia and equatorial Africa⁹. Almost the entire Central African rainforest grows in this climate zone. The Yucatan rainforest in Mexico, Guatemala and Belize, and much of mainland Asia's rainforest also grow in this forest-savanna climate¹⁰. Over thousands of years, there is a slow back and forth struggle between forests and savannas in these areas, driven by many different factors¹¹, though large blocks of rainforests have remained relatively stable over time. Today, humans degrade enormous rainforest areas each year

◀ *This wet and frost-free climate allows plants to continually grow throughout the year without periods of energy conservation due to frost or drought.* ▶

so that the tropical rainforests become drier and lose the ability to withstand fires¹². If conditions change significantly, the forest ecosystem can collapse and transition to savanna. Thousands of kilometres of degraded rainforest burn every year due to human caused forest degradation, and human induced fires¹³.

In some areas, the soil and climatological conditions create transitional forests between rainforests and dry savannas. These are called everything from tropical dry forests or tropical monsoon forests, to seasonal tropical forests and tropical moist deciduous forests. This forest type has a prolonged and distinct dry season during which many of the trees shed their leaves¹⁴. They tend to flank the rainforest to the north or south. Even though many of these transitional forests can have a dense canopy much of the year and consist of broad-leaved trees, due to the drier climate and prolonged dry season, the trees have a lower stature than those of the rainforest. These forests also consist of fewer plant and animal species, and they store less carbon in live biomass¹⁵.

They can, however, have high endemic species composition. These forests can consist of a certain amount of fire adapted tree species, making them more adapted to fires than a rainforest environment¹⁶. However, this fire adaptability varies, even within the same forest area, and none can withstand fires of high intensity and durability¹⁷. Not all tropical dry or monsoon forests are transitional forests. The largest tropical dry forest in the world, which also is a transitional forest, is the Chiquitano forest in Bolivia and Brazil¹⁸.

Temperature

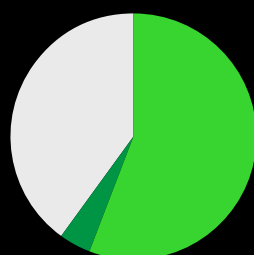
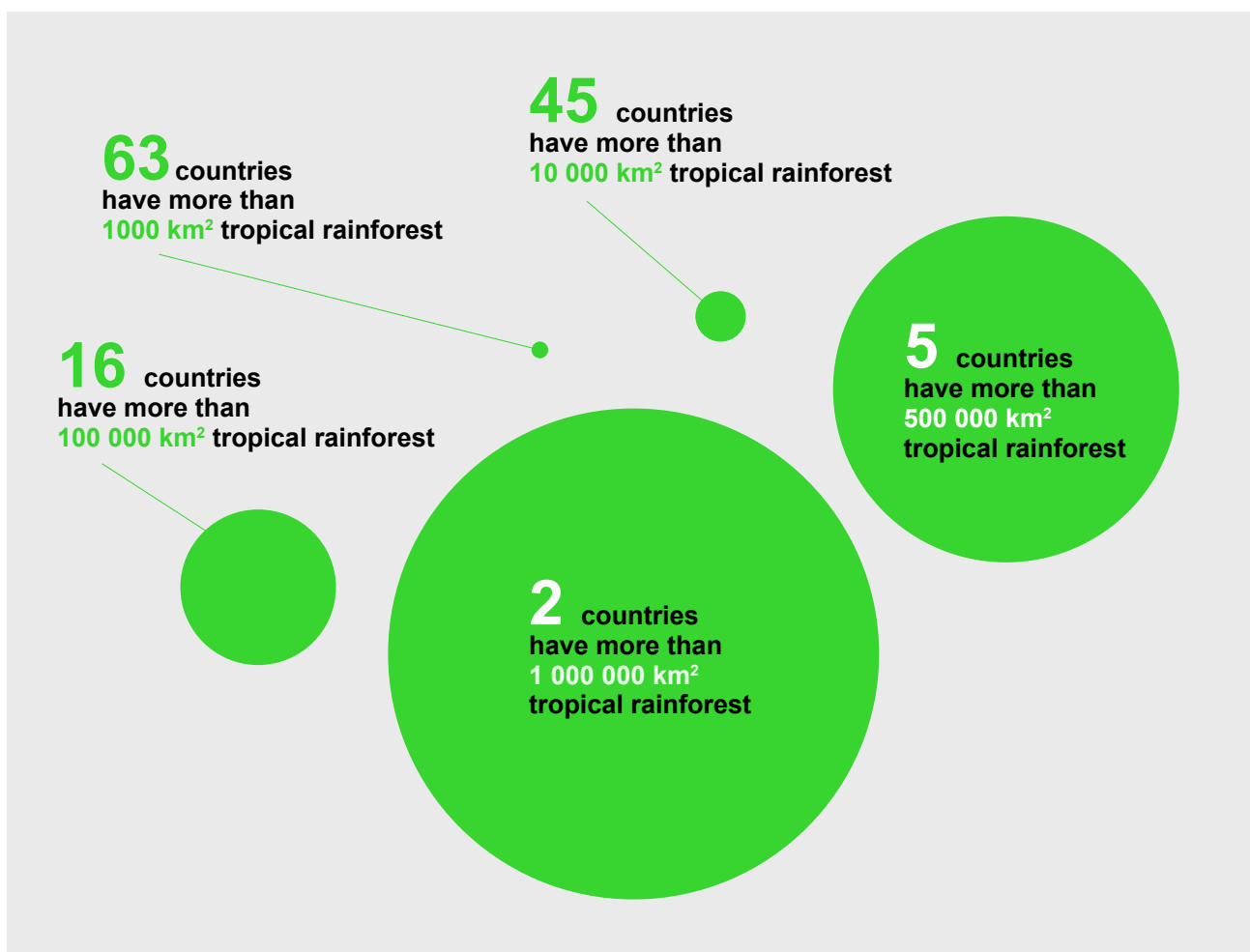
In terms of temperature, a defining factor for a tropical rainforest is that the climate is frost-free. Some areas of montane rainforest may experience rare and brief occurrences of night frost, but not more than what plants and trees that are not adapted to frost can withstand¹⁹. This wet and frost-free climate allows plants to continually grow throughout the year without periods of energy conservation due to frost or drought. This climate creates the most powerful plant growth conditions of any environment on the planet²⁰.

According to the Food and Agriculture Organization of the UN, the frost-free regions of the world are not strictly restricted to the latitude based definition of the tropical zone. There are tropical rainforests as far north as the foothills of the Himalayas, beyond the tropic of Cancer, and as far south as northern Argentina, beyond the tropic of Capricorn²¹. 🌍

Tropical rainforest in the world: 9 538 022 km²

73 countries still have tropical rainforest

French Guyana, Guadeloupe, and New Caledonia are overseas departments of France. Taiwan is counted as a country.



■ The tropical rainforest of the world
■ The Americas 60 %
■ The Amazon 56 %

America

South America	5 542 029
Central America (incl. Mexico)	194 606
Caribbean	11 403
North America (USA - Hawaii)	1 986
Total	5 750 024

Africa

Central Africa ²²	1 740 672
West Africa ²³	84 826
Madagascar	39 730
East Africa ²⁴	32 374
Total	1 897 602

Asia

Islands (Incl. Sri Lanka, Philippines, Taiwan, excl. West Papua)	660 971
Indochina (From Myanmar to Vietnam and China, incl. mainland Malaysia)	421 481
Indonesian Papua	326 310
India, Bangladesh and Himalaya	119 315
Total	1 528 077

Oceania

Total 2019	362 319
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Tropical rainforest per biome

Amazon/Orinoco/Andes	5 343 645
Central African rainforest (from eastern Nigeria to Rwanda/Uganda/Burundi, Cabinda)	1 722 668
New Guinea (island)	607 135
Borneo	337 905
Northern Triangle/Eastern Himalaya (continuous rainforest area from Nepal to northern Myanmar)	146 232
Sumatra	135 591
Chocó-Darien/Andes west (From Ecuador to Colombia and Panama)	103 648
Sulawesi	90 071
Yucatan/Maya rainforest (located in Mexico, Belize and Guatemala)	72 587
Atlantic rainforest South America (eastern Brazil, eastern Paraguay, and northern Argentina)	69 179
Guinea rainforest (West Africa) (From Guinea to western Nigeria)	67 086
Madagascar	39 730
Selva Miskito (northern Nicaragua and southern Honduras)	25 546
New Britain (Island in Papua New Guinea)	25 449
Isthmian-Atlantic/Talmancan (Caribbean coast, western Panama to southern Nicaragua)	21 492
Konkan/Western Ghat (India's southwest coast)	15 056
Maluku (Island in Indonesia)	13 737
Australia	11 715

Rainforest Foundation Norway's (RFN) priority countries

6 648 116 km² of tropical rainforest combined
Represent 70 % of the world's tropical rainforest

Brazil, Peru and Colombia	have 46 % of the world's tropical rainforest
Brazil	has 33 % of the world's tropical rainforest
Brazil	has 47 % of all tropical rainforest in RFN's priority countries
Papua (both provinces)	has 39 % of Indonesia's tropical rainforest
Democratic Republic of Congo (DRC)	has 53 % of Africa's tropical rainforest

The world's tropical rainforest in km²



Photo: Rainforest Foundation Norway

South America	
Brazil 2001	3 401 394
• Amazon ²⁵	3 343 620
• Atlantic Rainforest ²⁶	57 774
Brazil 2019²⁷	3 158 231
• Amazon	3 102 398
• Atlantic Rainforest	56 476
Peru 2001 ²⁸	691 000
Peru 2019	671 300
Colombia 2001	548 000
• Amazon/Andes ²⁹	470 102
• Choco/Darien/Andes west ³⁰	77 898
Colombia 2019³¹	533 000
• Amazon/Andes	457 298
• Choco/Darien/Andes west	75 702
Venezuela 2001 ³²	385 309
• Amazon/Orinoco ³³	357 940
• Andes-Amazon ³⁴	9 735
• Caribbean Highland ³⁵	5 793
Venezuela 2019³⁶	380 909
• Amazon/Orinoco	347 391
• Andes-Amazon	9 449
• Caribbean highland	5 559
Bolivia 2001	312 870
Bolivia 2019³⁷	293 336
Guyana 2001 ³⁸	173 000
Guyana 2019	171 750
Suriname ³⁹	128 000
Suriname 2019	126 780
Ecuador 2001 ⁴⁰	106 000
• Amazon/Andes east ⁴¹	96 864
• Choco/Darien/Andes west ⁴²	9 647
Ecuador 2019	104 787
• Amazon/Andes east	95 379
• Choco/Darien/Andes west	9 408
French Guyana 2001 ⁴³	78 500
French Guyana 2019	78 013
Paraguay 2001 ⁴⁴	15 803
Paraguay 2019	10 703
Argentina 2007⁴⁵	13 220
Total 2019	5 542 029
Original	6 631 240

North and Central America	
Mexico 2001 ⁴⁶	92 100
• Yucatan (Maya) ⁴⁷	47 273
Mexico 2019	86 160
• Yucatan (Maya)	43 123
Panama 2001 ⁴⁸	29 000
• Choco/Darien ⁴⁹	20 614
• Isthmian-Atlantic/Talamancan ⁵⁰	9 498
Panama 2019	28 282
• Choco/Darien	18 538
• Isthmian-Atlantic/Talamancan	9 241
Guatemala 2001 ⁵¹	25 800
• Yucatan/Maya ⁵²	23 614
Guatemala 2019	21 000
• Yucatan/Maya	18 974
Honduras 2001 ⁵³	21 500
• Selva Miskito ⁵⁴	18 712
Honduras 2019	17 930
• Selva Miskito	15 581
Nicaragua 2001 ⁵⁵	20 200
• Selva Miskito ⁵⁶	12 670
• Isthmian-Atlantic/Talamancan ⁵⁷	3 420
Nicaragua 2019	15 600
• Selva Miskito	9 965
• Isthmian-Atlantic/Talamancan	2 094
Costa Rica 2001 ⁵⁸	14 900
• Isthmian-Atlantic/Talamancan ⁵⁹	10 260
Costa Rica 2019	14 651
• Isthmian-Atlantic/Talamancan	10 157
Belize 2001 ⁶⁰	11 600*
Belize 2019	10 490
USA (Hawaii) 2001 ⁶¹	2 000
USA (Hawaii) 2019	1 986
El Salvador 2001 ⁶²	506
El Salvador 2019	493
Total 2019	196 592
Original (incl. Caribbean)	440 880

* All is part of the Yucatan/Maya

Caribbean

Cuba 2001 ⁶³	4 010
Cuba 2019	3 605
The Dominican Rep 2001 ⁶⁴	3 170
The Dominican Rep 2019	2 953
Jamaica 2001 ⁶⁵	2 370
Jamaica 2019	2 274
Trinidad & Tobago 2001 ⁶⁶	1 540
Trinidad & Tobago 2019	1 517
Puerto Rico 2001 ⁶⁷	645
Puerto Rico 2019	483
Guadalupe (France) 2001 ⁶⁸	369
Guadalupe (France) 2019	368
Dominica 2001 ⁶⁹	360
Dominica 2019	203
Total 2019	11 403

