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ILLICIT HARVEST, COMPLICIT GOODS:

THE STATE OF ILLEGAL DEFORESTATION FOR AGRICULTURE

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This report is an update of the 2014 Forest Trends report *Consumer Goods and Deforestation: An Analysis of the Extent and Nature of Illegality in Forest Conversion for Agriculture and Timber Plantations*, written by Sam Lawson, Art Blundell, Bruce Cabarle, Naomi Basik Treanor, Michael Jenkins, and Kerstin Canby.

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Executive Summary

Tropical deforestation is at the root of multiple global challenges facing humanity. Achieving the Paris Agreement's commitment to hold climate warming to well below 2°C above pre-industrial levels requires both rapid decarbonization of the world's economy and rapid reduction in emissions from deforestation and other land uses. Deforestation is one of the greatest drivers of biodiversity loss. Areas of tropical forest loss are global hotspots for zoonotic disease exposure and emergence. Access to forest land for clearance is also driving global increases in violence against indigenous peoples, local communities, and environmental defenders, as well as migration when communities are displaced.

While subsistence agriculture and logging still contribute to deforestation, commercial-scale agricultural expansion is now recognized as by far the single largest driver of deforestation worldwide and thus also of greenhouse gas emissions from land-use change. In 2010, the Consumer Goods Forum[1] resolved to achieve zero net deforestation by 2020 in four priority sectors: soy, palm oil, paper & pulp/timber, and beef. By 2014, when the New York Declaration on Forests was signed, a wave of corporations was making highly publicized zero deforestation commitments. The same year, Forest Trends released an analysis of the extent to which agricultural commodities are being grown on lands that have been illegally cleared of forests (Forest Trends 2014). The results were stark: almost half of all tropical deforestation between 2000 and 2012 was driven by the illegal conversion of forest lands for commercial agriculture, and half of the production from this agro-conversion was destined for export markets.

Today, the 2020 target year for achieving net zero commodity-driven deforestation has come and gone. A decade-long surge of voluntary corporate commitments has been unable to stem the tide of global forest loss. Clearing for commercial agriculture has continued and is, in fact, getting worse.

After more than a year of intense global focus on the COVID-19 pandemic, policy makers are beginning to emerge from the fog to face problems too long ignored. An urgent need to focus on near-term economic recovery threatens to sideline longer-term objectives in many countries. But global greenhouse gas emissions, after falling more than 6 percent in 2020 from a massive drop in travel and economic activity, already appear to be roaring back. Meanwhile scientific evidence attesting to the need for aggressive global climate action and biodiversity protection continues to roll in.

To combat further forest loss, the European Commission (EC), United Kingdom (UK), and United States (US) are all considering legislation or other trade measures that would prohibit the import of commodities grown on deforested land. There is a strong interest to know to what extent legislation based on the legality of the imported agricultural commodity would address broader deforestation. It is also important to clarify how donor and consumer nations can best support producer countries, industry, and other stakeholders to uphold national laws and regulations when it comes to the conversion of forested lands for agriculture.

[1] CEO-level organization of 400 global consumer goods manufacturers and retailers with a combined revenue of more than US$2.8 trillion (2.1 trillion Euros).

Several initiatives have quantified how much and where deforestation is driven by commercial agriculture, and even how much of this deforestation was driven by international trade. However, fewer analyses have been able to determine the extent to which agricultural commodities are being grown on lands that have been *illegally* cleared of forests. This study therefore focuses on *illegal deforestation* driven by agricultural expansion, and places it within the scope and scale of all tropical deforestation. Forest Trends progressively walks readers through assessments of:

Defining "illegal deforestation"

This report defines illegal deforestation as forest clearing in violation of a producer country's legislative framework (e.g., their laws and regulations) at the time the deforestation took place. The analysis focused only on material violations, specifically on illegalities in licensing (e.g., failures to obtain permits or permission from landowners, conduct environmental impact assessments, corrupt and fraudulent authorizations, etc.) and on forest clearance (overharvesting, outside of boundaries, tax evasion, etc.). Breaches of international law or customary law are not included unless they are integrated into national legislation.

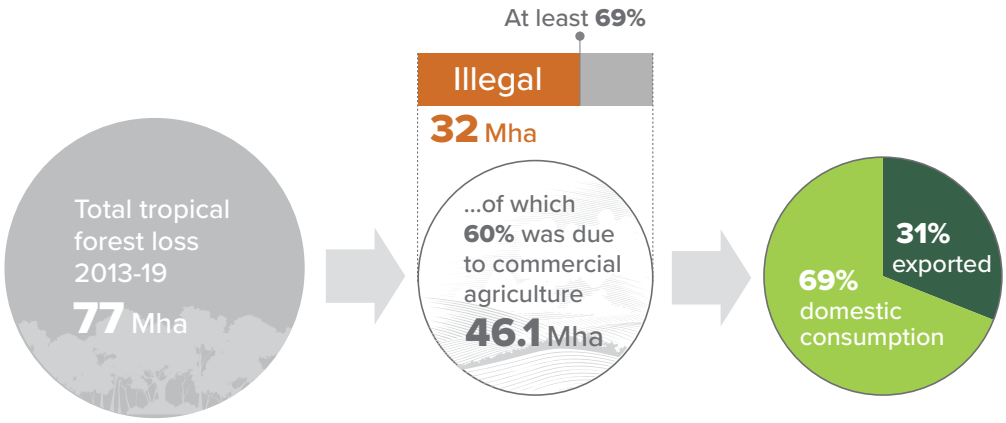
- *deforestation* writ large, all of which is of concern for its impacts on climate, biodiversity, and people;
- *agro-conversion* because it is the largest driver of permanent forest loss across the tropics;
- *illegal agro-conversion* because it is particularly egregious in its contravention of rights and shared community values as expressed through sovereign law and regulation; and,
- *agro-conversion for export* because the actors involved in these supply chains stretch around the globe, and consumers around the world share some culpability for deforestation.

This report revisits Forest Trends' 2014 report, by reassessing the extent of illegal agro-conversion across the tropics from 2013 to 2019, and finds a similar story: more forest land is being illegally cleared to make way for agricultural crops and pastures than ever before.

KEY FINDINGS: GETTING AN ACCURATE PICTURE

This report finds that almost two-thirds (60 percent) of tropical forest loss was driven by commercial agriculture between 2013 and 2019. Almost three-quarters (69 percent) of this agro-conversion was conducted in violation of national laws and regulations (Figure 1). In fact, the rate of illegal deforestation during this period increased by 28 percent compared to 2000 to 2012: from 3.5 million hectares (Mha) per year to 4.5 Mha per year. These estimates of illegal deforestation are likely an underestimate because many countries have only limited data on which to assess illegality. Thorough audits rarely happen. Thus an absence of evidence of illegality should not be taken as evidence of compliance with laws and regulations.

Figure 1 | Area of tropical forest loss (million hectares; Mha) driven by commercial agriculture, and estimates of how much loss was illegal (%) and exported (%), 2013-2019



Key findings of this report include:

1. **77 Mha of tropical forests were lost between 2013 and 2019[2]: the equivalent of clearing more than five Manhattans every day for seven years.** During this time, average annual tropical forest loss surged to more than 11 Mha per year, compared to 7.3 Mha per year in the first 12 years of the 21st century – an increase of 52 percent. Brazil, Indonesia, and the Democratic Republic of Congo (DRC) together accounted for 51 percent of all tropical forest loss between 2013 and 2019. All three have seen increases in average annual loss (by 14 percent, 17 percent, and 162 percent, respectively) during this time.

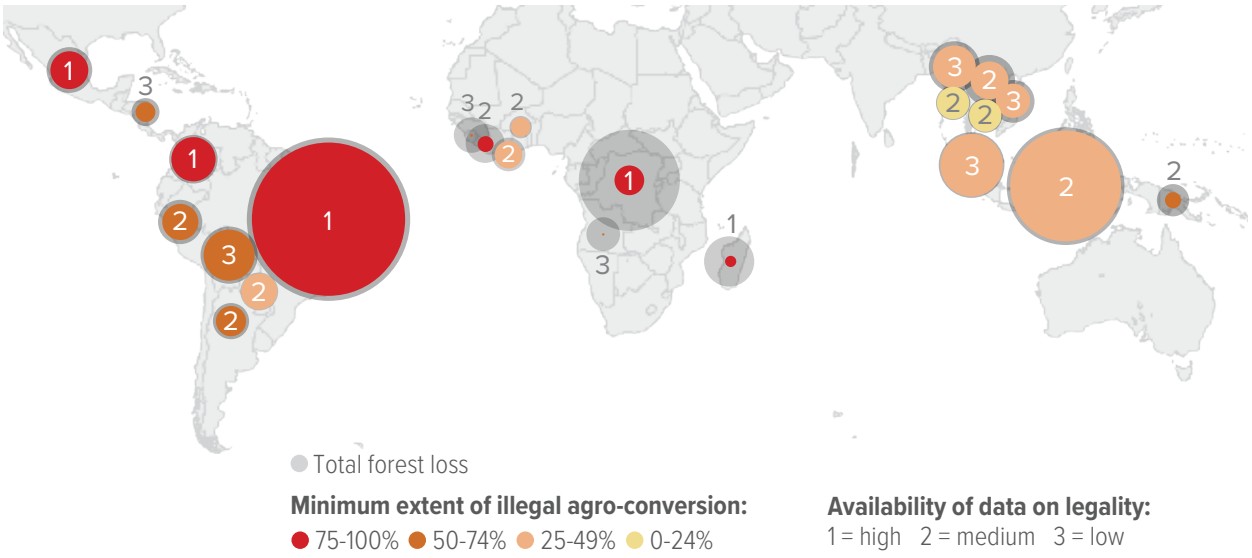
2. **Almost two-thirds (60 percent) of tropical deforestation between 2013 and 2019 was driven by commercial agriculture.** Commercial agriculture was the primary identifiable driver of forest loss everywhere except Africa, where subsistence agriculture reportedly drove almost all deforestation. More than 6.58 Mha of tropical forests were cleared each year to make way for commercial agricultural operations. This represents an *increase* of 28 percent in the average annual scale of agro-conversion as compared to 2000 to 2012.