Africa

DRC 2001	1 050 000	Tanzania 2001 ⁸³	7 320
DRC 2019⁷⁰	1 001 700	Tanzania 2019	7 051
Gabon 2001 ⁷¹	227 000	Kenya 2001 ⁸⁴	6 500
Gabon 2019	224 610	Kenya 2019	6 042
Republic of Congo 2001 ⁷²	212 000	Uganda 2001 ⁸⁵	5 090
Republic of Congo 2019	208 760	Uganda 2019	4 447
Cameroon 2001 ⁷³	191 000	Sierra Leone 2001 ⁸⁶	2 760
Cameroon 2019	184 920	Sierra Leone 2019	2 495
CAR 2001 ⁷⁴	73 600*	Guinea 2001 ⁸⁷	2 330
CAR 2019	72 050	Guinea 2019	2 189
Liberia 2001 ⁷⁵	44 300	Mozambique 2001 ⁸⁸	1 200
Liberia 2019	42 020	Mozambique 2019	1 092
Madagascar 2001 ⁷⁶	48 200	South Sudan 2001 ⁸⁹	837
Madagascar 2019	39 730	South Sudan 2019	819
Equat. Guinea 2001 ⁷⁷	22 500	Rwanda 2001 ⁹⁰	537
Equat. Guinea 2019	21 912	Rwanda 2019	534
Angola 2001 ⁷⁸	21 810	Burundi 2001 ⁹¹	248
• Cabinda	3 690	Burundi 2019	245
Angola 2019	20 675	Togo ⁹²	Below 100***
• Cabinda	3 490	Benin ⁹³	Below 100***
Ethiopia 2001 ⁷⁹	18 900	Sao Tomé & Príncipe	Below 100***
Ethiopia 2019	18 189	Malawi ⁹⁴	Below 100***
Nigeria 2001 ⁸⁰	19 000**	Zambia ⁹⁵	0
Nigeria 2019	17 740	Totalt 2019:	1 897 602
Ivory Coast 2001 ⁸¹	13 700**	Original	4 017 705
Ivory Coast 2019	10 350		
Ghana 2001 ⁸²	10 900**		
Ghana 2019	10 032		

* Most is degraded ** Most is heavily degraded *** Not part of the total

Asia

Indonesia 2001	938 000
• Papua	332 100
• Borneo	289 420
• Sumatra	149 630
• Sulawesi	97 790
• Maluku (The largest island)	14 410
Indonesia 2019⁹⁶	843 200
• Papua ⁹⁷	326 310
• Borneo ⁹⁸	250 825
• Sumatra ⁹⁹	135 591
• Sulawesi ¹⁰⁰	90 071
• Maluku (The largest island)	13 737
Myanmar 2001 ¹⁰¹	140 000
• Northern Triangle ¹⁰²	80 400
Myanmar 2019	134 230
• Northern Triangle	78 195
Malaysia 2001¹⁰³	159 000
• Borneo ¹⁰⁴	106 100
• Peninsula ¹⁰⁵	52 900
Malaysia 2019	132 700
• Borneo	87 080
• Peninsula	45 620
India 2001 ¹⁰⁶	98 192
• Arunachal Pradesh ¹⁰⁷	45 900*
• Konkan/Western Ghat	15 144
India 2019	95 168
• Arunachal Pradesh	44 790
• Konkan/Western Ghat	5 056
Laos 2001 ¹⁰⁸	83 200
Laos 2019	75 470
Vietnam 2001 ¹⁰⁹	67 300
Vietnam 2019	60 730
Thailand 2001 ¹¹⁰	59 400
Thailand 2019	58 180
Philippines 2001 ¹¹¹	45 900
Philippines 2019	44 470
Cambodia 2001 ¹¹²	42 800
Cambodia 2019	30 600
China 2001 ¹¹³	17 400
• Himalaya/Northern Triangle	2 739
China 2019	16 651
• Himalaya/Northern Triangle	2 716
Bhutan 2001 ¹¹⁴	16 100*
Bhutan 2019	16 033
Nepal 2001 ¹¹⁵	7 250*
Nepal 2019	7 214

Sri Lanka 2001 ¹¹⁶	5 960
Sri Lanka 2019	5 861
Brunei 2001 ¹¹⁷	4 310
Brunei 2019	4 173
Taiwan 2001 ¹¹⁸	2 527
Taiwan 2019	2 497
Bangladesh 2001 ¹¹⁹	966
Bangladesh 2019	900
Total 2019	1 528 077
Original	3 009 375

Oceania

Papua New Guinea 2001 ¹²⁰	326 000
• Islands ¹²¹	39 770
• New Britain	26 900
• Main island ¹²²	286 230
PNG 2019	318 680
• Islands	37 855
• New Britain	25 449
• Main island	280 825
Solomon Islands 2001 ¹²³	19 900
Solomon Islands 2019	18 790
Australia 2000 ¹²⁴	12 745
Australia 2019	11 715
Fiji 2001 ¹²⁵	5 330
Fiji 2019	5 270
New Caledonia (France) 2008¹²⁶	4 034
Vanuatu 2001 ¹²⁷	3 680
Vanuatu 2019	3 642
Palau 2001 ¹²⁸	190
Palau 2019	188
Samoa 2004 ¹²⁹	0,8**
Total 2019	362 319
Original	481 313

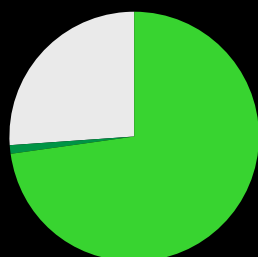
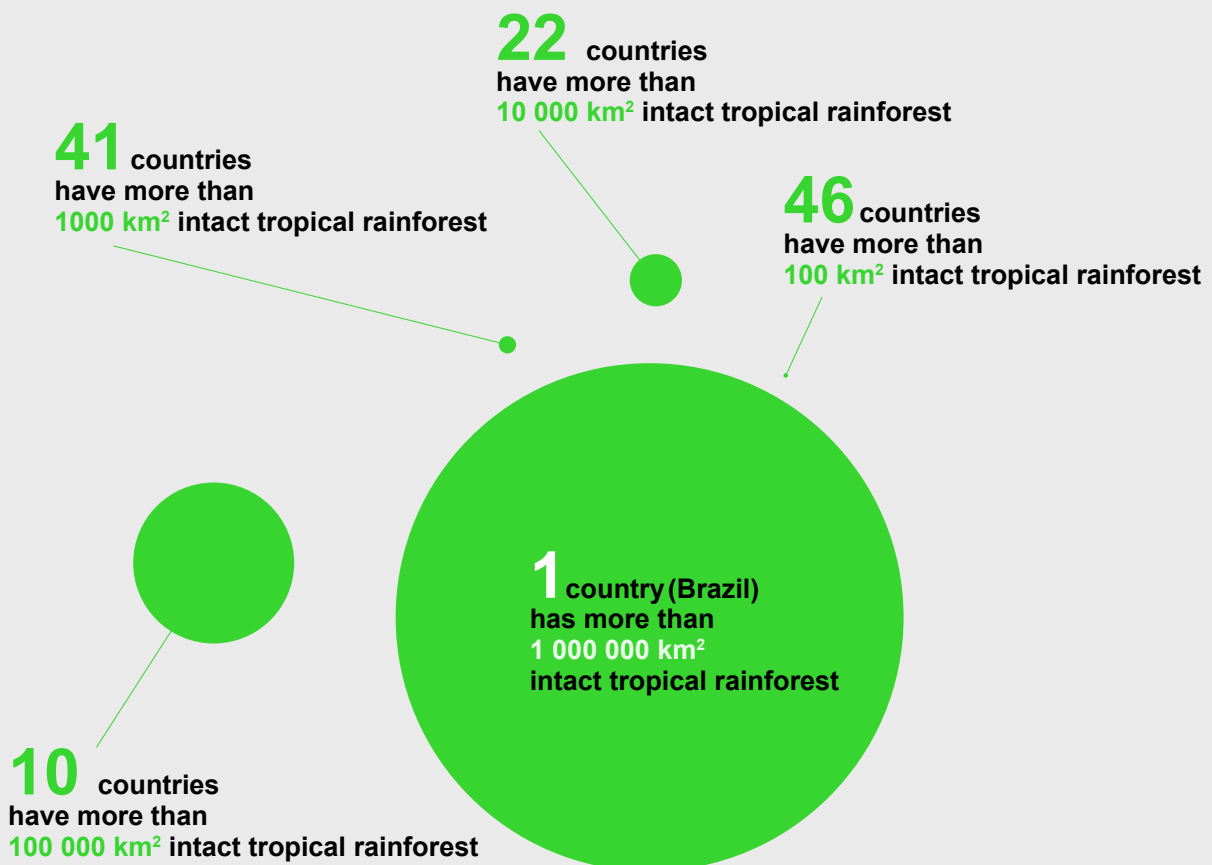
Summary

South America	5 542 029
Africa	1 897 602
Asia	1 528 077
Oceania	362 319
North and Central America	196 592
Caribbean	11 403
Total	9 538 022
Original	14 580 513

* Part of the Eastern Himalaya rainforest ** Not part of the total

Intact* tropical rainforest in the world in 2016: 5 247 415 km²

55% of the world's rainforest is intact



■ The intact tropical rainforest of the world
■ The Americas **74 %**
■ The Amazon **73 %**

* Refers to how much of the world's tropical rainforest that is still left in an intact condition.

Intact tropical rainforest per geographical region

South America	3 859 140
Africa	835 962
• Central Africa (DRC, Congo rep., Gabon, Equ. Guinea, Cameroon, Angola, Uganda, CAR)	818 023
• West Africa (Nigeria, Ivory Coast, Liberia)	3 479
• East Africa (Tanzania, Ethiopia)	2 960
• Madagascar	11 500
Oceania (includes the entire New Guinea island)	268 664
• Melanesia (Indonesian Papua and Papua Barat, PNG, Solomon Islands, Vanuatu)	264 512
• Australia	4 152
Asia (excl. Indonesian Papua)	251 366
• Continental (India, Bhutan, Myanmar, Thailand, Malaysian mainland, Laos, Vietnam)	82 276
Central America (incl. Mexico)	46 630
Caribbean (only the Dominican Republic)	558
Total	5 247 415

Intact tropical rainforest per biome (2016)

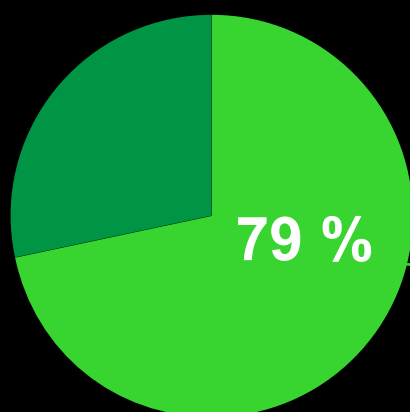
Amazon/Orinoco/Andes east	3 832 480
Central African rainforest (eastern Nigeria to Uganda)	817 719
New Guinea (island)	248 920
Borneo (three countries)	93 520
Sumatra	36 281
Northern Triangle/eastern Himalaya	31 744
Sulawesi	28 270
Choco-Darien (Colombia, Panama, Ecuador)	24 054
Yucatan/Maya (Mexico, Guatemala, Belize)	17 420
Northern Triangle (Northern Myanmar, bordering China and India)	16 214
Eastern Himalaya (Arunachal Pradesh, Bhutan)	15 530
Madagascar	11 500
New Britain (Island in Papua New Guinea)	8 260
Selva Miskito (Nicaragua north, Honduras east)	7 880
Isthmian-Atlantic/Talmancan (Caribbean coast, western Panama to southern Nicaragua)	5 521
Australia	4 152
Maluku (the largest island in Indonesia)	3 930
Atlantic rainforest South America (Eastern Brazil, Paraguay, north-eastern Argentina)	2 900
Guinea rainforest (West Africa) (From Guinea to eastern Nigeria)	2 894

Share of intact tropical rainforest in the world

Brazil	42,0 %
DRC	11,5 %
Peru	10,0 %
Colombia	6,5 %
Indonesia	5,5 %
PNG	2,4 %
Myanmar	0,5 %
America (North America, South America, Central America, Caribbean)	74,0 %
Africa (Includes Madagascar)	16,0 %
Asia (Includes Indonesian Papua)	6,5 %
Oceania (Excludes Indonesian Papua)	2,5 %
Amazon/Orinoco/Andes east	72,0 %
Central Africa	15,5 %
New Guinea (island)	4,8 %
Borneo	1,8 %
Continental Asia	1,6 %
Sumatra	0,7 %

Share of the countries' tropical rainforest in intact condition

Peru	77,5 %*
Brazil	70,5 %
Colombia	63,0 %
DRC	60,0 %
The world	55,0 %
PNG	39,0 %
Indonesia	35,0 %
Myanmar	17,5 %
Amazon/Orinoco/Andes east	68,0 %
Central Africa	47,0 %
New Guinea (island)	41,0 %
New Britain (Island in PNG)	32,5 %
Selva Miskito	32,5 %
Sulawesi	31,5 %
Northern Triangle/Eastern Himalaya	30,0 %
Madagascar	28,5 %
Maluku (the largest island)	28,5 %
Sumatra	27,0 %
Yucatan/Maya	24,5 %
Isthmian-Atlantic/Talmancan	24,0 %
Borneo	22,5 %
Choco-Darien	21,5 %
Australia	21,0 %
Atlantic rainforest South America	6,0 %
Guinea rainforest (West Africa)	4,0 %



Intact tropical rainforest in RFN priority countries have

4 133 900 km²

of the world's intact tropical rainforest

* Largest share in the world



Photo: Thomas Marent

Intact tropical rainforest in the world in 2016 in km²¹³⁰



Photo: Rainforest Foundation Norway

South America

Brazil 2016	2 230 000
• Amazon/Orinoco/Andes east	2 227 100
• Atlantic rainforest	2 900
Peru 2016	518 000
Colombia	339 000
• Choco/Darien	15 820
• Andes East	3 615
• Amazon lowland	319 565
Venezuela	298 000
Bolivia	138 100
Guyana	121 000
Suriname	97 700
French Guyana (France)	60 600
Ecuador	48 800
Argentina	7 940
Total 2016	3 859 140

Central America (incl. Mexico)

Mexico	13 200
Panama	11 300
• Choco/Darien	9 727
Nicaragua	6 060
Guatemala	4 730
Honduras	4 600
Belize	3 710
Costa Rica	3 030
Total	46 630

Caribbean

The Dominican Republic	558
Total	558

Africa

DRC	604 000
Republic of Congo	103 000
Gabon	72 800
Cameroon	30 200
Madagascar	11 500
CAR	4 760
Equatorial Guinea	1 860
Liberia	1 970
Ethiopia	1 650
Tanzania	1 310
Ivory Coast	924
Angola	889
Nigeria	585
Uganda	514
Total	835 962

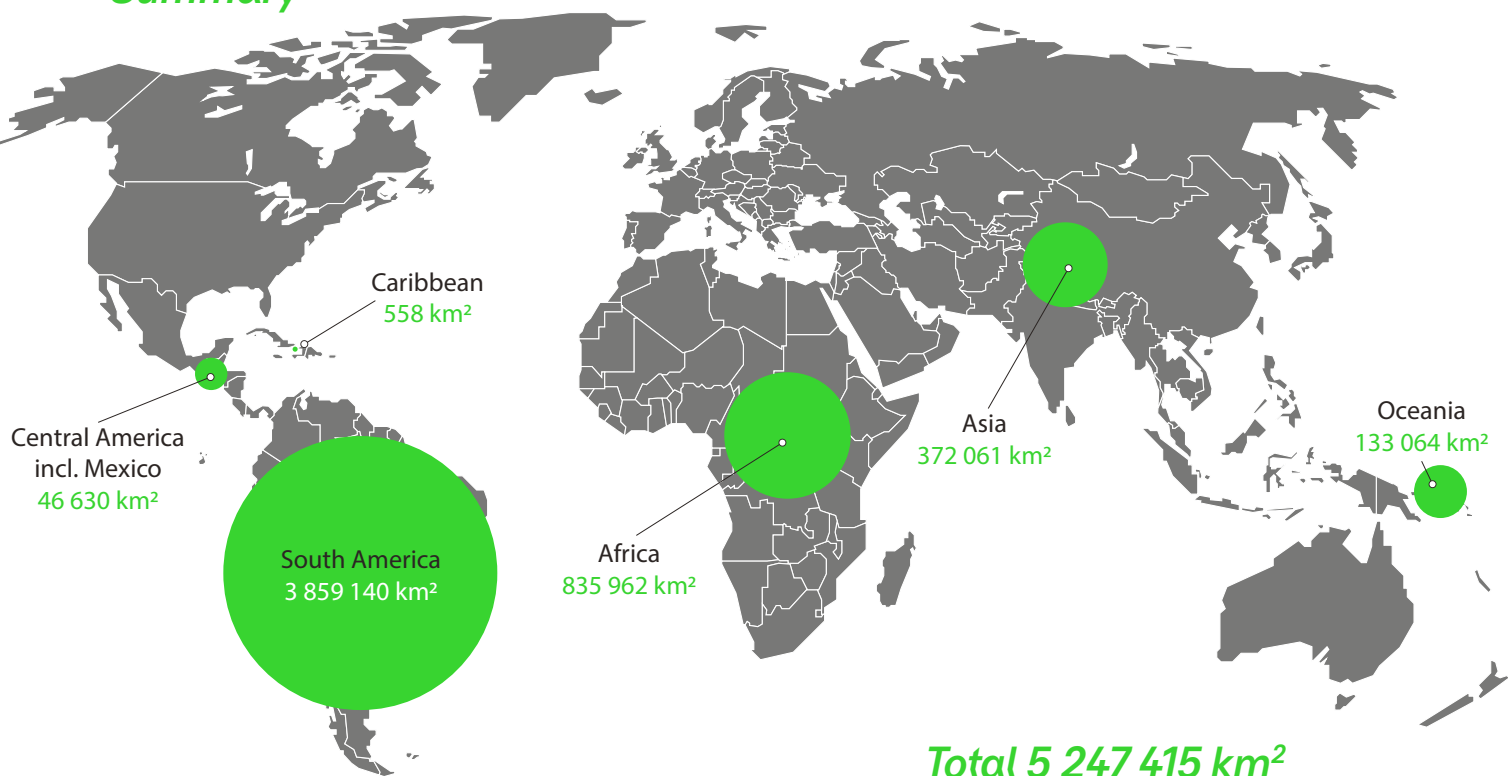
Asia

Indonesia	294 000
• Papua (both provinces)	135 600
Myanmar	23 900
India ¹³¹	15 441
Malaysia	15 200
• Mainland	8 290
Thailand	10 580
Philippines	3 430
Laos	3 410
Vietnam	2 580
Bhutan	1 910
Brunei	1 610
Total	372 061

Oceania

Papua New Guinea	125 000
• Islands	11 680
Australia	4 152
Solomon Islands	3 270
Vanuatu	642
Total	133 064

Summary



Deforestation in km²



Photo: Live Danielsen

South America

Brazil 2002-2019	243 163
• <i>Amazon</i>	241 180
• <i>Atlantic rainforest</i>	1 983
Brazil 2019	13 511
• <i>Amazon</i>	13 420
• <i>Atlantic rainforest</i>	91
Peru 2002-2019	19 700
Peru 2019	1 620
Bolivia 2002-2019 ¹³²	19 178
Bolivia 2019 ¹³³	1 212
Colombia 2002 - 2019	15 000
• <i>Amazon/Andes east and central</i>	13 083
• <i>Choco/Darien</i>	1 917
Colombia 2019	1 150
Venezuela 2002-2019	4 800
• <i>Amazonas</i>	3 606
• <i>Andes/Amazon</i>	885
Venezuela 2019	588
Paraguay 2002-2019	4 613
Paraguay 2019	299
Ecuador 2002-2019	1 730
• <i>Amazon/Andes east</i>	1 486
• <i>Choco/Darien</i>	242
Ecuador 2019	122
Guyana 2002-2019	1 250
Guyana 2019	130
Suriname 2002-2019	1 220
Suriname 2019	140
French Guyana 2002-2019	487
French Guyana 2019	23
Argentina	N/A
Total 2002-2019	311 141
Total 2019	18 795

North and Central America

Mexico 2002-2019	5 940
• <i>Yucatan/Maya</i>	4 150
Mexico 2019	658
Guatemala 2002-2019	4 800
• <i>Yucatan/Maya</i>	4 640
Guatemala 2019	303
Nicaragua 2002-2019	4 600
• <i>Selva Miskito</i>	2 705
Nicaragua 2019	339
Honduras 2002-2019	3 570
• <i>Selva Miskito</i>	3 131
Honduras 2019	329
Belize 2002-2019	1 110
Belize 2019	87
Panama 2002-2019	718
• <i>Choco/Darien</i>	2 076
• <i>Isthmian-Atlantic/Talamanca</i>	253
Panama 2019	62
Costa Rica 2002-2019	249
• <i>Isthmian-Atlantic/Talamanca</i>	103
Costa Rica 2019	14
USA (Hawaii) 2002-2019	14
USA (Hawaii)	1
El Salvador 2002-2019	13
El Salvador 2019	1
Total 2002-2019	21 014
Total 2019	1 794

Caribbean

Cuba 2002-2019	409
Cuba 2019	1
Dominican Rep. 2002-2019	217
Dominican Rep. 2019	5
Puerto Rico 2002-2019	162
Jamaica 2002-2019	96
Jamaica 2019	3
Trinidad & Tobago 2002-2019	23
Trinidad & Tobago 2019	1
Dominica 2002-2019	157
Guadalupe 2002-2019	1
Total 2002-2019	1 065
Total 2019	10

Africa	
DRC 2002-2019	48 300
DRC 2019	4 750
Madagascar 2002-2019	8 470
Madagascar 2019	542
Cameroon 2002-2019	6 080
Cameroon 2019	544
Ivory Coast 2002-2019	3 350
Ivory Coast 2019	116
Republic of Congo 2002-2019	3 240
Republic of Congo 2019	306
Liberia 2002-2019	2 280
Liberia 2019	234
Gabon 2002-2019	2 390
Gabon 2019	138
CAR 2002-2019	1 550
CAR 2019	115
Nigeria 2002-2019	1 260
Nigeria 2019	121
Angola 2002-2019	1 135
• Cabinda	200
Angola 2019	94
Ghana 2002-2019	868
Ghana 2019	58
Ethiopia 2002-2019	711
Ethiopia 2019	74
Uganda 2002-2019	643
Uganda 2019	33
Equatorial Guinea 2002-2019	588
Equatorial Guinea 2019	43
Kenya 2002-2019	458
Kenya 2019	28
Tanzania 2002-2019	269
Tanzania 2019	27
Sierra Leone 2002-2019	265
Sierra Leone 2019	35
Guinea 2002-2019	133
Guinea 2019	11
Mozambique 2002-2019	108
Mozambique 2019	8
South Sudan 2002-2019	18
South Sudan 2019	3
Rwanda 2002-2019	3
Burundi 2002-2019	3
Total 2002-2019	82 122
Total 2019	7 280

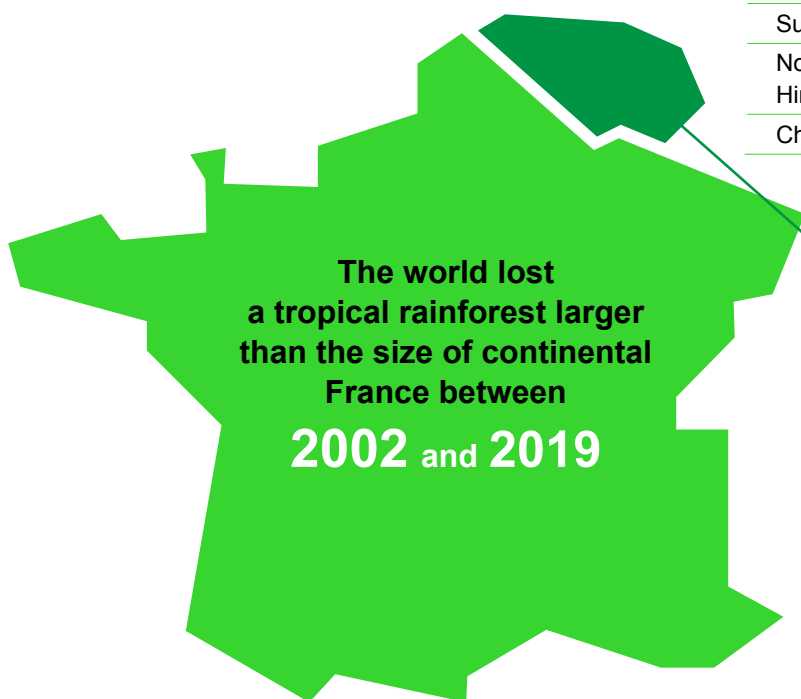
Asia	
Indonesia 2002-2019	94 800
• Sumatra	38 443
• Borneo	39 627
• Papua	6 060
• Sulawesi	7 999
• Maluku (largest island)	673
Indonesia 2019	3 240
Malaysia 2002-2019	26 300
• Borneo	19 020
Malaysia 2019	1 200
Cambodia 2002-2019	12 200
Cambodia 2019	629
Laos 2002-2019	7 730
Laos 2019	720
Vietnam 2002-2019	6 570
Vietnam 2019	309
Myanmar 2002-2019	5 770
• Northern triangle	2 205
Myanmar 2019	383
India 2002-2019	3 024
• Arunachal Pradesh	1 110
• Konkan/Western Ghat	88
India 2019	151
Philippines 2002-2019	1 430
Philippines 2019	76
Thailand 2002-2019	1 220
Thailand 2019	26
China 2002-2019	749
• Eastern Himalaya/Northern Triangle	23
China 2019	14
Brunei 2002-2019	137
Brunei 2019	4
Sri Lanka 2002-2019	99
Sri Lanka 2019	4
Bhutan 2002-2019	67
Bhutan 2019	3
Bangladesh 2002-2019	66
Bangladesh 2019	4
Nepal 2002-2019	36
Nepal 2019	2
Taiwan 2009-2019	30
Taiwan 2019	1
Total 2002-2019	160 228
Total 2019	6 766

Oceania	
PNG 2002-2019	7 320
• <i>Islands</i>	1 916
• <i>New Britain</i>	1 451
• <i>Mainland</i>	5 404
PNG 2019	580
Solomon Islands 2002-2019	1 110
Solomon Islands 2019	123
Fiji 2002-2019	60
Fiji 2019	1
Vanuatu 2002-2019	38
Vanuatu 2019	1
Palau 2002-2019	2
Australia 2002-2019	1 018
Australia 2019	173
New Caledonia	N/A
Total 2002-2019	9 548
Total 2019	878

Total deforestation in the world	
2002-2019	585 118
2019	35 523

Deforestation per biome 2002-2019	
Amazon/Orinoco/Andes east	302 075
Central Africa	62 997
Borneo	58 784
Sumatra	38 443
New Guinea (island)	11 464
Yucatan (Maya)	9 830
Sulawesi	7 999
Selva Miskito	5 836
Choco/Darien	4 235
Northern Triangle/Eastern Himalaya	2 710
Atlantic rainforest South America	1 880

Tropical rainforest loss per biome 2019	
Amazon/Orinoco/Andes East	18 266
Central Africa	6 150
Borneo	2 173
Yucatan/Maya	818
Sumatra	733
New Guinea (Island)	720
Selva Miskito	518
Atlantic Rainforest SA	437
Sulawesi	417
Northern Triangle/Eastern Himalaya	304
Choco/Darien	171



The world lost on average a tropical rainforest area the size of Belgium every year in the same period.

Methodology



Photo: Thomas Marent

How to define a tropical rainforest?

The World Wide Fund for Nature (WWF) has defined a broad ecological region called “Tropical and Subtropical Moist Broadleaved Forests”¹³⁴. This is more inclusive than what strictly constitutes a tropical rainforest according to UN Food and Agriculture Organization (FAO) tropical rainforest definition and zoning¹³⁵. It includes drier deciduous forest types that do not have the same ecological qualities as a tropical rainforest, like the “Bahia Interior Forest”¹³⁶.