3. **At least 69 percent of agro-conversion was conducted in violation of national laws and regulations, and this is likely an underestimate.** Illegal agro-conversion was responsible for at least 31.7 Mha of the total 77 Mha of tropical forest loss between 2013 and 2019 (Figure 2) – an area roughly the size of Norway. This equates to an average annual loss of more than 4.5 Mha per year, an increase of 28 percent from the 2000 to 2012 period (3.5 Mha per year). Illegal activities were narrowly defined as only those of material import, such as obtaining land illegally, clearing in excess of permits, fraud and corruption, human rights abuses, and breaches of environmental law.

   These estimates are considered conservative. In countries where governance is weak and corruption widespread, the lack of evidence of illegality is typically not an indication that the agro-conversion is in compliance, but an indication that more reporting is required. Where comprehensive compliance audits do exist, evidence of illegal deforestation is widespread. For example, in Brazil, at least 95 percent of all deforestation was illegal. Similarly, Indonesia's Supreme Audit Agency found less than 20 percent of palm oil operations in compliance with national laws and regulations.

[2] Global Forest Watch. 2020. "Tree cover loss by dominant driver." Time range selected: 2001-2019, using methods from Curtis et al. 2018. Washington DC, USA: Global Forest Watch, World Resources Institute. www.globalforestwatch.org.

Figure 2 | Proportion of agro-conversion in violation of national laws and regulations (minimum estimate), 2013-2019[3]



4. **Soy, palm oil, and cattle products drive global figures of illegal deforestation, but other smaller-scale commodities, such as cocoa, rubber, coffee, and maize, are also leading causes of illegal deforestation in some regions, with devastating effect.** Identifiable illegal deforestation is pervasive in the expansion of croplands for soy (93 percent of agro-conversion across all soy-growing countries in this study), cocoa (93 percent), and cattle products (beef at 81 percent and leather at 87 percent). The global average proportion of illegality for palm oil (59 percent) is constrained by low data availability in Malaysia, although 81 percent of clearing for Indonesia's palm oil is estimated to be illegal. Global estimates for commodities like rubber, coffee, and maize are limited by data availability, but are still high enough to show significant issues with legal compliance. The country case studies that accompany this report detail coffee and cocoa production expanding into protected areas in Honduras and West Africa; in Argentina, maize is the leading driver of deforestation, of which at least 65 percent is in contravention of land zoning laws.

5. **Emissions from illegal ago-conversion account for at least 42 percent of all emissions from tropical deforestation.** Illegal agro-conversion was likely responsible for at least 2.7 gigatons (Gt) of carbon-dioxide equivalent (CO_2e) per year, and 19 Gt of CO_2e between 2013 and 2019. On an annual basis, that's more than India's emissions from fossil fuels in 2019, and if illegal agro-conversion were a country, its emissions would be third-largest after China and the US. The largest producer of emissions from illegal agro-conversion was Latin America (13.7 Gt), mainly due to massive forest loss in Brazil associated with fires over the last few years.

6. **More than 31 percent of agricultural commodities linked to deforestation were exported, raising significant concerns about their association with illegal deforestation.** In 2019, exports of ten agricultural commodities valued at US$55 billion were linked to agro-conversion – mostly those grown in Latin America and Asia. This trade represents emissions of at least 1.2 Gt CO_2e per year from more than 14 Mha of forest land cleared between 2013 and 2019.

[3] Figure 2 represents only the 23 countries assessed in this study, which together account for 87 percent of global tropical forest loss.

It is not possible to calculate at a global level precisely what share of illegally produced commodities are ultimately exported from their country of origin. This report examines 23 case study countries and finds at least one-fifth – and in some cases virtually all – of agricultural exports were linked to illegal deforestation, depending on the commodity and country of origin. Given the evidence available, the risk is non-negligible and must be assumed to be high for widely traded commodities like soy and palm oil.

7. **Deforestation for agro-commodity production that is driven by export demand varies, but has increased overall since 2013, which will affect the potential impact of consumer and demand-side measures.** However, the proportion of production linked to agro-conversion that is then exported has declined from 49 percent in the 2000 to 2012 period to 31 percent since 2013. This is because in some countries, deforestation is not driven by commercial agriculture (DRC, Madagascar, Sierra Leone) or their agricultural products are not destined for export (Colombia, Bolivia, Mexico). In these countries especially, demand-side measures such as corporate purchasing policies or import regulations will be less effective than programs which strengthen domestic governance; programs for sustainable management of the land and forest sectors must take leading roles.

   Demand-side measures, however, will be effective when a high proportion of deforestation for agro-commodity production is being driven by export demand, as is the case for example in Indonesia, Malaysia, and Laos. However, agro-exports are increasingly headed to markets in China and India, where regulatory and consumer pressures for environmental protections are lower. If demand-side regulatory measures are only adopted in some major markets (such as the US, Europe, and Australia) but not in others, a bifurcation of trade is likely, with high-risk commodities continuing to find buyers in import markets without legislation or trade measures blocking illicit goods.

CONCLUSION

Even in the face of shortcomings in producer country monitoring and reporting (in particular, a lack of rigorous auditing), the evidence presented in this report reveals that illegal agro-conversion and the subsequent illegality of associated agricultural commodities remains an immense problem that has been getting worse. This report reveals the ugly truth: that much of global agribusiness trade is linked to operations that illegally clear forests.

While the findings of this report seem dire, there is hope. Brazil was successful in drastically reducing deforestation up until 2012 – and in doing so contributed more to addressing climate change through a reduction in related emissions than any other single country. Indonesia has successfully reduced its deforestation every year since a peak in 2016. Forest Trends observes continued leadership from some corners of industry. There is increasing global political focus on natural climate solutions, including legislation addressing the imports of agricultural products associated with deforestation – either legal or illegal – now being developed by the EC, UK, and US.

In a forthcoming report, Forest Trends will propose a path forward for curbing illegal land-use change and advancing forest country objectives for zero deforestation. In the meantime, this report shows that too much of the world's agricultural production and trade carries a high risk of including illicit harvests, leaving companies and their customers complicit in tropical forest loss and trafficking in illegal products.

1 Introduction

This report assesses the scope and scale of illegal deforestation in the tropics that has been driven by commercial agriculture. Numerous reports in the past decade have demonstrated how commercial-scale agricultural expansion is by far the single largest driver of deforestation worldwide and thus also of greenhouse gas emissions from land-use change. There have also been analyses on how much of this deforestation was driven by consumer demand from around the world. Fewer analyses, however, have focused on the extent to which agricultural commodities are being grown on lands that have been illegally cleared of forests – in violation of a country's own national laws and regulations.

This report places *illegal deforestation* within the scope and scale of all tropical deforestation, and progressively walks readers through assessments of:

- *deforestation* writ large, all of which is of concern for its impacts on climate, biodiversity, and people;
- *agro-conversion* because it is the largest driver of permanent forest loss across the tropics;
- *illegal agro-conversion* because it is particularly egregious in its contravention of rights and shared community values as expressed through sovereign law and regulation; and,
- *agro-conversion for export* because the actors involved in these supply chains stretch around the globe, and consumers around the world share some culpability for deforestation.

In 2010, the Consumer Goods Forum[4] resolved to achieve zero net deforestation by 2020 in four priority sectors: soy, palm oil, paper & pulp/timber, and beef. By 2014, when the New York Declaration on Forests was signed, a wave of corporations was making highly publicized zero deforestation commitments. The same year, Forest Trends released an analysis of the extent to which agricultural commodities around the world were being grown on illegally deforested land (Forest Trends 2014). The results were stark: almost half (49 percent) of all tropical deforestation between 2000 and 2012 was driven by illegal conversion of forest lands for commercial agriculture, and half of the production from this agro-conversion (50 percent) was destined for export markets.

Today, the 2020 target year for achieving net zero commodity-driven deforestation has come and gone. A decade-long surge of voluntary corporate commitments in Europe and the US was unable to stem the tide of global forest loss, despite concerted effort on the part of leading companies and an extensive network of efforts supporting the strategy.

Illegal deforestation

Conversion of forests that takes place in contravention of a country's legislative framework (e.g., their laws and regulations) at the time the deforestation took place. Breaches of international or customary law were not included unless they are integrated into national legislation.

[4] CEO-level organization of 400 global consumer goods manufacturers and retailers with a combined revenue of more than US$2.8 trillion (2.1 trillion Euros).

This study confirms what was revealed in 2014 – that the phenomenon of illegal forest clearing for commercial agriculture has continued at an alarming rate and is, in fact, getting worse. Agricultural products harvested from these lands are destined for markets around the world, tainting international supply chains with illegality.

While some geographies have made progress, others have experienced backsliding. **To date, the overall picture is that reaching zero agro-conversion is getting harder, not easier.** The average annual rate of tropical forest loss increased from about 7.3 Mha per year in the first 12 years of this century, to 11 Mha per year since then (GFW 2020, using Hansen et al. 2013). Forest Trends found that 60 percent of this tropical forest loss (6.6 Mha per year) was driven by commercial agriculture, an increase of more than 28 percent in the average annual scale of agro-conversion as compared to 2000 to 2012 (5.1 Mha per year), even though the proportion of deforestation attributable to agro-conversion decreased somewhat from 71 percent (Forest Trends 2014). Likewise, **at least 69 percent of agro-conversion from 2013 to 2019 (4.5 Mha per year) was conducted in violation of national laws and regulations,** an increase of 28 percent over the average annual rate from 2000 to 2012 (from 3.5 Mha per year), despite a slight decrease in the proportion of illegal conversion (from at least 49 percent to at least 41 percent of all tropical forest loss).

All is not lost, however. There are proof points around the world that give glimmers of hope. Brazil made immense progress reducing deforestation from a peak in 2004 to 2012 through a combination of political leadership, legal enforcement, rural credit restrictions for farmers, and voluntary industry self-regulation – although the last few years of backsliding remind the world that lasting transformation will require much broader and deeper domestic political agreement (see Annex 1). The Government of Norway and the UN Green Climate Fund (in its largest payment to date) paid the Government of Indonesia US$160 million in compensation for reducing emissions from deforestation starting in 2014. It is clear that the country's multi-year effort to protect and restore peat lands, and international support for this and other programs, have been positive factors. However, like Brazil, these gains are at risk of being undermined if, for example, Indonesia tries to boost economic activity at the expense of forests and peatlands under its COVID-19 response. There are also early signs that cocoa-driven deforestation in West Africa may have reached a tipping point, with major cocoa traders banding together and leading the call in Europe for increased action and regulation.

To stem further forest loss, the European Commission (EC), United Kingdom (UK), and United States (US) are all considering legislation or other trade measures that would prohibit the import of commodities grown on illegally converted land. There is a strong interest to know to what extent legislation based on the legality of the agricultural commodity would address broader deforestation, and how donor and consumer nations can support producer countries, industry, and stakeholders to uphold national laws and regulations when it comes to the conversion of forested lands to agricultural fields.

These stories are good reminders that successful governance and rule of law in the land sector are hard-won but possible on national scales. In a forthcoming report, Forest Trends will propose a path forward for curbing illegal land-use change and advancing forest country objectives for zero deforestation. The following sections outline the current situation by region including the extent of deforestation, how much is driven by agro-conversion, how much of that conversion is illegal, and how much resulting product is exported. Country-level analysis is provided in Annexes 1-3.

Key Definitions

Full list can be found in the Glossary, p. 56

Agro-commodities: Commercially produced agricultural commodities, including crops, livestock, and products from tree plantations.

Agro-conversion: Loss of forest driven by commercial agriculture.

Commercial agriculture: Large- or small-scale, including crops, pasture (mainly cattle), and monoculture tree plantations. Excludes subsistence farming.

Forest/Forest cover: Forest areas with greater than 50 percent tree cover that are greater than five meters tall.

Forest loss/Deforestation: Complete removal of forest cover (areas with at least 51 percent of tree cover).

2 Summary of Methodology

This study estimates illegal deforestation for purposes of commercial agriculture in the tropics, and associated exports of key agricultural commodities from 2013 to 2019. A more detailed description of methodology and data used can be found in Appendices 1 through 6.

PART 1
Estimating illegal deforestation for commercial agriculture and associated trade

To estimate tropical deforestation driven by the illegal clearing of forest lands for commercial agriculture and then calculate associated trade of agricultural commodities, Forest Trends followed the following steps:

Step 1: Estimating tropical forest loss, 2013-2019 (Variable A)

The amount of forest loss for each tropical country was obtained from the Global Forest Watch (GFW 2020, using Hansen et al. 2013) database of annual change in tree cover between 2013 and 2019, inclusive for all forests with greater than 50 percent canopy cover – primary as well as secondary forests and plantations. Plantations were 8 percent of all forest loss over this period.

Step 2: Estimating percentage of tropical forest loss linked to commercial agriculture (Variable B)

The study used the GFW (2020) database, which uses the methodology of Curtis et al. (2018) for drivers of forest loss in each country. However, for the countries most affected by deforestation, Forest Trends conducted 23 country studies (Annexes 1-3). The remaining 101 countries comprise the "rest of the world" and account for only 13 percent of all tropical forest loss. Key sources of information include national REDD+ reporting and Pendrill et al. (2019, updated with data to 2017). In particular, Forest Trends focused on the role of commercial agriculture driving tropical forest loss between 2013 and 2019, which includes all major crops, cattle, and forestry products from tree plantations.

Step 3: Estimating percentage of forest conversion driven by commercial agriculture that was likely illegal (Variable C)

In this report, legality is framed in the context of recognizing each country's sovereign rights. "Illegality" is therefore defined as the conversion of forests that takes place in contravention of a country's legislative framework, including its laws, regulations, instructions, and any other legal instrument that penalizes non-compliance (Box 1). International treaties are not included in this definition unless they have been incorporated into national law. For each of the country studies, the literature was reviewed to evaluate compliance of forest clearing (agro-conversion) against the relevant legislative framework at the time the deforestation took place.

BOX 1

Typology of Illegalities in the Conversion of Forests for Commercial Agriculture

This report defines illegal deforestation as forest clearing in violation of the producer country's own laws and regulations at the time the deforestation took place. The methodology focuses only on material violations (those that are substantial and most serious), specially on violations occurring during the licensing and forest clearing processes. Breaches of international law or customary law are not included unless integrated into national legislation. Typical examples include:

Non-compliance with licensing or permit processes:

- Failure to consult communities affected by commercial operations
- Lacking the consent of landowners
- Forced relocation of local communities without compensation
- Allocated in areas zoned for permanent forest cover (e.g., protected areas, forest estates where only sustainable forest management is permitted)
- Failure to obtain regulatory approval (e.g., lacking socio-/environmental impact assessments, failing to produce pre-qualification requirements)
- Failure to post performance bonds
- Concessions allocated in excess of the limits on total area for an individual/company

Non-compliance with harvesting or land clearance requirements:

- Clearance prior to obtaining appropriate permits
- Clearance without consent and/or compensation of affected communities
- Illegal use of fire
- Failure to pay taxes and fees, including on timber extracted during conversion
- Clearance of forest outside boundaries of license area
- Pollution of waterways with, for example, logging debris
- Failure to comply with regulations (e.g., related to road construction and culvert/bridge design to minimize erosion)
- Felling of protected tree species
- Clearance of forest in prohibited zones within concession area, including steep slopes, river buffer areas, and deep peat soils
- Clearing in excess of maximum proportion of the concession area permitted

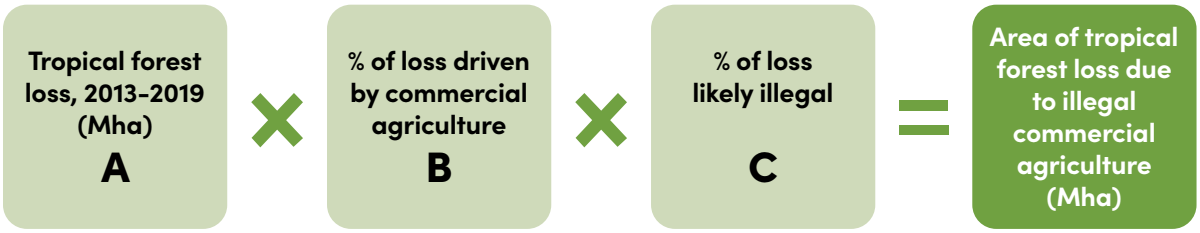
Corruption at any stage of these processes:

- Licenses issued improperly and/or at below market value in exchange for bribes
- Rights obtained through fraud, coercion, or other illegal means
- Monitoring and enforcement reductions in exchange for bribes
- Failure to pay royalties on timber harvested, fees, and/or taxes

Step 4: Calculating forest loss driven by agro-commodities linked to illegal conversion

For the 23 countries that comprised 87 percent of all tropical forest loss, Forest Trends used the case studies (Annexes 1-3) to derive best estimates of Variables A, B, and C. For the "rest of the world," Forest Trends used GFW (2020) data for each country (Variables A and B), and the regional average for Variable C (Africa, Asia, or Latin America). The product of these variables provides a best estimate of the area of tropical forest lost to agro-commodities linked to illegal conversion for each country (Equation 1). To test the implication of using regional averages for Variable C for the "rest of the world," Forest Trends conducted a sensitivity analysis by substituting a "best case scenario," where all agro-clearing was assumed to be legal and a "worst case scenario," where all the agro-conversion was assumed to be illegal (Appendix 3). Given that the 101 countries in the "rest of the world" comprised only 13 percent of tropical deforestation, it was assumed that global results would not vary too widely among the three scenarios. This sensitivity analysis also allowed Forest Trends to examine the impact of having to use regional averages for seven of the case study countries that lacked sufficient data on compliance (Variable C).

Equation 1: Formula used to calculate area of tropical forest loss due to illegal conversion for commercial agriculture, 2013-2019



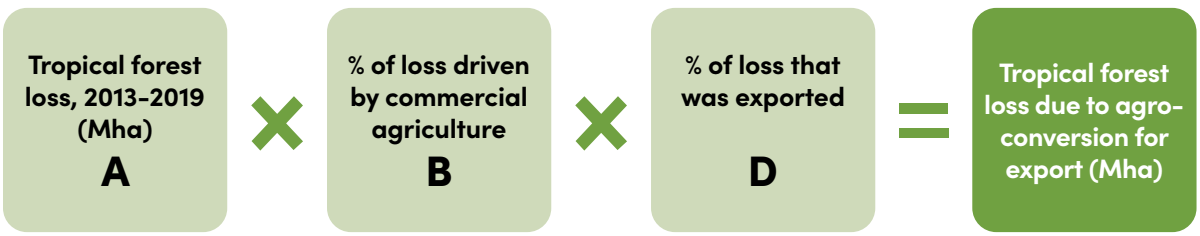
Step 5: Percentage of agro-commodities linked to deforestation and exported (Variable D)

The primary source of data for Variable D was the Pendrill et al. (2020) analysis of embodied deforestation and country of consumption. For commodity-specific analysis in each country study, the proportion of production exported was calculated with production data from the United Nations Food & Agriculture Organization (UN FAO) and trade data from the UN's International Trade Statistics Database (UN Comtrade). Where a country produced more than one export commodity, the amount of deforestation embedded in the trade was weighted by the size of each commodities' trade and its link to deforestation.

Step 6: Calculating tropical forest loss driven by agro-commodities for export

The product of Variables A, B, and D provides Forest Trends' best estimate of the area of tropical forest lost due to agro-commodity production for export markets (Equation 2).

Equation 2: Formula used to calculate tropical forest loss driven by exported agro-commodities, 2013-2019



Step 7: Estimating emissions from agro-commodity conversion (Variable E)

This report estimated the amount of carbon dioxide-equivalent (CO_2e) emissions from forest loss using analyses by Harris et al. (2021).