The lower lying areas of the ecozone defined by FAO as “Tropical mountain

systems” include premontane evergreen rainforests and cloud forests which grow at elevations above 1000 - 1500 meters above sea level (masl), depending on local variations. Tropical cloud forests can grow up to about 2500 masl, and they have much of the same ecological qualities as lowland rainforests¹³⁷. Although cloud forests normally receive less rainfall than lower lying rainforests, they can capture moisture directly from an almost constant mist that forms due to a cooler temperature, and this way maintain as wet and evergreen, and support a rich ever-growing

plant environment. Cloud forests normally have lower tree stature but can be more species-rich per area than the lowland rainforests.

Global Forest Watch (GFW)¹³⁸ operates with a forest definition called “primary forest”, defined as tropical humid forest that has not been completely removed and regrown in recent history (30-50 years). This forest category has been defined by scientists from the University of Maryland (Turubanova et. al.)¹³⁹, and the data is available for the public at the GFW net based forest monitoring platform¹⁴⁰. The

extent of this forest category was established for the year 2001, and it is now possible to monitor the state and change of this forest for every year from 2002 to 2019.

GFW's "primary humid tropical forest" fits quite well with FAO's "tropical rainforest" ecozone and the parts of FAO's "tropical mountain systems" ecozone that correspond to sub-montane evergreen rainforests and cloud forests¹⁴¹. It does, however, deviate from FAO in two significant areas: The Yucatan forest in Mexico, and the Chiquitano forest in Bolivia and Brazil. It also deviates from FAO in smaller parts of the South American savanna (Cerrado), southern Africa, Laos and Vietnam, and northern India. To determine if these forest areas fit the "tropical rainforest" definition of this report, we have compared them to the WWF's world's ecological regions overview¹⁴².

The Chiquitano forest in South America is clearly described by WWF as a tropical dry forest. Due to a prolonged and distinct dry season, this forest has a 500 mm yearly precipitation deficit to sustain a rainforest environment¹⁴³. The Chiquitano transitions from semi-deciduous to deciduous forest. This forest is located outside of FAO's tropical rainforest ecozone, in what FAO calls the "tropical moist forest" ecozone. While this forest falls within GFW's definition of "humid tropical forest", it does not fit well with what constitutes a tropical rainforest defined in this report, as it does go through a solid drought stress period which affects plant growth during the dry season.

On the other hand, the WWF's "Yucatan Moist Forests"¹⁴⁴ ecological region is not defined as a tropical rainforest by FAO. It lies within FAO's definition of a "tropical moist forest"¹⁴⁵, with a delimitation criteria of annual precipitation between 1000 mm and 2000 mm, and a dry season of 3-5 months. However, this is such a broad category that it includes everything from semi-evergreen broadleaved dense moist forests, which fits well with what is termed tropical rainforest in this report, to

◀◀ *To determine the extent and historical loss of tropical rainforest, we have used the Global Forest Watch platform and the land cover category termed "primary forest"* ▶▶

more open and drier short statured woodlands like the Miombo in southern Africa¹⁴⁶ and the Cerrado¹⁴⁷ and Chaco¹⁴⁸ in South America.

Global Forest Watch's "primary forest"

To determine the extent and historical loss of tropical rainforest, we have used the Global Forest Watch platform and the land cover category termed "primary forest", which is the same as the above-mentioned definition of humid tropical forest that has not been completely removed and regrown in recent history (30-50 years). We have left out the areas of this land cover category that do not fit with a tropical rainforest definition, by comparing it to FAO's eco-zoning and WWF's descriptions of the world's ecological regions. These are the Chiquitano dry forest and parts of the dry and humid Chaco forest and Cerrado savanna in Bolivia, Brazil and Paraguay; the Kabompo Dry Evergreen Forest¹⁴⁹ in north-western Zambia and eastern Angola; and the moist deciduous forests of eastern and southern India¹⁵⁰. We have also left out most of the patches of tropical gallery (or

riparian) forests that grow in wet soils by rivers and lakes on tropical savannas. These do not have the same ecological qualities as tropical rainforests¹⁵¹, although historically they may have served as important sanctuaries for rainforest species when local climatic conditions have been unfavourable for rainforest environments.

We have used a canopy threshold of minimum 30 % as baseline for what constitutes a forest. This is a very low canopy threshold for a tropical rainforest and includes heavily degraded forest areas. It does not, however, include previously (30-50 years) deforested areas. This distinction is important, because degraded forests, if left alone, can restore key ecological functions much faster than completely removed forests (deforestation), depending on the degree of degradation¹⁵². We have compared the 30 % + canopy threshold with a 75 % + canopy threshold and found a difference of no more than 345 390 km² globally.

WWF's ecological regions of the world is a layer that can be applied to the GFW map. However, it is only possible to analyse this layer on tree cover extent with a 30 % + canopy threshold. It does not allow for analysing the extent of "primary humid tropical forest", so unfortunately the ecoregion layer cannot be applied for the purpose of this report. We have instead compared the WWF's ecoregion layer with the political boundaries of regions and municipalities, and included the primary humid tropical forest cover of the municipalities that best corresponds with the limits of the ecological regions of interest for the purpose of this report (e.g. to divide highland rainforests from lowland rainforests, and divide the dry forests of Bolivia and Paraguay from the rainforests etc.).

For some reason, the GFW platform does not include "primary humid tropical forest" data for Australia. To determine the tropical rainforest extent of Australia we have therefore compared the tree cover 30 % + layer with the Queensland tropical

rainforest layer of WWF's ecological regions, and subtracted the area of tree plantations.

For Argentina, the method applied in this report could not be used to determine the tropical rainforest cover of the country within a reasonable margin of error, so the data used here are official data from 2007.

Deforestation data for tropical rainforests in Argentina is not available. However, it was possible to estimate the extent of intact tropical rainforest in Argentina using the method described in this report.

We have compared the GFW data with other research on tropical rainforest extent and degradation for each rainforest country for comparison, all of which are referenced in the footnotes. With some exemptions, there is a very high consistency between available official rainforest data and other research on rainforest cover, and the data extracted in this report for GFW's "primary forest" cover. For some countries, there are minor data discrepancies due to different forest monitoring methods. For the countries with the largest discrepancies, the differences are most likely due to the exclusion of younger secondary forest in the GFW data. At a global scale, though, the discrepancies are minor, suggesting a close match between GFW's "primary forest" category and what constitutes a natural forest within the tropical rainforest ecozone as defined in this report.

Intact tropical rainforest

We have used the Intact Forest Landscape (IFL)¹⁵³ definition to estimate how much of the world's tropical rainforest that is still left in a pristine condition. An intact forest by this definition, differs from non-degraded primary forests by having a threshold of minimum 500 km² forest patch size. This makes sense because even if the forest canopy has not been reduced, small forest patches lose their ability to uphold key ecological functions, like conserving biodiversity and store carbon. By using this definition of an intact forest, all standing tropical rainforest that do not match this is

considered degraded to a certain extent. We have estimated the extent of intact tropical rainforest by including the IFL areas that overlap the above mentioned "primary humid tropical forest" layer, excluding the areas of this category that do not fit with a tropical rainforest biome as described above.

There are different ways of defining what constitutes an intact forest, and debates are vibrant within the forest research community about the most pertinent definition. Nonetheless, intact forests are important to map and monitor so that conservation policies can urgently target the most valuable forest estates left in the world with the right measures. To halt degradation and fragmentation of intact forest areas may require different and additional policy measures than a more general policy to reduce or halt deforestation and degradation, as we have seen in many REDD+ and other initiatives the last decade. At the same time, it must be stressed that all natural forests, no matter what state of degradation they are in, do possess valuable ecosystem services worthy of conservation measures. Many degraded forests can also recover to

an intact state relatively quickly if protected, which for a deforested area can take centuries. Defining and monitoring intact forests does not underplay the ecological value of degraded forests, and measures to protect the intact forests should not undermine current or future efforts to halt deforestation in natural forest in general. But to measure and expose the real conditions of the world's last natural forests, is a crucial tool both to guide policies and to skew more conservation efforts towards forests in general.

Original tropical rainforest cover

We have used FAO's tropical rainforest ecozone¹⁵⁴ to determine the approximate original extent of tropical rainforest, and this way be able to compare the original with the present state of this magnificent forest biome¹⁵⁵. This is approximate, as no one knows exactly how much tropical rainforest there were before humans started to severely destroy this ecosystem a few hundred years ago. FAO's ecozone research constitutes an attempt to estimate both the existing and the potential extent of the world's main ecosystems by defining their present ecological zone based on primarily climatic conditions. This way, and with some caution, it is an estimation of the natural extent of the world's main ecosystems, as they were before humans began destroying them significantly. Over the course of thousands and millions of years, the tropical rainforest has to a certain extent increased and shrunk, back and forth, by natural causes like climate change. Most of the tropical rainforest destruction caused by humans, however, has happened only over the course of the past century. 🌳

◀◀ *Intact forests are important to map and monitor so that conservation policies can urgently target the most valuable forest estates left in the world.* ▶▶

Endnote

- 1) <http://www.fao.org/3/ad652e/ad652e07.htm#TopOfPage>
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- 9) <https://www.worldwildlife.org/ecoregions/at0718>
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- 23) Nigeria, Ivory Coast, Ghana, Liberia, Guinea, Sierra Leone
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- 26) GFW primary forest 30 % + canopy cover in the regions of Santa Catarina, Parana, Sao Paulo, Rio de Janeiro, Espirito Santo, Bahia, Sergipe and Alagoas.
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- 28) GFW primary forest 30 % + canopy cover
According to official estimates Peru had 684 226 km² of rainforest in 2018:
<http://geobosques.minam.gob.pe/geobosque/view/perdida.php>
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- 29) GFW primary forest 30 % + canopy cover in relevant regions
- 30) GFW primary forest 30 % + canopy cover in relevant regions.
- 31) GFW primary forest 30 % + canopy cover.
Official figures for the Amazon and Andes (below 2500 masl) and pacific rainforest = 524 772 km². There are also some rainforest in the Caribbean and Llanos regions, but these regions also have a lot of other types of tropical forest.
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https://www.researchgate.net/profile/Dolors_Armenteras/publication/236173774_Ecosistemas_de_los_andes_Colombianos/links/547b439c0cf205d16881c3f0/Ecosistemas-de-los-andes-Colombianos.pdf page 50, 51 and 81) – We have used this report to find rainforest data for the Andean region.
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- 32) GFW primary forest 30 % + canopy cover.
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33) GFW primary forest 30 % + canopy cover in the regions of Amazon, Bolivar og Delta Amacuro, and Maturin in Monagas, and Benitez in Sucre.
<https://www.worldwildlife.org/ecoregions/nt0147>
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<https://lacgeo.com/guianan-moist-forests-ecoregion>

34) GFW primary forest 30 % + canopy cover in the regions of Tachira, Merida, Trujillo, and Lara, and in the municipalities of Alberto Arvelo, Cruz paredes, Bolivar, Aragua, Carabobo, Yaracuy, Falcon.
 Venezuela has some highland rainforest in the Andes which is part of the rainforest that stretches from Venezuela into Colombian Andes and Amazon regions.
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35) GFW primary forest 30 % + canopy cover in all municipalities in the region of Sucre except from Benitez, and in the regions of Miranda, Vargas, Caracas, Aragua, Carabobo, Yaracuy, Falcon.
<https://www.worldwildlife.org/ecoregions/nt0117>

36) GFW 2002-2019 primary forest loss subtracted

37) GFW primary forest 30 % + canopy cover in the following municipalities of Santa Cruz region: Chiquitos, Cordillera, and Jose Miguel de Velasco. Government forest data from the following study suggest a tropical rainforest area in Bolivia of 323 389 km² in 2013: <https://observatorioocdbolivia.files.wordpress.com/2015/06/01-memoria-tecnica-mapa-bosque-2013-otca.pdf> The following forest areas described in this paper fit a tropical rainforest definition: Bosque Amazonico, Bosque Yungas, Bosque Tucumano, Bosque de Llanos Inundables. In this figure, the Chiquitano and the Chaco dry forests as determined according to official estimates has been excluded. This is thus more accurate than what is presented in this report. Still it is not very far off, so the general picture presented in this report for the state of the tropical rainforest in Bolivia is probably within a reasonable error margin.
<http://www.fao.org/3/a-az169s.pdf> (page 9-11) the Chiquitano forest, which forms part of GFW's primary humid tropical forest definition, is not tropical rainforest.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4874403/>
https://www.researchgate.net/figure/Views-of-the-Bolivian-Chiquitano-tropical-dry-forest-during-the-dry-season-The-inset_fig7_257649971
https://www.researchgate.net/figure/Ecoregions-of-Ecuador-Peru-and-Bolivia-1-Western-Ecuador-moist-forests-2-Ecuadorian-dry_fig82_303041091
<https://www.worldwildlife.org/ecoregions/nt0212>
<https://www.museoelkempff.org/sitio/Informacion/Publicaciones/Chiquitano%20Forest%20text.pdf>
https://photos.mongabay.com/07/brazil/amazon_basin_map-max.jpg
 Much of the forest fire in Bolivia occurs in Chiquitano, and it was hard hit in 2019:
<https://theconversation.com/its-not-just-brazils-amazon-rainforest-thats-ablaze-bolivian-fires-are-threatening-people-and-wildlife-122335>
<https://es.mongabay.com/2019/08/bolivia-incendios-bosques-chiquitania-fotos/>
<https://www.fcbc.org.bo/bosque-seco-chiquitano/>
https://web.archive.org/web/20071018040214/http://www.idrc.ca/es/ev-100668-201-1-DO_TOPIC.html
<https://www.cfb.org.bo/bolivia-forestal/bosques-en-bolivia>
https://www.researchgate.net/figure/Ecoregions-of-Ecuador-Peru-and-Bolivia-1-Western-Ecuador-moist-forests-2-Ecuadorian-dry_fig82_303041091
 Forest zones Bolivia: <https://geo.gob.bo/portal/?GeoBolivia-Mapa-del-mes-Abril-2015>

38) GFW primary forest extent 30 % + canopy cover.
<http://www.fao.org/3/a-az232e.pdf> (page 10) Guyana has on page 9 in the defined 3 forest types: Tropical High Forest, Savanna Forest > 30 % canopy cover, og mangrove forests. Tropical high forest is tropical rainforest. The data on page 9 include water surfaces. So we have used the total on page 10, and subtracted the savanna total on page 9. That indicates a total rainforest cover of 163 890 km² in 2010 according to official data.
<https://www.regjeringen.no/contentassets/6a81714468874be7bf210-d4d09cfa33/measurementandreportingofforest-guyana.pdf> page 4, High Forest 156 465 km² in 2009.