PART 2
Estimating the quantity and value of exports from converted forestland

Forest Trends estimated the quantity and value of exports in 2019 for specific agricultural commodities that originated from converted forestland: beef and leather, palm oil, soy, pulp and paper, rubber, cocoa, coffee, and maize. Deforestation linked to this trade was tracked in the focus 23 countries over the last 30 years (since ~1990), not just on land cleared of forests since 2013. To calculate the amount of tropical forest loss embodied in exports and the risk of contamination by illegal deforestation, the following steps were taken:

Step 1: Estimating quantity and value of exports (Variable F)

For each relevant commodity and country, 2019 trade data was obtained from UN Comtrade and relevant literature, where available.

Step 2: Estimating percentage of production coming from agro-conversion (Variable G)

The proportion of production for each commodity that originated from land cleared of forest was obtained from a literature review. Estimates of deforestation between 1990 and 2013 were obtained from Forest Trends (2014).

Step 3: Estimating the risk of agro-commodity contamination by illegal agro-conversion

Illegality was evaluated for the deforestation associated with the commercial agricultural commodities (Variable C). When production of a commodity is widespread across the country, Variable C (the estimate of illegality used above) was used. When a commodity is grown in a specific region (such as Paraguayan soy grown in the eastern Atlantic Forest region that has a Zero Deforestation Law) then the illegality estimate is commodity specific. Forest Trends (2014) and other literature provided estimates of illegality for land cleared prior to 2013.

Step 4: Calculating total volume of exports linked to deforestation

The product of Variables F and G provides Forest Trends' best estimate of the total volume of exported commodities that was likely contaminated by its link to deforestation.

Equation 3: Formula used to calculate tropical forest loss embodied in agro-commodity exports, 2013-2019

For each commodity, for each major producing country

Total volume or value of exports (tonnes or US$) **F** × **% of production from land converted from forests since 2000** **G** = **Total volume or value of exports linked to deforestation (tonnes or US$)**

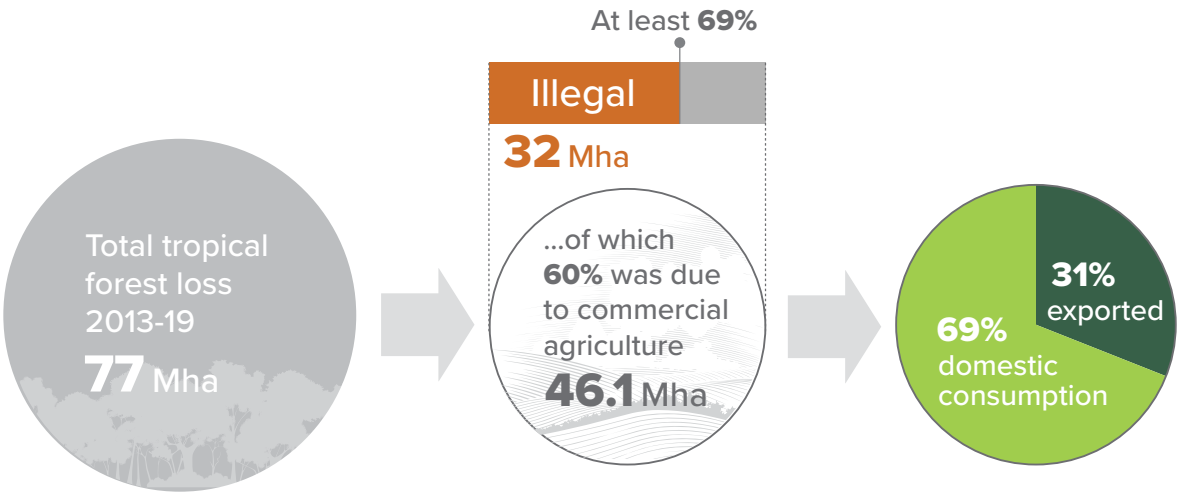
3 Detailed Findings

To tackle deforestation, the following fundamental questions need to be understood: where are the forests being lost, and what activities are driving this forest loss? This allows for targeted efforts and specific recommendations on how to approach specific industries, products, or countries where they will have the greatest impact. For example, tools to tackle illegal deforestation will be entirely different than those needed to combat broader deforestation.

Several initiatives have quantified how much and where deforestation is driven by commercial agriculture. Some have gone as far as to estimate how much of this deforestation was driven by international trade. Global Forest Watch publishes annual data on forest loss based on the methodology of Hansen et al. (2013) and the drivers of that loss, including commodity-driven agriculture, based on Curtis et al. (2018) and FAO's Global Forest Resources Assessment reports.[5] In a study published in *Global Environmental Change*, Florence Pendrill and colleagues (2019) addressed both agro-conversion driven deforestation and connected it to global trade drivers. They quantified how much and where deforestation occurred from the expansion of croplands, pasture, and tree plantations, and identified which products were grown on this converted land. They then integrated their results with global trade flow data to assess how much deforestation was likely driven by international trade.

However, fewer analyses have been able to determine the extent to which agricultural commodities are being grown on lands that have been illegally cleared of forests. This study focuses on *illegal deforestation* driven by commercial agriculture, and places it within the context and scale of all deforestation across the tropics.

Figure 1 | Area of tropical forest loss (million hectares; Mha) driven by commercial agriculture, and estimates of how much loss was illegal (%) and exported (%), 2013-2019



[5] FAO's Global Forest Resources Assessment documents how the world's forests are changing. The reports are released every five years.

The rate of deforestation across the tropics has been increasing.

Over the past seven years, the world has lost, on average, more than 10.9 Mha of tropical forest each year. In total, this equals approximately 77 Mha lost (Figure 1), or an area 1.5 times the size of France. This deforestation rate is 52 percent higher than the average losses of 7.2 Mha per year reported by Forest Trends (2014) from 2000 to 2012.

Brazil, Indonesia, and the Democratic Republic of Congo (DRC) have the largest areas of tropical forest in their respective regions and alone account for more than half (51 percent) of all forest loss in the tropics from 2013 to 2019. Therefore, addressing deforestation in these three countries will be key to addressing local challenges, such as livelihood and food security, as well as global challenges such as climate change. Country analyses (Annex 1–3) suggest that all three continue to suffer from high annual rates of deforestation and, more significantly, their average annual forest loss has continued to rise (by 14 percent, 17 percent, and 162 percent, respectively, since the initial Forest Trends study assessing the years 2000 to 2012[6]). While targeting Brazil, Indonesia, and DRC will be strategic pressure points in addressing deforestation on a global scale, it is just as critical to make progress in the other countries that make up the remaining 49 percent of tropical forest loss.[7]

In this report, Forest Trends defines "forests" as those lands with more than half of their area covered by vegetation taller than five meters. Setting a high threshold of greater than 50 percent tree cover focused the analysis on well forested landscapes, such as primary forests, that still provide robust ecosystem services (e.g., supporting well-functioning pollination, water and nutrient cycles, and carbon sinks).

"Deforestation" and "forest loss" are defined as the complete and permanent loss of trees in a forested area. This report covers all forest types found in tropical countries, including tropical rainforests, the dry forests of the Brazilian Cerrado, and the Gran Chaco of South America.

The rate of tropical deforestation driven by commercial agriculture is increasing in the tropics.

Agro-conversion, where areas of forests are cleared or burned to make way for crops or livestock, is the number one driver of tropical deforestation worldwide. As demand for land for commercial agriculture rises and falls, so does overall deforestation in the tropics.

Forest Trends estimates that more than 46 Mha – almost two-thirds (60 percent) of all tropical deforestation – was driven by commercial agriculture between 2013 and 2019 (Figure 1). This loss was equivalent to more than 23 football fields every minute over the last seven years. More significantly, this agro-conversion continues to increase, despite years of pledges by companies to help reduce deforestation. More than 6.5 Mha of tropical forests were cleared each year, representing an *increase* of 28 percent (as compared to 2000 to 2012, when the average annual loss stood at 5.1 Mha).

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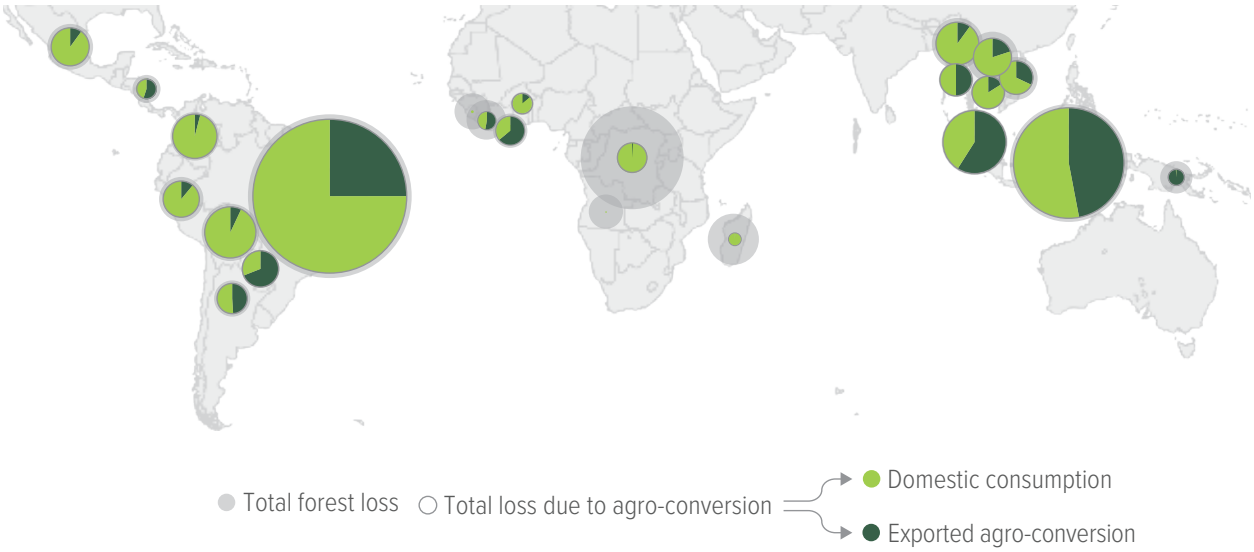
[6] Although a change to Global Forest Watch's methodology in 2012 confounds these results (Potapov et al. 2015).