39) GFW primary forest extent 30 % + canopy cover.
 Official data indicate 153 190 km² of rainforest in 2015:
<http://www.fao.org/3/a-az343e.pdf> (page 18)
<http://www.fao.org/docrep/013/al634E/al634E.pdf>

40) GFW primary forest extent 30 % + canopy cover.
 Official data indicate an evergreen forest cover below 2900 masl at 98 936 km² in 2013:
<http://www.fao.org/3/a-az203s.pdf> (page 22-23) not included «bosque siempreverde Andino de la ceja Andina» as this is above 2900 masl and the plants experience frost. This forest type is also called «bosque andino de montano alto»: <http://infobosques.com/descargas/biblioteca/200.pdf> (page 17 og 18)
 The category «bosque siempre verde andino montano» is included. It grows up until 2900 at is for the most part evergreen cloud forest.
<https://biblio.flacoandes.edu.ec/libros/digital/55826.pdf>
<http://suia.ambiente.gob.ec/documents/10179/185860/>

MAE_2016_11_21+ART+LIBRO+REDD+17+nov+2016.pdf/e282f00c-37b2-4183-8349-54ecc9837bc8
http://www.quitoambiente.gob.ec/ambiente/imagenes/Secretaria_Ambiente/Documentos/patrimonio_natural/biodiversidad/guia_ecosistemas_dmq.pdf
https://www.researchgate.net/publication/311535643_The_Ecuadorian_National_Forest_Inventory
<http://app.sni.gob.ec/sni-link/sni/PDOT/NIVEL%20NACIONAL/MAE/ECOSISTEMAS/DOCUMENTOS/Sistema.pdf>

41) GFW primary forest extent 30 % + canopy cover in the regions COTOPAXI, SANTO DOMINGO, PICHINCHA (not CAYAMBE), IMBABURA (not PIMAMPIRO), SANTO DOMINGO DE LOS TSACHILAS, ESMERALDAS, PEDERNALES

42) GFW primary forest extent 30 % + canopy cover in relevant regions.

43) GFW primary forest extent 30 % + canopy cover.
<http://www.fao.org/3/a-az215f.pdf> (page 17) indicate a rainforest cover of 81 293 km².
 The entire French Guyana is covered by FAO's tropical rainforest ecozone.

44) GFW primary forest extent 30 % + canopy cover in the regions ITAPUA, GUAIRÁ, CAAZAPÁ, ALTO PARANÁ, CAAGUAZÚ, CANIND-EYÚ, SAN PEDRO, AMAMBAY, CONCEPCIÓN, CORDILLERA
<https://www.mdpi.com/1999-4907/8/10/389/htm> (under the chapter «results»: 27 000 km² in 2000, lost 7 500 km² between 2000 and 2016). The largest part of the Alto-Parana ecoregion that is defined as tropical rainforest lies in eastern Paraguay.
<http://foris.fao.org/static/data/fra2010/ecozones2010.jpg>
https://www.unep-wcmc.org/system/dataset_file_fields/files/000/000/301/original/Paraguay_brochure_ENG_150121.pdf?1423823959
<https://www.mdpi.com/1999-4907/8/10/389/htm>

45) Book: *National Forest Inventories: Assessment of Wood Availability and Use* redigert av Claude Vidal, Iciar A. Alberdi, Laura Hernández Mateo, John J. Redmond:
<https://books.google.no/books?id=YbGVDQAAQBAJ&pg=PA124&lp-g=PA124&dq=selva+misionera+argentina+extension&source=bl&ots=iD-0vUgwpls&sig=ACfU3U3Dv2L7oDe4dhTvKZNQmmB83z-FU5g&hl=no&sa=X&ved=2ahUKEwjZ8KysqKHpAhXhxaYKHxUSB-cEQ6AEwGnoECAkQAQ#v=onepage&q=selva%20misionera%20argentina%20extension&f=false> (page 131) The data is from 2007, but there is very little deforestation of this type of forest in Argentina so it should be fairly accurate still. GFW primary forest includes parts of the Chaco forest that we have not been able to separate from the overall data. Argentina's tropical rainforest grows in two areas: Northern Argentina consists of the southernmost part of the Andean highland rainforest. This category includes three forest types, of which two do not fit the definition of a tropical rainforest. The category «selva pedemontana» grows up until 900 masl and receives most of its rain during 6 months or less. This is a typical monsoon forest and a transition forest between rainforest and dry Chaco forest. The forest that grows between 900 and 1600 masl is a frost free broadleaved forest that is dominated by tropical species. It is called «selva montana». Here it rains throughout the year at it's characteristics fits well with a tropical rainforest definition. This forest type has a much higher biodiversity than the two other forest types in this area. The forest that grows above 1600 masl is a subtropical cloud forest and is called «bosque montano». It receives regular frost and is dominated by frost tolerant species like conifers. Argentina also has a part of the tropical rainforest that grown in the Alto Parana ecoregion. It is known in Argentina as «Selva Misionera». Much of this region, though, is too dry or too cold to sustain a tropical rainforest. According to FAO, the forest in and around Iguazu is tropical rainforest. We have not found separate data for this forest in Argentina so we have used the forest categories in the report of «Iguazu» and «closed canopy forest». We have excluded mixed forest and open canopy forest.
<https://www.redalyc.org/pdf/540/54026849005.pdf> (page 54-55) Shows that it has not been much change in the extent of «Selva Montana» and «Bosque Montano» from 2012.
<https://www.worldwildlife.org/ecoregions/nt0150>
https://www.researchgate.net/publication/297403547_Bosques_nublados_del_neotropico_Argentina
<http://proyungas.org.ar/wp-content/uploads/2014/12/SelvaPedemontanaadelasYungas.pdf>
https://www.researchgate.net/profile/Lucio_Malizia/publication/237467584_Reserva_de_la_Biosfera_de_las_Yungas_armando_el_rompecabezas_entre_todos/links/55d49a7808ae6788fa35203e/Reserva-de-la-Biosfera-de-las-Yungas-armando-el-rompecabezas-entre-todos.pdf

46) GFW primary forest cover 30 % + canopy cover.
 Mexico uses the definition «Selva Perennifolia» which is an evergreen broadleaved forest. Under this category there is also semi-evergreen forests(subperennifolia) where as much as 25 % of the trees shed the leaves during the drier season. Mexico has more than 18 000 km² of could forest. We have not found data that separate tropical from temperate cloud forests.
<http://www.fao.org/3/a-az275s.pdf> (page 24-25)
 GFW primary forest cover 30 % + canopy cover for 2010 fits very well with official data for selva perennifolia in 2010.
<http://bioteca.biodiversidad.gob.mx/janium/Documentos/6529.pdf>
<http://bioteca.biodiversidad.gob.mx/janium/Documentos/6515.pdf>
<https://www.biodiversidad.gob.mx/ecosistemas/bosqueNublado>
<http://www.biodiversidad.gob.mx/ecosistemas/ecosistemas.html>
<https://blog.globalforestwatch.org/people/30-years-forest-protection-yucatan-peninsula>

- 47) GFW primary forest cover 30 % + canopy cover in relevant regions.
- 48) GFW primary forest cover 30 % + canopy cover. Forest data for Panama varies greatly in different FAO-reports. To compare GFW primary forest cover with official data we have used the Forest Resource Assessment report from 2010, which has data from 2008 and is the most conservative estimate of forest cover in the country. We have subtracted the dry forest area estimate in the azuero earth project research from 2009. This indicates a tropical rainforest area of about 30 000 km². This fits well with GFW primary forest cover 2010. GFW primary forest cover also fits well with FAO's ecozone of tropical rainforest. <http://www.fao.org/docrep/013/al595S/al595S.pdf> (page 8) https://azueroearthproject.org/wp-content/uploads/2012/12/A.D0007_Por-tillo_2009_eng.pdf (page 7) <http://www.fao.org/3/a-az302s.pdf> (page 26-27) tropical rainforest in 1992 covered 42 249 km². <https://prezi.com/xqgn-sdoudqg/bosques-tropicales-en-panama/> https://www.gacetaoficial.gob.pa/pdfTemp/28229_A/Gace-taNo_28229a_20170303.pdf https://www.google.com/url?sa=t&rtct=j&q=&esrc=s&source=web&cd=12&ved=0ahUKEwiq-um96_bAhWhJJoKHR9DCm-8QFghVMAs&url=https%3A%2F%2Fwww.unredd.net%2Findex.php%3Fview%3Ddownload%26alias%3D14899-superficie-bosco-sa-y-tasa-de-deforestacion-en-panama%26category_slug%3Dsiste-ma-satelital-monitoreo%26option%3Dcom_docman%26item-id%3D134&usq=AOvVaw2jPdRkivOz6qoxvhTwcosa
- 49) GFW primary forest cover 30 % + canopy cover in relevant regions.
- 50) GFW primary forest cover 30 % + canopy cover in relevant regions.
- 51) GFW primary forest cover 30 % + canopy cover. <http://www.fao.org/3/a-az228s.pdf> (page 10) data from 2003 include mixed forests which are not rainforests. Guatemala differs between leaved forests and conifer forests. The latest official data of leaved forest cover are from 1999. This fits well with GFW primary forest cover. GFW primary forest cover also fits well with FAO's tropical rainforest ecozone. <http://www.fao.org/3/ad402s/AD402s08.htm> (Bosques de Latifoliadas 28 346 km² in 1999) <https://www.worldwildlife.org/ecoregions/nt0303> http://www.infoiarna.org.gt/recursos-informativos/publicaciones/?_sft_serie=serie-perfil-ambiental-de-guatemala https://web.archive.org/web/20090510073911/http://www.usaid.gov/gt/docs/tropical_forest_assesment.pdf <http://www.uvg.edu.gt/investigacion/ceab/cea/doc/informe-cobertu-ra-forestal-2010.pdf> (page 10) http://www.uvg.edu.gt/investigacion/ceab/cea/doc/otras%20publicaciones/mapa_Dinamica_SIG91-01.pdf <https://www.guateambiente.org/estado-actual-de-los-bosques-en-guatemala/>
- 52) GFW primary forest cover 30 % + canopy cover in relevant regions.
- 53) GFW primary forest cover 30 % + canopy cover. Mapa Forestal y de Cobertura de la Tierra de Honduras: Análisis de Cifras Nacionales, Nota Técnica N° 08, page 17 - "bosque latifoliado húmedo" = 25 787 km² in 2014. http://www.reddccdgiz.org/documentos/doc_1697518440.pdf In the report "Evaluacion Nacional Forestal" from 2006 page 34, official data estimate a tropical rainforest cover of 25 589 km²: <https://books.google.no/books?id=uUqOg3J5rngC&pg=PA34&lp-g=PA34&dq=tipo+de+bosques+honduras&source=bl&ots=Wcbi-jU5ZC8&sig=ACfU3U1qJ-GgRibAm26JE7g-adHjdqT8Og&hl=no&sa=X&ved=2ahUKEwiAnc6zOrPpAhVMI4sKH8e08CvAQ6AEwG3oEAcAgQA-Q#v=onepage&q&f=false> In Honduras' official data to FAO and in the Forest Reference Level Honduras 2020 (page 6) - bosque latifoliado húmedo is estimated to cover more than 31 000 km² in 2019 and more than 37 000 km² in 2009. This is possibly due to a canopy cover threshold of 10 % and that it includes deforested and regrowing forest: https://redd.unfccc.int/files/nrf_2020_honduras.pdf <http://www.fao.org/3/a-az235s.pdf> (page 10, «bosque latifoliado»)
- 54) GFW primary forest cover 30 % + canopy cover in relevant regions.
- 55) GFW primary forest cover 30 % + canopy cover. In «Inventario Nacional Forestal de Nicaragua 2010» page 69 it is explained that Nicaragua classifies its forests as leaved forest (bosque latifoliado), conifer forests (conifero), and mixed forests (mixto) and mangrove forests (manglar). The leaved forest consists of both rainforest and dry forest. In FREL 2019 there is a distinction between «bosque latifoliado» og «bosque seco» (dry forest). Total forest area of the former was 28 871 km² in 2015. Lots of secondary regrowing forest. https://redd.unfccc.int/files/nref_nacional_vf_170119.pdf <http://www.marena.gob.ni/Enderredd/wp-content/uploads/MemoriasOrgan-izaciones/Investigaciones/Atlas.pdf> <http://riul.unanleon.edu.ni:8080/jspui/retrieve/4149> https://publications.iadb.org/publications/spanish/document/Diag-n%C3%B3stico_del_sector_forestal_en_Nicaragua_Movilizando_el_sector_forestal_y_atrayendo_inversiones_es_es.pdf <http://www.fao.org/3/a-az291s.pdf>
- 56) GFW primary forest cover 30 % + canopy cover in relevant regions.
- 57) GFW primary forest cover 30 % + canopy cover in relevant regions.
- 58) GFW primary forest cover 30 % + canopy cover. <http://www.fao.org/3/a-az191s.pdf> (page 19) «bosque maduro» and «bosque secundario» = 23 216 km² in 2013. Just about all forest in Costa Rica grows within FAO's tropical rainforest ecoregion. There are some dry forests northwest in the country. The category «bosque maduro» represents primary rainforest. This is at least 75 years old and has to a very little degree been modified by humans. Most is located in protected areas. The area of «bosque maduro» and
- GFW primary forest cover are similar. Costa Rica also has substantial areas of secondary regrowing forests. https://rainforests.mongabay.com/deforestation/archive/Costa_Rica.htm https://unredd.net/index.php?option=com_docman&task=doc_download&gid=13242&Itemid=53 https://www.sirefor.go.cr/pdfs/afiche_Inventario_Forestal_Nacional.pdf https://www.researchgate.net/figure/Figure1-Ecoregions-used-for-macroecological-analyses-in-the-Costa-Rica-Panama-Colombia_fig1_233399299
- 59) GFW primary forest cover 30 % + canopy cover in relevant regions.
- 60) GFW primary forest cover 30 % + canopy cover. <http://www.fao.org/3/a-az165e.pdf> (page 9) 2010 data.
- 61) GFW primary forest cover 30 % + canopy cover. <https://www.globalspecies.org/ecoregions/display/OC0106>
- 62) GFW primary forest cover 30 % + canopy cover. <http://www.fao.org/3/a-az205s.pdf> (page 8) 329 km² in 2002.
- 63) GFW primary forest cover 30 % + canopy cover. <http://www.joeroman.com/wordpress/wp-content/uploads/2018/02/galford-et-al-2018.pdf> - "Cuban land use and conservation, from rainforests to coral reefs" 2018 (page 3 and 8) indicate 12 668 km² of wet forest on Cuba in 2015. This deviates greatly from GFW primary forest cover and is probably due to that Cuba has lots of secondary young regrowing forest. <https://www.worldwildlife.org/ecoregions/nt0120> <http://documents.worldbank.org/curated/en/957541468270313045/pdf/multi-page.pdf>
- 64) GFW primary forest cover 30 % + canopy cover. <http://www.fao.org/3/a-az202s.pdf> (page 11), «bosque latifoliado húmedo», «bosque latifoliado nublado», and «bosque latifoliado semi-húmedo» combined cover an area of 10 187 km² in 2010. The big deviation from GFW primary forest cover is probably due to extensive areas of secondary young regrowing forest. http://www.grupojaragua.org.do/documents/Informe_MonitoreoBicknell_BahorucoS_GJ2012-2013_conResumen_ed.pdf <http://taareasdominicanas.com/bosques-la-republica-dominicana/>
- 65) GFW primary forest cover 30 % + canopy cover. <http://www.fao.org/3/a-az246e.pdf> (page 9) Closed broadleaved, disturbed broadleaved, mangrove, and swamp estimated area of 2 693 km² in 2010. Most of Jamaica is within FAO's tropical rainforest ecozone. <http://www.forestry.gov.jm/node/386>
- 66) GFW primary forest cover 30 % + canopy cover. <http://www.fao.org/3/a-az356e.pdf> (page 11-12) Evergreen and semi-evergreen seasonal forest, montane forest swamp forest = 1 263 km² in 2010.
- 67) GFW primary forest cover 30 % + canopy cover. <http://www.fao.org/3/a-az310e.pdf> (page 13) Subtropical rainforest, subtropical moist forest, Lower mountain rainforest and mangrove forest combined area of 4 192 km² in 2008. Lots of young secondary forest. The entire island lies within FAO's tropical rainforest ecozone.
- 68) GFW primary forest cover 30 % + canopy cover. <http://www.fao.org/3/a-az226f.pdf> (page 10) Forêt ombrophile = 360 km² in 2010.
- 69) GFW primary forest cover 30 % + canopy cover. GFW primary forest samsvarer med myndighetenes 2010 tall i country report fao 2015. <http://www.fao.org/3/a-az201e.pdf> (page 12)
- 70) GFW primary forest cover 30 % + canopy cover. The region Haut-Katanga in the south has about 11 km² of GFW primary forest cover. This is part of the «Miombo Woodland» and is not rainforest. Data on rainforest cover in DRC varies a lot. According to DRC's FREL from 2018 DRC had 1 145 260 km² of rainforest in 2009. https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf https://www.observeiro-comifac.net/docs/edf2010/FR/Etat-des-forets_2010.pdf At the same time, official data from 2005 indicate a rainforest area of 987 000 km²: <http://www.fao.org/3/a-az198f.pdf> (page 12). The large deviation may be due to that the former include secondary young regrowing forest, as the same report estimates a secondary forest area of 182 930 km² in DRC. This is forest that has been either completely removed and is in a state of regrowing or has the potential to regrow. The Royal Society report indicate a rainforest area in DRC of 1 071 810 km² in 2005 canopy cover 70 % +: <https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2012.0300> (page 4) https://carpe.umd.edu/sites/default/files/focb_aprelimassess_en.pdf
- 71) GFW primary forest cover 30 % + canopy cover. Total forest cover in Gabon in 2015 = 229 700 km²: <http://www.fao.org/3/a-az217f.pdf> (page 12-13). Royal Society report indicate a rainforest cover of 224 160 km² in 2005 canopy cover 70 % +: <https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2012.0300> (page 4)
- 72) GFW primary forest cover 30 % + canopy cover. Official data indicates 217 895 km² in 2012: <http://www.fao.org/3/a-az189f.pdf> (page 11-12) Royal Society report indicate 209 320 km² in 2005 canopy cover 70 % +: <https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2012.0300> (page 4)
- 73) GFW primary forest cover 30 % + canopy cover. Official data indicate a rainforest area of 191 043 km² in 2004. <http://www.fao.org/3/a-az180f.pdf> (page 8). Royal Society report = 200 370 km² in 2005, 70 % + canopy cover: <https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2012.0300> (page 4)
- 74) GFW primary forest cover 30 % + canopy cover. Verhegghen & Defourny, 2010, rainforest cover = 69 237 km²:

https://www.observatoire-comifac.net/docs/edf2010/FR/Etat-des-forets_2010.pdf

Royal Society report = 58 330 km² in 2005 canopy cover 70 % +:

<https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2012.0300> (page 4).

Official data from 1989: <http://www.fao.org/3/a-az183f.pdf> (page 11) = 32 732 km² of dense primary and secondary forest.

75) GFW primary forest cover 30 % + canopy cover.

<http://www.fao.org/3/a-az259e.pdf> (page 11 and 17)

Total forest cover 2015 = 41 000 km². The entire country lies within FAO's tropical rainforest zone. <http://www.fao.org/forestry/country/61326/en/lbr/> Some consist of areas that has 50 % of agricultural land (page 11 in the fao-report). Rainforest, both degraded and relatively intact that is not part of the forest/agricultural mosaic landscape covers an area of 34 555 km² in 2003.

Royal Society report indicates a rainforest area of 45 520 km² in 2005 canopy cover 70 % +:

<https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2012.0300> (page 4)

<https://www.worldwildlife.org/ecoregions/at0130>

76) GFW primary forest cover 30 % + canopy cover.

Official rainforest data for the year 2010 = 46 582 km²:

<http://www.fao.org/3/a-az264f.pdf> (page 8)

77) GFW primary forest cover 30 % + canopy cover.

Verhegghen & Defourny, 2010 indicate a rainforest area of 21 206 km² in 2010:

https://www.observatoire-comifac.net/docs/edf2010/FR/Etat-des-forets_2010.pdf (page 29)

Royal Society report indicates a rainforest area of 21 630 km² in 2005:

<https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2012.0300> (page 4)

FREL Equatorial Guinea 2020 indicates a rainforest area of 24 278 km² in 2018. This includes secondary forest:

https://redd.unfccc.int/files/eg_fri_submissions_2020_01_13.pdf (page 45-46)

78) GFW primary forest cover 30 % + canopy cover in Cabinda, Zaire, Uige, Bengo, Cuanza Norte, Malanje, Luanda, Cuanza Sul, Benguela.

We have not included GFW tropical primary forest that is located outside of FAO's tropical rainforest ecozone. This is in the eastern parts of the country.

About all forest in Cabinda belongs to the Central African rainforest biome. In the rest of Angola there are rainforest areas spread out on hilltops in the north. Angola forms part of the Southern Congolian Forest-Savanna Mosaic and western Congolian forest-savanna mosaic, which can sustain both savannas and rainforest. According to FAO, large parts of northern Angola lies within the tropical rainforest ecozone.

<https://globalforestatlas.yale.edu/congo/ecoregions/congo-basin-ecoregion>

<https://www.worldwildlife.org/ecoregions/at0718>

<https://www.worldwildlife.org/ecoregions/at1001>

https://link.springer.com/chapter/10.1007/978-3-030-03083-4_2

<https://phytokeys.pensoft.net/article/8679/>

<https://www.cambridge.org/core/journals/bird-conservation-international/article/namba-mountains-new-hope-for-afromontane-forest-birds-in-angola/A18319114AABB9B43991022AFD41B31A>

https://www.researchgate.net/figure/A-Location-of-Angola-in-Africa-B-Location-of-Cuanza-Norte-in-Angola-C-Vegetation_fig1_319314405

<http://www.fao.org/forestry/country/61326/en/ago/>

79) GFW primary forest cover 30 % + canopy cover.

Ethiopia's «moist afro-montane biome» = 85 000 km². This is an evergreen moist forest where some trees shed their leaves during the drier season.

https://redd.unfccc.int/files/ethiopia_fre_3.2_final_modified_submission.pdf

(page 20 og 65).

<http://www.ebi.gov.et/biodiversity/ecosystems-of-ethiopia/moist-forest-ecosystem/>

<https://theecologist.org/2016/mar/24/ethiopia-s-vulnerable-tropical-forests-are-key-securing-future-coffee>

<https://knowledge.unccd.int/sites/default/files/inline-files/ethiopia-ldn-country-report-final.pdf>

http://redd.unfccc.int/files/ethiopia_fre_3.2_final_modified_submission.pdf

(page 19)

80) GFW primary forest cover 30 % + canopy cover.

Royal Society report indicates a rainforest area of 31 580 km² in 2005:

<https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2012.0300> (page 4)

https://www.researchgate.net/figure/Map-of-Nigeria-showing-the-rain-forest-and-the-locations-representative-pedons-color_225285508

http://www.itto.int/sfm_detail?id=12350000

81) GFW primary forest cover 30 % + canopy cover.

Royal Society report indicates a rainforest area of 15 300 km² in 2005:

<https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2012.0300> (page 4)

FREL 2018, forêt dense tropicale + forêt décidue humide tropicale (semi deciduous) = 18 350 km² in 2000:

https://redd.unfccc.int/files/01_01_2017_ri_nerf_version_finale.pdf

<https://www.worldwildlife.org/ecoregions/at0130>

<http://www.fao.org/3/a-az192f.pdf>

<https://www.worldwildlife.org/ecoregions/at0130>

82) GFW primary forest cover 30 % + canopy cover.

Royal Society report indicates a rainforest area of 14 870 km² in 2005:

<https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2012.0300> (page 4)

https://redd.unfccc.int/files/ghana__modified_frl_november_10_2017_clean.pdf

<https://eros.usgs.gov/westafrika/land-cover/deforestation-upper-guinean-forest>

83) GFW primary forest cover 30 % + canopy cover.

Most of Tanzania's rainforest grows in the «Eastern Arc Mountains». This a highland rainforest with an estimated extent of 5 340 km² in 1998:

[http://www.bioone.org/doi/pdf/10.2982/00102-8317\(1998\)87%5B29:FAFAL-1%5D2.0.CO%3B2](http://www.bioone.org/doi/pdf/10.2982/00102-8317(1998)87%5B29:FAFAL-1%5D2.0.CO%3B2)

<http://www.afrizap.com/en/east-africa-rainforest>

<https://www.worldwildlife.org/ecoregions/at0109>

<http://easternarc.or.tz/eastern-arc-mountains/index.html>

<https://www.mountkilimanjaroguide.com/kilimanjaro-facts.html>

<https://earthobservatory.nasa.gov/IOTD/view.php?id=89605>

84) GFW primary forest cover 30 % + canopy cover.

Kenya has around 200 km² of tropical lowland rainforest (Imatong). The rest is highland rainforest. Kenya operates with a forest category called

Montane and western rainforest in FREL 2019. Official data estimates an

extent of 10 066 km² of this forest type in 2018. But this includes conifer

forests that grow on the western sides of the mountains and at higher

altitudes:

https://redd.unfccc.int/files/national_frl_report_for_redd_in_kenya.pdf

(page 31 and 82)

http://www.helsinki.fi/science/taita/reports/Peltorinne_Forest_types.pdf

<https://softkenya.com/kenya/south-nandi-forest/>

<http://datazone.birdlife.org/site/factsheet/south-nandi-forest-iba-kenya/text>

<http://datazone.birdlife.org/site/factsheet/north-nandi-forest-iba-kenya>

<https://www.worldwildlife.org/ecoregions/at0108>

<https://www.globalspecies.org/ecoregions/display/AT0108>

85) GFW primary forest cover 30 % + canopy cover.

Tis report from 2006 indicates a rainforest cover of 9 242 km²:

http://www.vub.ac.be/klimostoolkit/sites/default/files/documents/uganda_biodiversity_assessment_usaid.pdf (page 14)

<http://www.fao.org/3/a-az362e.pdf> page 13, rainforest cover in 2005 =

7 752 km²

86) GFW primary forest cover 30 % + canopy cover.

We have not found any other reliable data on rainforest cover in the

country. All Upper Guinean Forest is rainforest, but almost all is heavily

degraded.

https://www.researchgate.net/publication/332963336_What_Happened_to_the_Forests_of_Sierra_Leone

<https://eros.usgs.gov/westafrika/land-cover/deforestation-upper-guinean-forest>

<https://www.worldwildlife.org/ecoregions/at0130>

87) GFW primary forest cover 30 % + canopy cover.

We have not found any other reliable data on rainforest cover in the

country.