[7] Individually, other countries' deforestation may not have a large profile for global issues such as climate change, but local and regional ecosystem impacts can negatively affect livelihoods, displacement of communities, biodiversity, flood protection and even abilities to control the emergence of zoonotic disease – which can subsequently trigger impacts at regional or global scales.

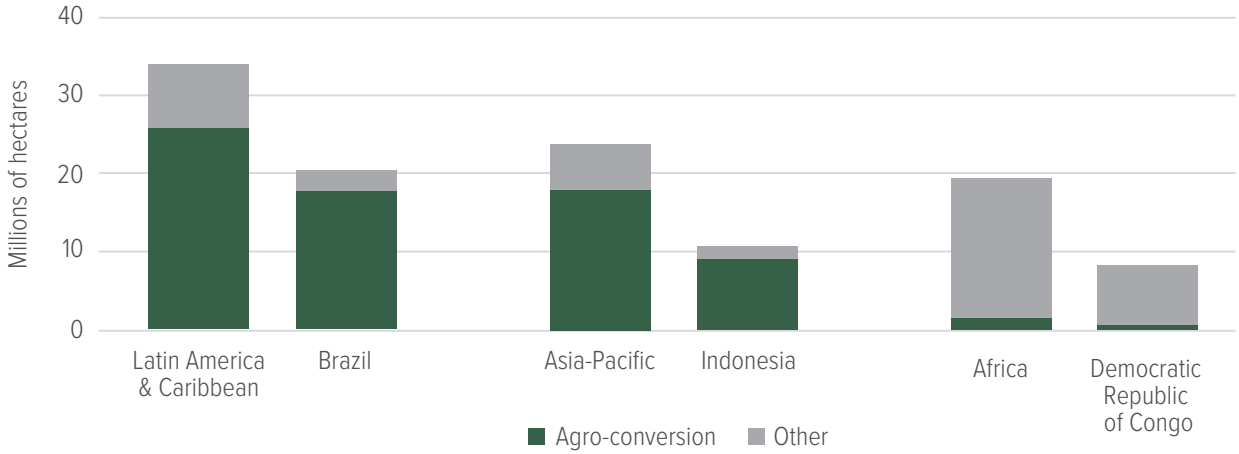
Figure 2 | Total tropical forest loss, 2013-2019



Notes: Calculations by Forest Trends.

These losses were not spread equally across the tropics. Overall, just two countries, Brazil and Indonesia, were responsible for almost two-thirds of all reported global agro-conversion, 39 percent and 20 percent respectively (Figure 2). About three-quarters of forest loss in Asia and Latin America was reportedly driven by commercial agriculture (more than 18 Mha and 26 Mha, respectively). Brazil is not alone in Latin America in reporting a rising rate of forest loss due to commercial agriculture; the same is occurring across most of tropical Latin America. For example, deforestation in Colombia has increased in areas previously isolated by civil war, and the Gran Chaco dry forests have experienced intensive conversion.

Figure 3 | Regional tropical forest loss (millions of hectares; Mha) driven by commercial agriculture and the main contributing country, 2013-2019



Notes: Calculations by Forest Trends.

In contrast to most of the tropical world, commercial agriculture was not the primary identifiable driver of forest loss in Africa. Here, one-quarter of global tropical forest loss occurred, but only 10 percent of it was

reportedly due to agro-conversion (Figure 3). Extensive logging roads open the forest for subsistence agriculture, the driver for almost all deforestation according to Global Forest Watch (2020, using Curtis et al. 2018). Monitoring the causes of deforestation in Africa can be challenging, however, given the difficulty discerning small-holder commercial agriculture plots from subsistence agriculture, and the fact that several common commodities grown in Africa, such as cocoa and coffee, are often grown under shade tree cover (and thus difficult to analyze with satellite imagery). Yet, at a time when yields are reportedly decreasing in Africa, Forest Trends found that as cocoa bean production increased by roughly 50 percent in Côte d'Ivoire and Ghana between 2010 and 2018, so did the area of land used to grow cocoa. Area (ha) of land under cocoa production in Côte d'Ivoire increased by 76 percent, while Ghana increased cocoa production area by 12 percent.

Across the globe in all regions, interrelated direct and indirect drivers of deforestation make a comprehensive understanding of the situation difficult. Subsistence farmers are often blamed for deforestation, but industrial forestry and the logging roads built to facilitate it often precedes forest clearing, indicating that the timber sector shares responsibility, albeit indirectly, for much of the deforestation. Efforts to give land titles to the poor or policies that allow settlers to claim title for productive land are also leading to forest loss. In Vietnam, the indigenous people of the Central Highlands are displaced by government-sponsored migrants who move to the hills and expand agriculture, pushing the indigenous ethnic groups into the forest where they clear trees – possibly illegally – for small-scale agriculture. In other places, boom and bust cycles of large-scale agricultural commodities lead to an ever-expanding list of commodities driving the rapid expansion of crops into forested areas.

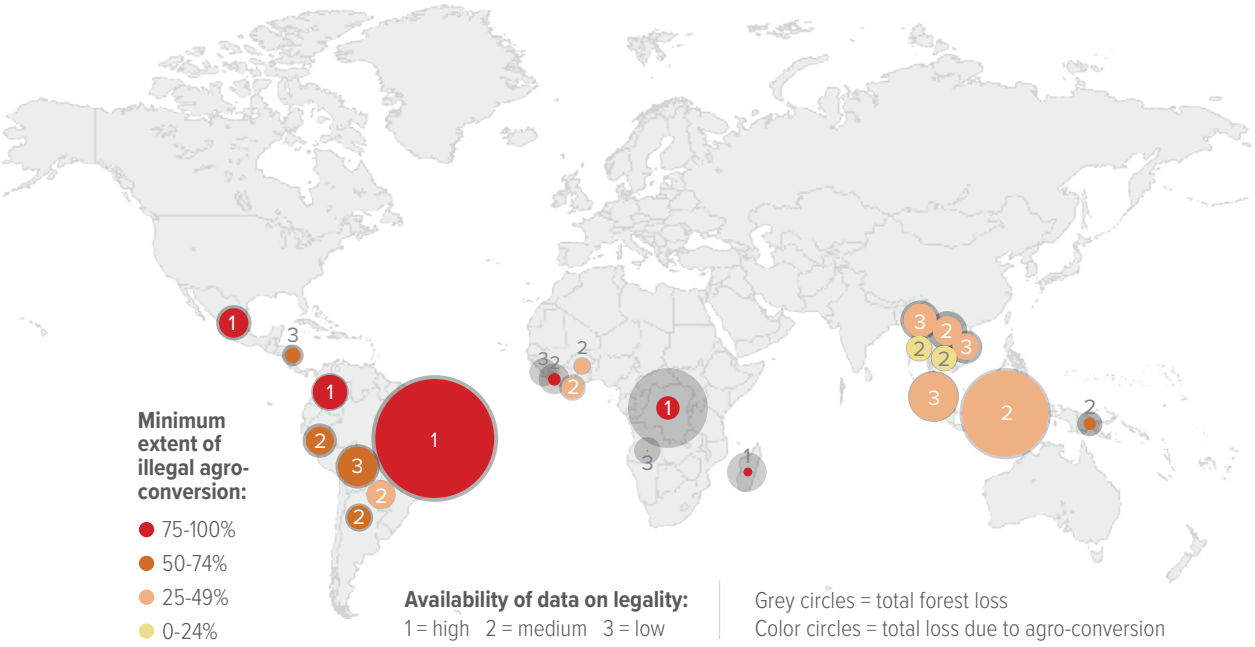
In other countries, loopholes in the law, agricultural permits, as well as fraudulent land claims and land speculation are leading to forest clearing. Agricultural permits are sometimes used as a short cut to access valuable timber, with no intention to establish crops after the timber harvest. For example, in Colombia, two-thirds of forest loss is reportedly land grabbing under the guise of conversion for pasture (Minambiente 2017). In Cambodia, Economic Land Concessions have been described as "mechanisms for the ruling elite to enable land grabbing…and selling of high value timber" (Beauchamp et al. 2018). In Papua New Guinea, it is the value of the timber driving the agro-conversion; timber exports from illegal clearance conducted under agricultural permits account for 63 percent of all timber exports (Global Witness 2017; 2018a; 2020; Filer 2020). All these processes are part of the complex pattern of land-use change where forest loss intersects with agriculture.

The rate of illegal deforestation for commercial agriculture is also increasing across the tropics.

At least 69 percent of all agro-conversion in the tropics was the result of illegal deforestation (Figure 4). For purposes of this report, Forest Trends focused only on material violations, specifically on illegalities in licensing (e.g., failures to obtain permits or permission from landowners, conduct environmental impact assessments, corrupt and fraudulent authorizations, etc.), forest clearance (overharvesting, outside of boundaries, tax evasion, etc.), or incidences of fraud and corruption. Breaches of international law or customary law are not included unless they are integrated into national legislation.

Overall, illegal agro-conversion was responsible for the loss of at least 31.7 Mha of the total 77 Mha of tropical forest loss between 2013 and 2019 – an area roughly the size of Norway. This appears to be an increase over the amount of illegal deforestation driven by commercial agriculture that was reported in the Forest Trends (2014) report: from 3.5 Mha per year between 2000 and 2012, to 4.5 Mha per year, an increase of more than 28 percent.

Figure 4 | Proportion of agro-conversion in violation of national laws and regulations (minimum estimate), 2013-2019[8]



Notes: Calculations by Forest Trends.

Even more disconcerting is the fact that this estimate of illegal agro-conversion is conservative. It is only possible to evaluate compliance if robust reviews (or audits) have been completed for at least a representative (randomly selected) portion of the sector. **For purposes of this report, Forest Trends is only reporting estimates of well-documented illegality.** While published case studies of illegal deforestation occurring on specific plantations or operations suggest that non-compliance is widespread, Forest Trends could not use these reports to scale up estimates for the entire sector, or for the entire country.

For eleven of 23 case studies, representing just over about one-third of all tropical agro-conversion, the countries have not conducted and reported comprehensive audits, meaning Forest Trends was unable to make sector-wide estimates of illegality. Therefore, these eleven assessments are necessarily conservative, and likely underestimates. ***Where such compliance audits have not been conducted, an absence of evidence must not be misconstrued as evidence of an absence of illegality.***

In the five countries (Brazil, Mexico, Argentina, Madagascar, and DRC, representing almost half of all agro-conversion) where there has been reliable reporting of nation-wide levels of compliance, the rate of illegality is extreme. For example, in Brazil, compliance can be adjudged for the entire commercial agriculture sector, made possible by the Environmental Rural Registry (CAR) database and an ability to match private property boundaries with forest loss data, Forest Code rules, and deforestation. This evidence indicates that virtually all (at least 95 percent) operations that cleared forests in Brazil are not in compliance with the laws governing forest clearing. In 2019, forest clearing was 99.5 percent illegal (Rezende de Azevedo et al. 2019). Mexico requires authorization for agro-conversion from the Ministry of the Environment and Natural Resources, and a study of the period 2005 to 2015 identified that less than 3 percent of forest loss had been authorized

[8] Figure 4 represents only the 23 countries assessed in this study, which together account for 87 percent of global tropical forest loss.

(Beraud-Macías et al. 2018). Argentina's Forest Law of 2007 requires land to be zoned based on its conservation value. However, a Greenpeace Argentina (2018) study concluded that deforestation in zones where clearing is not permitted was 50 percent of all deforestation, and a further 15 percent was on land that had not been zoned at all. In Madagascar, all forest clearance for agriculture is illegal according to Decree 87-143 of 1987.

Even in countries where only a subsection of agro-conversion may have been audited, there are similarly high levels of illegality. For example, the Supreme Audit Agency of Indonesia found less than 20 percent of the oil palm sector in compliance with the national laws and regulations – more than 80 percent non-compliance. Overall, where data is available, illegality was reportedly widespread, but limited data availability or low-quality data constrained analyses and reduced the ability to document illegality.[9]

Problems with limited data are compounded by contradictions within legal frameworks and make the identification of legal versus illegal agro-conversion challenging, a situation that not only constrains enforcement efforts but also investment by actors trying to be responsible. In Indonesia, for example, while the Constitution guarantees customary rights, national laws and regulations often are inconsistent or undermine these rights. In Bolivia and Honduras forest regulations lack clarity, with laws that simultaneously promote agricultural expansion and the protection of forests (Bolivia), or declare deforestation for agriculture illegal but agroforestry allowed (Honduras) (Vallejo 2011; Government of Honduras 2008). In many countries around the world, disputes are caused by overlapping titles and claims, with concessions for logging, mining, and agriculture overlapping each other and local land rights – making it difficult to understand the exact drivers of deforestation and enforce non-compliance with environmental laws and regulations. Malaysia and Vietnam also have contradictory laws defining what is legal versus illegal, and land classifications with mapped boundaries are not publicly available.

Perhaps it should not be surprising that national-level assessments of legal compliance are lacking for so many countries, nor that illegality is widespread. Perpetrators will go to great lengths to hide their illegal activities and/or launder the products of the illicit harvests. In many of the case study countries, governance is weak, enforcement under-resourced, corruption widespread, and monitoring and reporting on forest loss virtually non-existent. Indeed, the majority of tropical countries assessed in this report fall in the lower half of the Forest Trends (2020) comparative forest governance risk indicators.[10] Of the 23 country studies, 17 fall in the lower half, and six in the lowest 20 percent (Appendix 2).

Despite limited official reporting by producer countries, these results are robust.

Sensitivity analyses (Appendix 1) indicate that, despite the lack of reporting on illegality, Forest Trends' results are robust overall. Given the evidence available, Forest Trends can report with confidence that at least 69 percent of agro-conversion in the tropics was illegal between 2013 and 2019. If, instead of relying on the

[9] Forest Trends used sensitivity analyses, discussed below and in Annex 1: Methodology, to determine the impact on findings of the lack of producer-country government evaluation and reporting.

[10] Corruption has been shown to be highly correlated with the failure of a country's public sector to enforce laws or regulate industries effectively. Nearly half of the world's forests are in nations with what Transparency International calls "rampant" corruption and most of the forest crimes identified by Interpol and UNEP result from the inability of state forest administrations to enforce laws that regulate timber harvesting and trade. Forest Trends, national governance risk index compares national-level political, governance, business, economic, and corruption indexes to determine their level of consistency in country assessments. These indices draw on a broad range of relevant underlying data from the World Bank, African Development Bank, Asian Development Bank, Inter-American Development Bank, International Fund for Agricultural Development's programming criteria, United Nations and governmental aggregated data, as well as independent surveys and other primary data. The risk scores can only give an indication of the likely level of illegal deforestation in a country and ultimately speaks to the risk that corruption and poor governance undermines rule of law in the forest sector (Forest Trends 2020).

evidence available, it is assumed that all of the un-audited agro-conversion were illegal, the Forest Trends estimates of illegal tropical agro-conversion would jump to 94 percent, or 59 percent of all tropical forest loss. If it were assumed that none of the un-audited agro-conversion were illegal, then Forest Trends' global estimate of illegal agro-conversion would only drop from 69 to 61 percent. These could be considered the upper and lower bounds of illegal agro-conversion between 2013 and 2019: unlikely less than 61 percent, but maybe as high as 94 percent.

Soy, palm oil, cocoa, and cattle products (beef and leather) drive global figures of illegal deforestation, but other commodities, such as rubber, coffee, and maize, are also leading causes of illegal deforestation in some regions, with devastating effect.

Identifiable illegal deforestation is pervasive in the expansion of croplands for soy (93 percent of agro-conversion across all soy-growing countries in this study), cocoa (93 percent), and cattle products (beef 81 percent; leather 87 percent). The global average proportion of illegality for palm oil (59 percent) is constrained by low data availability in Malaysia, although 81 percent of clearing for Indonesia – the world's leading producer of palm oil – is estimated to be illegal. In Peru, it was estimated that more than 50 percent of oil palm was grown on illegally deforested lands.

The direct driver of most forest conversion in South and Central America was the expansion of cattle pasture. Of pasture in areas cleared of forests, 95 percent of all Brazilian and 97 percent of Mexican beef and leather products were considered at risk of having been produced on illegal agro-converted land. Illegal agro-conversion in Argentina and Paraguay for cattle grazing were estimated at 65 percent and 24 percent, respectively.

Illegal deforestation for the production of soy products was also centered in South America. Ninety-five percent of Brazilian soy linked to deforestation was estimated to have been produced in violation of national laws and regulations, as was 100 percent of soy linked to deforestation in Paraguay. Two thirds of Bolivia's soy production is exported, and more than half is likely to come from illegally cleared land.

Cocoa, rubber, wood fiber, and coffee production expanded significantly into forest areas in some countries. In Ghana, for example, forest conversion for cocoa represents one-third of the country's total tree cover loss. In Indonesia, over 1.6 Mha of forest since 2001 has been destroyed for wood fiber plantations and nearly another 1 Mha for rubber (Goldman et al. 2020). In Vietnam, 18 percent of forest loss in the Central Highlands in 2020 was for coffee and in Honduras' Ocotepeque, it is estimated that 56 percent of deforested land was converted to coffee (Chatham House 2020; Carbon Fund 2018).

Despite limits in data availability, non-compliance with national laws and regulations still appears significantly high – most notably for clearance within protected forest areas. Coffee and cocoa production are expanding into protected areas in Honduras and West Africa. An estimated 40 percent of cocoa from Cote d'Ivoire is the result of illegal forest clearing, and 13 percent of cocoa in Ghana is displacing forest, of which 45 percent is likely illegal. In Argentina, maize is the leading driver of deforestation, of which at least 65 percent is in contravention of land zoning laws. At least 17 percent of all rubber and rubberwood in Laos is estimated to have been produced on deforested lands and roughly half of rubber is grown in concessions where illegalities are well documented (98 percent of land leases in Laos are not legally compliant). In Cambodia, all rubber is likely grown on cleared forests and though illegalities are generally very poorly documented, at least 16 percent of Economic Land Concessions are illegal because they exceeded the maximum size limit.

Emissions from illegal ago-conversion account for at least 41 percent of all emissions from tropical deforestation.

All tropical forest loss has a massive impact on climate change because of the emissions associated with forest clearing (e.g., loss of vegetation and other carbon sinks, direct emissions from human activity, etc.) Illegal agro-conversion alone was likely responsible for at least 2.7 Gt of CO_2e per year, totaling 19 Gt of CO_2e between 2013 and 2019. On an annual basis, that's more than India's emissions from fossil fuels, and if it were a country, emissions from illegal agro-conversion would be third-largest globally after China and the US.

The largest producer of emissions from illegal agro-conversion during this time was Latin America (13.7 Gt), mainly due to massive forest loss in Brazil associated with fires over the last few years. For Brazil, this represents an increase of 54 percent from the preceding seven years (2006 to 2012, according to Harris et al. 2021) when Brazil was seriously addressing illegal logging and deforestation for agriculture and was able to reduce its total emissions more than any other country in the world.

Deforestation for agro-commodity production that is driven by export demand has increased overall since 2013. More than 31 percent of agricultural commodities linked to deforestation are exported, raising significant concerns about their association with illegal deforestation.

The average annual area of agro-converted land linked to exports has increased from 1.7 Mha per year to 2.0 Mha per year since the original 2000 to 2012 time period studied in Forest Trends' original report (2014). In 2019, exports of US$55 billion were linked to agro-conversion across ten commodities – mostly those grown in Latin America and Asia. This trade represents emissions of at least 1.2 Gt CO_2e per year from more than 14 Mha of forest land cleared between 2013 and 2019, an area twice the size of Ireland.