<https://www.worldwildlife.org/ecoregions/at0130>

<https://eros.usgs.gov/westafrika/land-cover/deforestation-upper-guinean-forest>

88) GFW primary forest cover 30 % + canopy cover.

Mozambique's rainforest grows along parts of the coast and in some

mountain areas in the north.

<https://www.theguardian.com/world/2018/jun/17/mozambique-mount-lic-rainforest-new-species>

<https://qz.com/africa/1320464/scientists-find-mozambiques-untouched-rainforest-on-top-of-an-african-mountain/>

http://www.africancuckoos.zoo.cam.ac.uk/downloads/Oryx_Bayliss2014.pdf

<http://blogs.wwf.org.uk/blog/habitats/forests/scientist-discovers-a-new-rain-forest-in-mozambique/>

89) GFW primary forest cover 30 % + canopy cover.

Highland rainforest in the Imatong.

<http://www.fao.org/tempref/docrep/fao/010/ah887e/ah887e00.pdf>

<https://www.worldatlas.com/articles/ecological-regions-of-south-sudan.html>

There are some lowland rainforest in what is called «Woodland Savannah

Recently Derived from Rain Forest»: https://www.researchgate.net/publication/311390991_Ecological_Zones_of_the_Sudan

<https://news.mongabay.com/2011/06/south-sudans-tropical-forests-fast-disappearing/>

90) GFW primary forest cover 30 % + canopy cover.

91) GFW primary forest cover 30 % + canopy cover.

92) GFW primary forest cover 30 % + canopy cover.

Togo has only 13 km² of rainforest left.

https://www.encyclopedia.com/places/africa/togo-political-geography/togo#FLORA_AND_FAUNA

93) GFW primary forest cover 30 % + canopy cover.

<https://www.britannica.com/place/Benin>

94) GFW primary forest cover 30 % + canopy cover = 50 km²

<http://www.malawi-info.net/country/article/525/malawi-forest-reserves>

<http://www.birdlife.no/internasjonalt/nyheter/?id=1841>

95) GFW primary forest cover 30 % + canopy cover 2018 = 387 km². But

with canopy cover at 75 % it is reduced to about 100 km². The area has a

yearly precipitation of 800 to 1250 mm. WWF defines this area as «dry

evergreen forest». It has two dry seasons, from August to October, and

from May to July – 6 months in total. This is a mixed forest of rainforest

plants, dry woodland plants and savanna plants.

<https://www.worldwildlife.org/ecoregions/at0203>

Zambian authorities also defines this forest as «dry evergreen woodland/

forest»:

http://zmb-nfms.org/luaii/images/technical_docs/1.-CLASSIFICATION-OF-ZAMBIAN-FORESTS.pdf

http://zmb-nfms.org/luaii/images/technical_docs/1.-CLASSIFICATION-OF-ZAMBIAN-FORESTS.pdf

https://www.researchgate.net/publication/232004223_Species_structure_in_Zambian_Miombo_Woodland

<https://www.youtube.com/watch?v=QbdCVC-8rFY>

96) GFW primary forest cover 30 % + canopy cover. Total forest area official data 2015 = 860 640 km². By subtracting the dry forest areas it is 853 525 km² in 2015. GFW primary forest cover for 2015 = 861 700 km².

<http://www.fao.org/3/a-az239e.pdf> (page 27)
Alpine forest: The Ecology of Papua: https://books.google.no/books?id=ix-DRAGAAQBAJ&pg=PT611&lpg=PT611&dq=mangrove+forests+papua+indonesia&source=bl&ots=bbgtblGvh&sig=I0vQOGk3Eqsazehg-7an-QUhBRm4&hl=no&sa=X&ved=0ahUKUkEwJm05G60ebaAhUdHwiKHRv_AeE4ChDoAQgyMAM#v=onepage&q&f=false
«Sumatra tropical pine forests» <https://www.worldwildlife.org/ecoregions/im0304>
http://wwf.panda.org/what_we_do/where_we_work/borneo_forests/about_borneo_forests/ecosystems/montane_forests/

97) GFW primary forest cover 30 % + canopy cover in relevant regions.

98) GFW primary forest cover 30 % + canopy cover in relevant regions.

99) GFW primary forest cover 30 % + canopy cover in relevant regions.

100) GFW primary forest cover 30 % + canopy cover in relevant regions.

101) GFW primary forest cover 30 % + canopy cover.

Official data on tropical wet evergreen forests, tropical semi evergreen forests and mangrove forests = 59 376 Km² in 2010. In addition, "hill and temperate evergreen forests" = 85 412 km². Much of the last category is in northern Myanmar where there are broadleaved evergreen forests growing up until 1800 masl.

http://www.apafri.org/activities/Myanmar2015/Day%201/Day1_Nyi%20Nyi%20Kyaw_Forests%20and%20Forestry%20in%20Myanmar.pdf (slide 16)
There are 8 eco regions in Myanmar that sustain tropical rainforest.

<https://www.worldwildlife.org/ecoregions/im0402>

<https://www.worldwildlife.org/ecoregions/im0140>

<https://www.worldwildlife.org/ecoregions/im0131>

<https://www.worldwildlife.org/ecoregions/im0109>

<https://www.worldwildlife.org/ecoregions/im0132>

<https://www.worldwildlife.org/ecoregions/im0119>

<https://www.worldwildlife.org/ecoregions/im0163>

<https://www.worldwildlife.org/ecoregions/im1404>

https://redd.unfccc.int/files/revision-myanmar_frl_submission_to_unfccc_webposted.pdf (page 13)

http://unosat-maps.web.cern.ch/unosat-maps/MM/OT20150413MMR/UNOSAT_A3_OT20150413MMR_LandClassification_2000_Rakhine.pdf

<http://www.awg-sf.org/myanmar/>

<https://www.ifc.org/wps/wcm/connect/defcc348-3773-4fcf-a298-281c53d-1cdd1/3c+SEA+Biodiversity%2C+hydro+and+climate+change+presentation.pdf?MOD=AJPERES&CVID=IDuVkbY>

https://www.researchgate.net/publication/240614379_Land_use_in_the_Northern_Forest_Complex_of_Myanmar_Burma_-_new_insights_for_conservation

<http://www.fao.org/forestry/country/61326/en/mmr/>

102) GFW primary forest cover 30 % + canopy cover in relevant regions.

103) GFW primary forest cover 30 % + canopy cover.

<http://www.fao.org/3/a-az266e.pdf>, page 19, total forest area = 202 290 km².

Official data from 2001 indicate a forest area of 177 700 km²:

http://www.eorc.jaxa.jp/ALOS/kyoto/mar2012_kc17/pdf/2-6_kc17_hamdan-omar_frim.pdf (page 3)

<https://www.biogeosciences.net/8/2635/2011/bg-8-2635-2011.pdf>

<http://whrc.org/wp-content/uploads/2016/02/Forest-Inventory-in-Malaysia.pdf>

<https://www.worldatlas.com/articles/ecological-regions-of-malaysia.html>

https://en.wikipedia.org/wiki/List_of_ecoregions_in_Malaysia#cite_note-Panda-6

104) GFW primary forest cover 30 % + canopy cover in relevant regions.

105) GFW primary forest cover 30 % + canopy cover in relevant regions.

106) GFW primary forest cover 30 % + canopy cover. We have subtracted GFW primary forest cover in the regions Odisha, Adhra Pradesh, and parts of the region Tamil Nadu that lies in the Western Ghats, which according to WWF is moist deciduous forests.

<https://www.worldwildlife.org/ecoregions/im0111>

<https://www.worldwildlife.org/ecoregions/im0150>

The following report indicates a rainforest area in India of 95 487 km² in 2015: <https://www.ncbi.nlm.nih.gov/pubmed/26615560> - Tropical Wet Evergreen and Tropical Semi-Evergreen.

<http://www.biologydiscussion.com/forest/5-types-of-forests-found-in-india-explained/6940>

https://nrsc.gov.in/Forest_Types?q=Land_Cover_NICES

107) GFW primary forest cover 30 % + canopy cover in relevant regions.

Arunachal Pradesh lies in Asia's northern limit of frost free areas. Official data indicates a combined area of "tropical wet forest" and "tropical semi-evergreen forest" of 47 147 km² – 70 % of the total forest cover in the region in 2007: http://fsi.nic.in/sfr2009/aranachal_pradesh.pdf page 61.

Forest types in Arunachal Pradesh: http://aranachalforests.gov.in/notifications/Forest_statistics%20of%20Arunachal%20Pradesh-2017.pdf

page 10

<http://fsi.nic.in/isfr19/vol2/isfr-2019-vol-ii-aranachal-pradesh.pdf>

108) GFW primary forest cover 30 % + canopy cover.

Official data of «evergreen forests» = 26 056 km² in 2015. «Mixed deciduous forest» og «coniferous forests» combined cover 94 000 km², of which most id «mixed deciduous forests»:

https://redd.unfccc.int/files/lao_2018_frel_submission_modified.pdf page 5.

http://www.rfo-sea.org/national_summary.htm

<http://www.fao.org/forestry/country/61326/en/lao/>

«Mixed deciduous forest» is a forest type that consists of semi-evergreen moist forests and conifer forests. It is likely that GFW primary forest cover for Laos includes the parts of the forest type that is more similar to «tropical semi-evergreen moist forest». GFW primary forest cover does not

overlap with WWF's ecozone called «central indochina dry forest», which is the only forest zone of the country that do not sustain rainforest in any way. There are five other eco regions in the country that do sustain a rainforest environment:

<https://www.worldwildlife.org/ecoregions/im0137>

<https://www.worldwildlife.org/ecoregions/im0121>

<https://www.worldwildlife.org/ecoregions/im0136>

<https://www.worldwildlife.org/ecoregions/im0152>

<https://www.worldwildlife.org/ecoregions/im0210>

http://portal.gms-eoc.org/uploads/map/archives/map/GMS-Ecoregions_18_hi-res_10.jpg

https://books.google.no/books?id=PQ8NHPLPb70C&pg=PT257&lpg=PT257&dq=mixed+deciduous+forests+laos&source=bl&ots=GAAuNAUKBw4&sig=ACfU3U2EwECTzJqtlFW_2kZjdvcieKcw-g&hl=no&sa=X&ved=2ahUKUkEwj2u8e4ntHpAhXG0qYKHQ8KBU0Q6A-EwEHoEaCaoQAQ#v=onepage&q=mixed%20deciduous%20forests%20laos&f=false (chapter 3.3).

<http://www.mekonginfo.org/assets/midocs/0001714-environment-forests-and-trees-of-the-central-highlands-of-xieng-khouang-lao-p-d-r-a-field-guide.pdf>

<http://www.fao.org/3/a-az255e.pdf>

109) GFW primary forest cover 30 % + canopy cover.

<https://www.worldwildlife.org/ecoregions/im0137>

National Forest Inventory and Statistics (NFIS) indicates a total evergreen forest cover, including mangroves, of 72 240 km² in 2016, and a secondary forest cover of 41 050 km²: http://www.rfo-sea.org/national_summary.htm.

The FREL 2016 indicates an area of 77 320 km² for the same forest type in 2010.

https://redd.unfccc.int/files/vietnam_frl_modified_submission_final_for_posting.pdf

<http://www.mekonginfo.org/assets/midocs/0002503-environment-forest-resources-management-and-development-in-vietnam.pdf> page 1,

Department for Forestry Development Closed broad-leaved tropical evergreen and semi-deciduous 56 486 km².

110) GFW primary forest cover 30 % + canopy cover.

Includes parts of "Southeastern Indochina Dry Evergreen Forests":

<https://www.worldwildlife.org/ecoregions/im0210>. Annual precipitation varies from 1200 mm to 2000 mm and with a dry season of 3-6 months.

This is semi-evergreen forest and parts of it can be defined as tropical rainforest. GFW primary forest cover fits well with FAO's delimitation of the tropical rainforest ecozone.

Official data indicates a tropical evergreen forest cover of 52 198 km² in 1998:

<http://www.fao.org/3/ac648e0a.htm>

<http://portal.gms-eoc.org/maps?cmbIndicatorMapType=archive&cmbIndicatorTheme=35&cmbIndicatorMap=10>

http://portal.gms-eoc.org/uploads/map/archives/lores/GMS-Ecoregions_18_Lo-Res_18_lo-res_10.jpg

<https://wildlifethailand.com/blog-posts/plants-and-fungi/96-forest-types-in-thailand>

<http://forprod.forest.go.th/forprod/ebook/%E0%B8%81%E0%B8%B2%E0%B8%A3%E0%B8%9B%E0%B9%88%E0%B8%B2%E0%B9%84%E0%B8%A1%E0%B9%89%E0%B9%83%E0%B8%99%E0%B8%9B%E0%B8%A3%E0%B8%B0%E0%B9%80%E0%B9%87%E0%B8%A8%E0%B9%84%E0%B8%97%E0%B8%A2/Forest%20in%20thailand%20eng.pdf>

<http://www.fao.org/3/a-az350e.pdf>

111) GFW primary forest cover 30 % + canopy cover.

Country report 2015 til FAO, Closed Forest Broadleaved and mangroves (40 % + canopy cover) = 22 010 km² in 2010, Open Broadleaved Forest = 43 110 km².

<http://www.fao.org/3/a-az306e.pdf> (page 21)

<https://www.worldatlas.com/articles/ecological-regions-of-the-philippines.html>

https://www.senate.gov.ph/publications/SEPO/AAG%20on%20Philippine%20Forest_Final.pdf

FAO's tropical rainforest ecozone and GFW primary forest cover are similar.

112) GFW primary forest cover 30 % + canopy cover.

Includes parts of the eco region Southeastern Indochina Dry Evergreen Forests:

<https://www.worldwildlife.org/ecoregions/im0210>. Annual precipitation varies from 1200 mm to 2000 mm and with a dry season of 3-6 months.

This is semi-evergreen forest and parts of it can be defined as tropical rainforest.