This report examines 23 case study countries and finds at least one-fifth – and in some cases virtually all – of agricultural exports were linked to illegal deforestation, depending on the commodity and country of origin. It is not possible to calculate at a global level precisely what share of illegally produced commodities are ultimately exported from their country of origin. Given the evidence presented here and the regional and country studies summaries that follow (Annexes 1-3), the risk of deforestation-linked products is non-negligible, even high, in the cases of widely traded commodities like soy and palm oil.

The percentage of deforestation for agro-commodity production that is driven by export demand varies, which will affect the potential impact of consumer and demand-side measures.

The overall proportion of production linked to agro-conversion that is then exported has declined from 49 percent in the 2000 to 2012 period to 31 percent since 2013. This is because in some countries, deforestation is not driven by commercial agriculture (DRC, Madagascar, Sierra Leone) or their agricultural products are not destined for export (Colombia, Bolivia, Mexico). In these countries especially, demand-side measures such as corporate purchasing policies or import regulations will be less effective than programs which strengthen domestic governance; programs for sustainable management of the land and forest sectors must take leading roles.

Demand-side measures, however, will be effective when a high proportion of deforestation for agro-commodity production is being driven by export demand, as is the case, for example, in Indonesia, Malaysia, and Laos. However, agro-exports are increasingly headed to markets in China and India, where regulatory and consumer pressure for environmental protections is lower. If demand-side regulatory measures are only adopted in

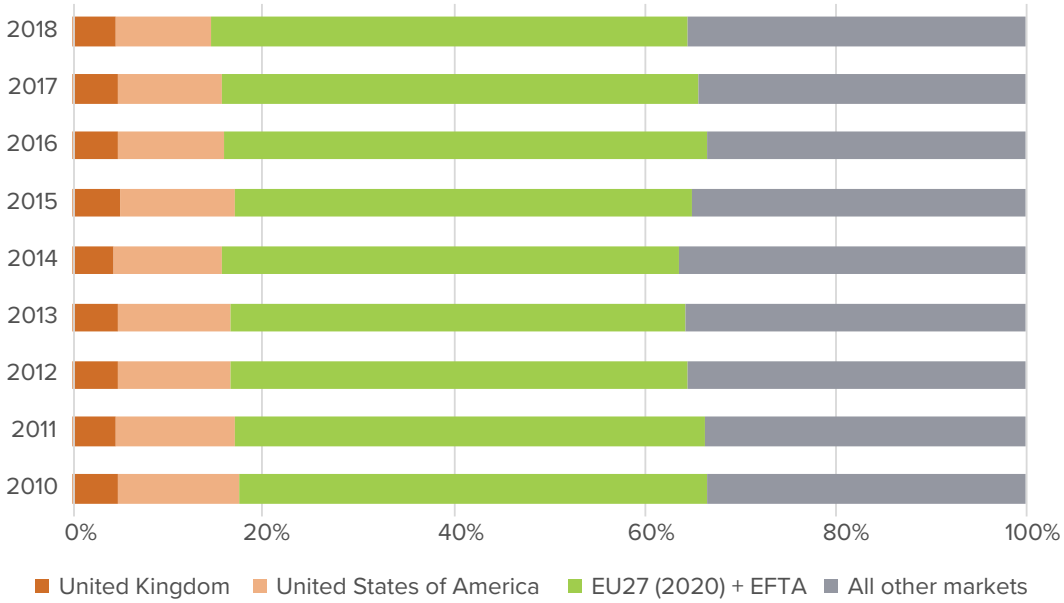
some major markets (such as the US, Europe, and Australia) but not in others, a bifurcation of trade is likely, with high-risk commodities continuing to find buyers in import markets without legislation or trade measures blocking illicit goods.

Can demand-side initiatives in Europe and North America help reach a tipping point?

Over the past decade, mainly in Europe and North America, a variety of demand-side measures have been designed and, to some degree, implemented by consumers, industry, and consumer governments, such as corporate purchasing policies, public procurement policies, and import regulations aimed at either eliminating all deforestation or illegal deforestation from supply chains. Governments in the UK, EU, and the US are notable for already starting on regulatory approaches to ensure imported agricultural commodities are not being sourced from deforested lands, or at least lands that were not illegally deforested. These efforts have been supported by certification or legality verification systems, voluntary or regulated disclosure processes, investor activism, and NGO campaigns.

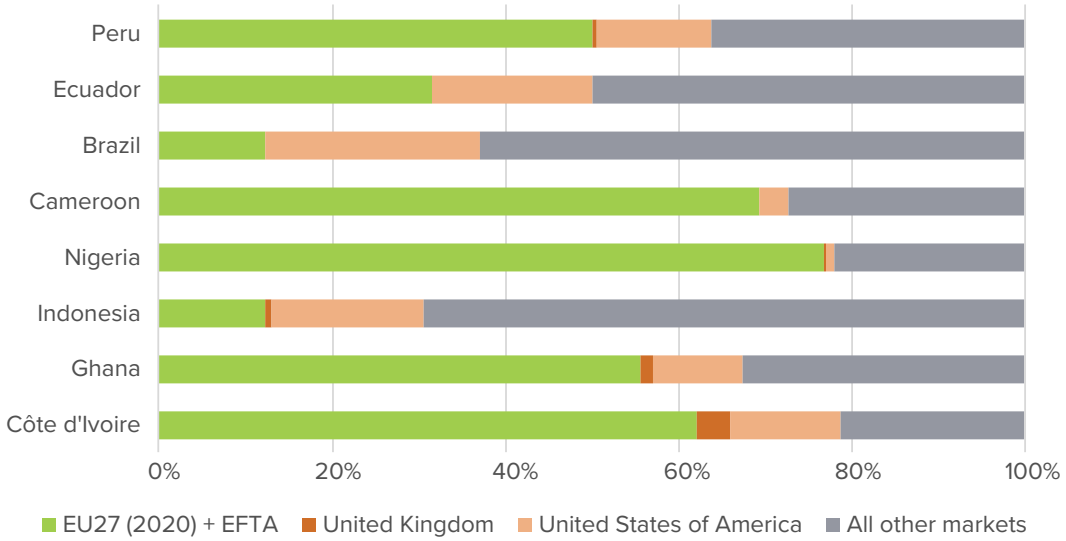
But the European and North American markets alone may not be enough to affect significant change. For cocoa products, these markets typically account for over 60% of all global imports and could thus hold significant leverage over the entire market (Figure 5), especially for some producer countries such as Nigeria, Cote d'Ivoire and Cameroon (Figure 6) (Norman & Saunders 2020). However, countries such as Brazil and Indonesia export less than 40% to these markets, and thus demand-side measures are likely to be less effective. Producer countries could increasingly export to countries with less market demand for sustainable and/or legal products. This is already the case for most soy and beef produced in tropical countries, where China and other countries hold increasingly larger shares of the market (Figures 7 and 8).

Figure 5 | UK, US, and EU share of global cocoa bean, cocoa products, and chocolate imports (%), 2010-2018



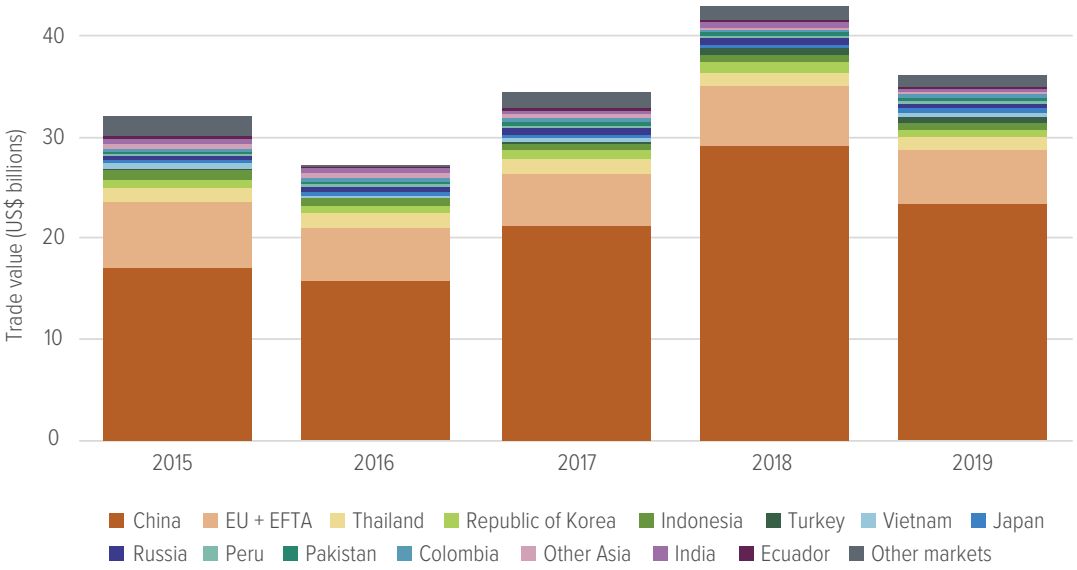
Source: Norman and Saunders 2020.