Official data of semi-evergreen, evergreen and mangrove forests to cover 41 050 km² in 2014:

http://www.rfo-sea.org/national_summary.htm

<https://www.worldwildlife.org/ecoregions/im0202>

<http://www.fao.org/3/a-az179e.pdf>

113) GFW primary forest cover 30 % + canopy cover.

<http://sourcecd.xtbg.cas.cn/yw/yw/200908/P020090827560702877262.pdf>

fra page 1: *There are only about 633,800 ha of old growth high diversity lowland tropical rain forests in China today, and much of these old growth lowland tropical forests are located in Xishuangbanna of southern Yunnan Province.*

The frost free rainforest in China grows in southeastern Xizang (Tibet), southern Yunnan, southwestern Guangxi, Hainan and southern Taiwan:

https://www.researchgate.net/publication/315532056_The_Tropical_Forests_of_Southern_China_and_Conservation_of_Biodiversity

https://www.researchgate.net/figure/The-tropical-seasonal-rain-forest-in-southern-Yunnan-China_fig2_239839917

<http://www.fao.org/forestry/country/61326/en/chn/>

<https://news.mongabay.com/2008/03/chinas-tropical-rainforests-decline-67-in-30-years/>

<https://news.mongabay.com/2015/07/rich-forest-diversity-found-in-new-yunnan-china-preserve/>
<http://en.people.cn/102775/208085/8364141.html>
<https://tropicalconservationscience.mongabay.com/content/v1/08-03-03-Hua.htm>

114) GFW primary forest cover 30 % + canopy cover.
<http://www.fao.org/3/a-az168e.pdf> page 7, Broadleaf 16 890 km² in 2010.
<http://www.rspnbnhutan.org/flora-and-fauna-of-bhutan-2/>
<http://www.fao.org/forestry/country/61326/en/btn/>
<http://www.fao.org/3/ad103e/AD103E03.htm>

115) GFW primary forest cover 30 % + canopy cover.
Classification of Nepalese Forests Classification of Nepalese Forests and Their Distribution in Protected Areas – 2008 – page 1-2:
Nepal lies just outside of the tropics in the global climatic zonation. However, bioclimatic tropicality extends into it up to an elevation of 1,000 m altitude.

<http://www.floraofnepal.org/countryinformation/vegetation/stainton>
<http://www.fao.org/forestry/country/61326/en/npl/>
<http://www.fao.org/3/w7719e/w7719e04.htm>
https://redd.unfccc.int/files/finalfr/nepal_jan2018.pdf
[https://en.wikipedia.org/wiki/Geography_of_Nepal#/media/File:Land_cover_map_of_Nepal_using_Landsat_30_m_\(2010\)_data.jpg](https://en.wikipedia.org/wiki/Geography_of_Nepal#/media/File:Land_cover_map_of_Nepal_using_Landsat_30_m_(2010)_data.jpg)
<http://www.fao.org/3/y1997e/y1997e1g.jpg>
<http://www.fao.org/forestry/country/61326/en/mmr/>

116) GFW primary forest cover 30 % + canopy cover.
<http://www.fao.org/3/a-az341e.pdf> (page 8) «montane forest», sub-montane», «lowland rainforest», wet monsoon forest» and «mangrove forest» cover 3 145 km² in 2010. «wet monsoon» has up to 3 months of dry season. It borders the rainforest and the two forest types to not differ much. They have many of the same species. Sri Lanka also has over 11 000 km² of «dry monsoon forests». This receives up to 2000 mm of rain annually, and has a dry season of 3-6 months. Parts of this forest does also fit with a tropical rainforest definition.

http://lk.chm-cbd.net/?page_id=182
<http://www.fao.org/3/a-az341e.pdf>
117) GFW primary forest cover 30 % + canopy cover.
<http://www.fao.org/3/a-az174e.pdf> (page 15) total forest cover 2015 = 3 770 km².

118) GFW primary forest cover 30 % + canopy cover in Pingtung and Taitung. The tropical zone in Taiwan is far south in the country. This is a tropical monsoon forest type similar to the one in southern China.
<https://link.springer.com/article/10.1007/s11258-009-9694-0>
<https://www.worldwildlife.org/ecoregions/im0171>
https://www.researchgate.net/publication/315532056_The_Tropical_Forests_of_Southern_China_and_Conservation_of_Biodiversity

119) GFW primary forest cover 30 % + canopy cover.
<http://www.fao.org/3/a-az161e.pdf> (Page 25) Forest defined as «Hill forest» is the only tropical rainforest left in the country, about 920 km² in 2005.

<https://www.usaid.gov/sites/default/files/documents/1865/Bangladesh-Tropical-Forests-and-Biodiversity-Assessment-2016.pdf>
<https://books.google.no/books?id=ydiZGNf0BtwC&pg=PA5&pg=PA5&dq=tropical+rainforest+bangladesh&source=bl&ots=qralz252cu&sig=Ce-geO8TF0CJAGig65aOxANzG-CY&hl=no&sa=X&ved=0ahUKEwj3keLSu-oLcAhWOK1AKHadFB3g4HhDoAQguMAE#v=onepage&q=tropical%20rainforest%20bangladesh&f=false>

<http://iopscience.iop.org/article/10.1088/1748-9326/aa84bb/meta>
http://en.banglapedia.org/index.php?title=Forest_and_Forestry

120) GFW primary forest cover 30 % + canopy.
FREL 2017 estimate «swamp forests», «Mangrove forests», «Low altitude forest on plains and fans», «Low altitude forest on uplands», and «Lower montane forest», to cover a total area of 308 321 km² in 2015. Forest above 3000 masl («Montane forest») = 3 948 km²

https://redd.unfccc.int/files/png_frl_submission-15.01.2017.pdf page 19.
<https://pharmacy.utah.edu/ICBG/pdf/WebResources/ForestBiodiversity/Shearman-State-of-the-Forests-of-PNG-2008.pdf> (page 13) «lowland rainforest», «lower montane forest», «swamp forest» and «mangrove forest» cover an estimate area of 316 955 km² in 2002.

<http://www.fao.org/3/a-az303e.pdf> - details for forest types only for the year 1996.

121) GFW primary forest cover 30 % + canopy: Bougainville, Milne Bay, New Britain, New Irland, Manus.

122) GFW primary forest cover 30 % + canopy.

123) GFW primary forest cover 30 % + canopy.
<http://www.fao.org/3/a-az336e.pdf> (page 16-17) total forest cover 2015 = 21 581 km²

<http://mofr.gov.sb/foris/forestArea.do#marker>
https://www.researchgate.net/publication/9043600_Rainforest_Composition_and_Histories_of_Human_Disturbance_in_Solomon_Islands
<http://www.fao.org/3/a-am626e.pdf>
<https://www.worldwildlife.org/ecoregions/aa0119>
https://www.jstor.org/stable/2416853?seq=1#page_scan_tab_contents

124) GFW treecover in natural forest areas of minimum 30 % in the tropical rainforest areas of Queensland defined by WWF: <https://www.worldwildlife.org/ecoregions/aa0117>

We have subtracted the tree cover in plantations (in Rockhampton, Isaac, Hinchinbrook, Cassowary Coast, Cairns) from the general tree cover data. Total plantations 355 km². Almost all tree cover loss happened in natural forests.

Link to selected area:
<https://www.globalforestwatch.org/map/geostore/8ad50371c6fac1f-7b2540c598c87c51b?analysis=eyJzaG93RHJhdyl6dHJlZX0%3D&->

<http://www.fao.org/3/a-az212e.pdf> (page 13)
<https://www.worldwildlife.org/ecoregions/oc0105>
<http://www.fao.org/docrep/006/AD672E/ad672e08.htm>

125) GFW primary forest cover 30 % + canopy.
<http://www.fao.org/3/a-az212e.pdf> (page 13)
<https://www.worldwildlife.org/ecoregions/oc0105>
<http://www.fao.org/docrep/006/AD672E/ad672e08.htm>

126) GFW primary forest cover for the year 2000 estimates 0 km². This does not seem to be correct.
IUCN estimate in the report Climate Change and Biodiversity in the European Union Overseas Entities that tropical rainforest cover 21 % of New Caledonia's land mass in 2008. This equals 3 900 km². We have added the mangrove forest area from 2009 Country Report to FAO 2015.

<https://portals.iucn.org/library/sites/library/files/documents/2010-064.pdf>
<http://www.fao.org/3/a-az289f.pdf> (Page 8) «Forêt dense sur substrat volcano-sédimentaire» and mangroves covered 6 826 km² in 2009.

https://www.researchgate.net/publication/280975121_New_Caledonia_A_Pleistocene_refugium_for_rain_forest_lineages_of_relict_angiosperms
<https://www.worldwildlife.org/ecoregions/aa0113>
<https://www.botany.one/2018/02/makes-new-caledonian-rainforests-different/>
<https://newcaledoniaplants.com/plant-catalog/humid-forest-plants/>
https://www.researchgate.net/publication/280975121_New_Caledonia_A_Pleistocene_refugium_for_rain_forest_lineages_of_relict_angiosperms

127) GFW primary forest cover 30 % + canopy cover.
<http://www.fao.org/3/a-az371e.pdf> (page 7-10) «mid-height forest», «low forest», «swamp forest», «mangrove forest» cover a combined area of 4 445 km² in 1992.

<https://www.worldwildlife.org/ecoregions/aa0126>
128) GFW primary forest cover 30 % + canopy cover.
http://micronesica.org/sites/default/files/2_kitalong.pdf
<http://palauecosystem.weebly.com/tropical-rainforest.html>
<http://www.fao.org/3/a-az301e.pdf>

129) GFW primary forest cover does not exist on Samoa. This is probably due to the fact that almost all is secondary young forest, heavily degraded and open secondary forest.
<http://www.fao.org/3/a-am246e.pdf> page 10, «medium forest» (between 40 og 65 % canopy cover) was estimated to cover 726 km² in 2004.

Closed forest (over 65 % canopy cover) covered only 0,8 km².
<http://www.fao.org/3/a-az325e.pdf>
<https://www.worldwildlife.org/ecoregions/oc0112>

130) We have used GFW to find «Intact Forest Landscapes» in rainforest regions with canopy cover at 75 % +.

131) The IFL area of Himachal Pradesh has been subtracted from the total, as there is no primary humid tropical forest there.

132) We have included the municipalities of the region Santa Cruz that best correspond to the Chiquitano and Chaco forests, which are Chitquitos, Cordillera, and José Miguel de Velasco. This is approximate. In the municipalities that are covered with Chiquitano and Chaco forests the deforestation was at almost 9 000 km² in the period.

133) In the municipalities that are covered with Chiquitano and Chaco forests the deforestation was 1212 km² in the period.

- 134) <https://www.worldwildlife.org/biomes/tropical-and-subtropical-moist-broadleaf-forests>
<https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/ES12-00299.1>
- 135) http://www.fao.org/3/ad652e/ad652e07.htm#P470_31994
<http://foris.fao.org/static/data/fra2010/ecozones2010.jpg>
- 136) <https://www.worldwildlife.org/ecoregions/nt0104>
- 137) <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/cloud-forest>
<https://books.google.no/books?id=4hi5BwAAQBAJ&printsec=frontcover&hl=no#v=onepage&q&f=false>
<https://biblio.flacsoandes.edu.ec/libros/digital/55826.pdf>
<https://www.canopyintheclouds.com/learn/>
- 138) <https://www.globalforestwatch.org/>
- 139) <https://iopscience.iop.org/article/10.1088/1748-9326/aacd1c#er-laacd1cs2>
https://iopscience.iop.org/1748-9326/13/7/074028/media/ERL_13_074028_SD.pdf
<https://glad.umd.edu/dataset/gfm/humid/humid-tropical-forest>
<https://wri-indonesia.org/en/blog/global-forest-watch-technical-blog-definition-and-methodology-2019-forest-loss-data-indonesia>
- 140) <https://www.globalforestwatch.org/>
- 141) <http://foris.fao.org/static/data/fra2010/ecozones2010.jpg>
- 142) <https://www.worldwildlife.org/biome-categories/terrestrial-ecoregions>
- 143) <https://www.worldwildlife.org/ecoregions/nt0212>
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4874403/>
- 144) <https://www.worldwildlife.org/ecoregions/nt0181>
<https://web.archive.org/web/20100308074846/http://www.nationalgeographic.com/wildworld/profiles/terrestrial/nt/nt0181.html>
- 145) <http://foris.fao.org/static/data/fra2010/ecozones2010.jpg>
<http://www.fao.org/3/ad652e/ad652e07.htm#TopOfPage>
- 146) <https://www.worldwildlife.org/ecoregions/at0719>
- 147) <https://www.worldwildlife.org/ecoregions/nt0704>
- 148) <https://www.worldwildlife.org/ecoregions/nt0210>
- 149) <https://www.worldwildlife.org/ecoregions/at0203>
- 150) <https://www.worldwildlife.org/ecoregions/im0111>
<https://www.worldwildlife.org/ecoregions/im0150>
- 151) https://www.researchgate.net/publication/271326041_Tropical_gallery_forests
<https://besjournals.onlinelibrary.wiley.com/doi/pdf/10.1046/j.1365-2664.1998.00300.x>
- 152) <https://iopscience.iop.org/article/10.1088/1748-9326/aacd1c>
- 153) <http://www.intactforests.org/index.html>
- 154) http://www.fao.org/3/ad652e/ad652e24.htm#P5754_508922
- 155) <http://www.fao.org/3/ad652e/ad652e00.htm#TopOfPage>

Rainforest Foundation Norway supports indigenous peoples and traditional populations of the world's rainforests in their efforts to protect their environment and secure their customary rights. RFN was established in 1989 and works with local environmental, indigenous and human rights organisations in the main rainforest countries in the Amazon region, Central Africa, Southeast Asia, and Oceania. RFN is an independent organisation, and part of the international Rainforest Foundation network, with sister organisations in the United Kingdom and the USA.

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