Figure 6 | Market share of EU, US, and UK imports of cocoa beans, cocoa products, and chocolate, 2019 (% of global imports in kg)



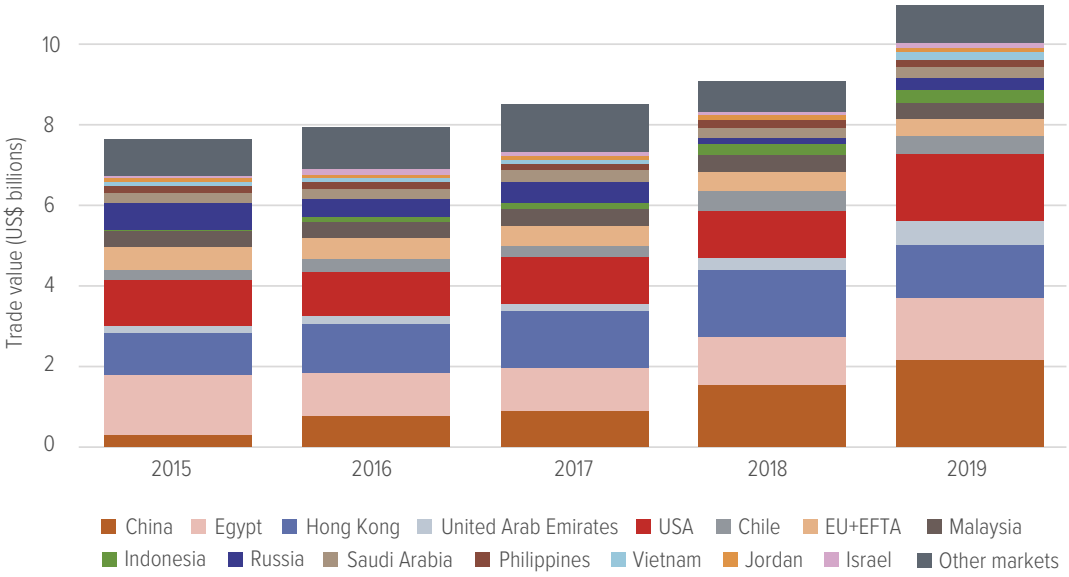
Source: Norman and Saunders 2020.

Figure 7 | Global importers of soy from tropical countries, 2015-2019



Source: Data from UN Comtrade, 2018, compiled and analyzed by Forest Trends.

Figure 8 | Top global importers of tropical beef (2015-2018)



Source: Data from UN Comtrade, 2018, compiled and analyzed by Forest Trends.

4 Latin America and the Caribbean Regional Summary

KEY STATISTICS

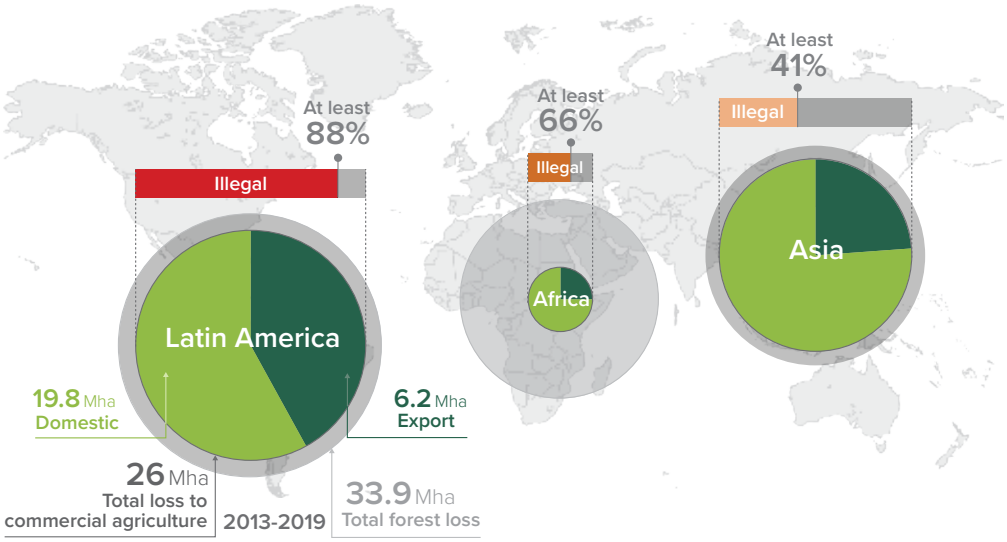
Forest loss in tropical Latin America and the Caribbean[11] (LAC), 2013-2019:

44% of all forest loss across the tropics

13.7 Gt of CO_2e Total gross emissions from tree cover loss

33.9 Mha total loss of tropical forests → of which **77%** due to commercial agriculture → of which at least **88%** likely illegal; **24%** likely exported

Figure 9 | Amount of tropical forest loss (Mha) driven by commercial agriculture, by domestic consumption versus export of commodities and minimum proportion of clearing that was likely illegal; Latin America and Caribbean data featured



Notes: Amount of tropical forest loss driven by commercial agriculture is represented by dark grey circles. The green pie charts represent the minimum proportion of clearing that was likely illegal, with domestic consumption depicted in light green and production destined for export in dark green.

Forest/Forest cover: Forest areas with greater than 50 percent tree cover that are greater than five meters tall.

Forest loss/Deforestation: Complete removal of forest cover (areas with at least 51 percent of tree cover).

Illegal deforestation: Conversion of forests that takes place in contravention of a country's legislative framework (e.g., their laws and regulations) at the time the deforestation took place. Breaches of international or customary law were not included unless they are integrated into national legislation.

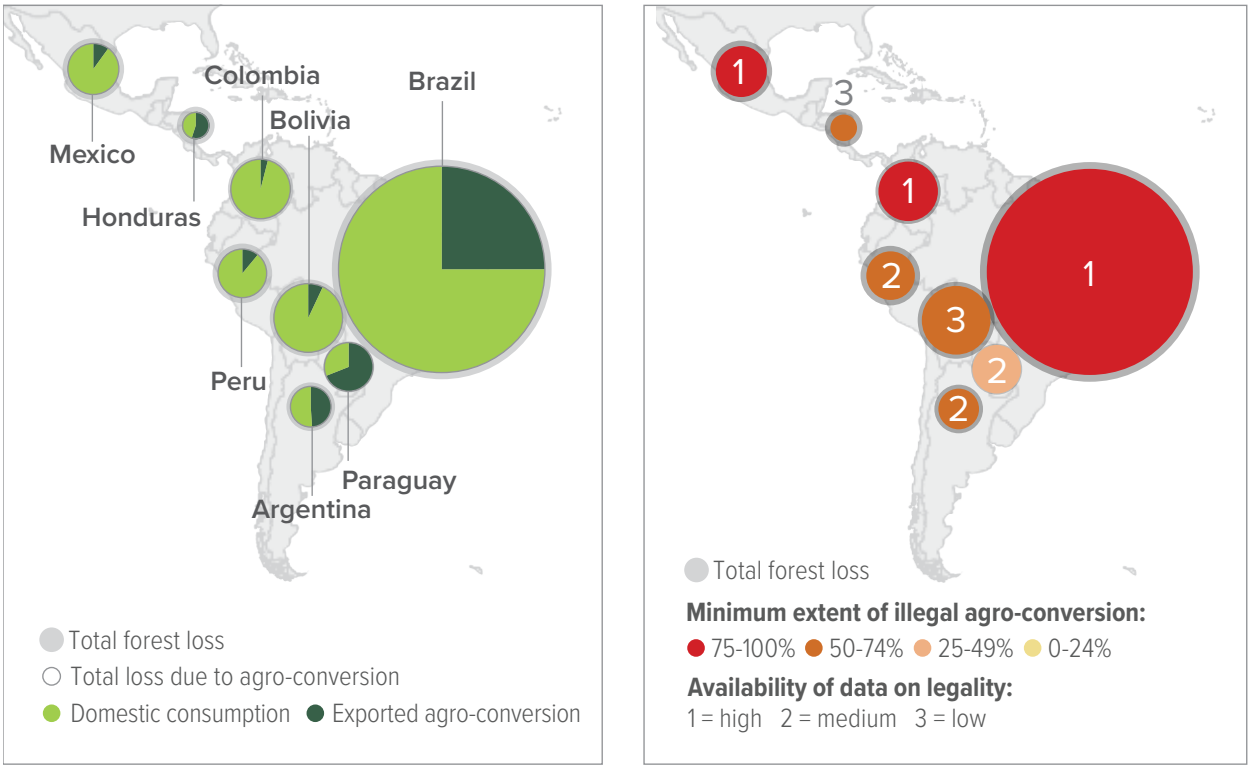
[11] 47 countries in tropical Latin America and the Caribbean, forest loss according to GFW (2020, using Hansen et al. 2013).

BOX 2

Latin America and the Caribbean: Key Findings

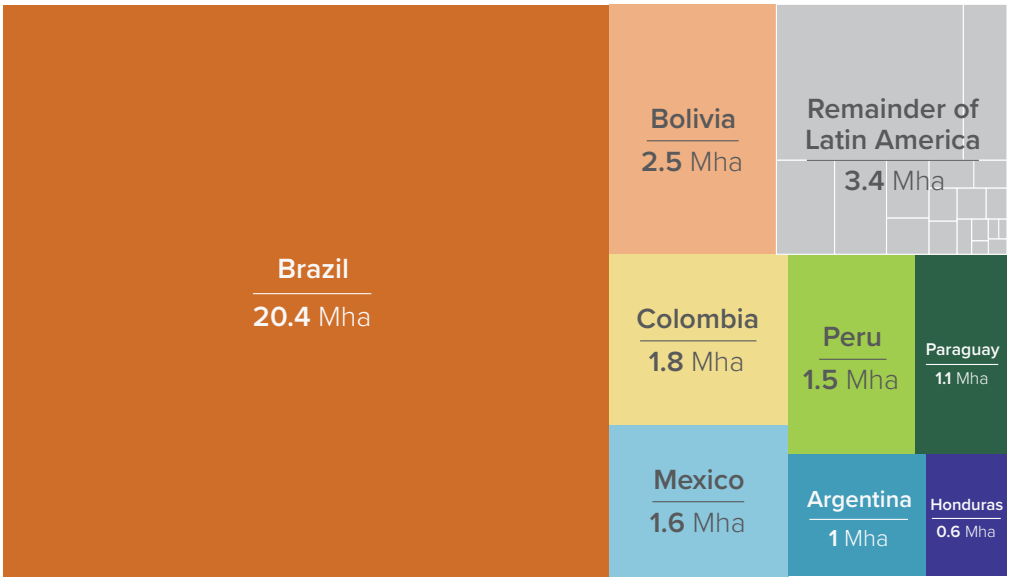
- Between 2013 and 2019, commercial agriculture in LAC was likely responsible for the clearance of more than 26 Mha of forest (Figure 9).
  - At least 88% of agro-conversion was likely illegal.
  - Given that 24% of the production linked to this agro-converion was exported, there is a risk that international buyers are linked to the loss of 6.2 Mha of forest.
  - These exports carried a high risk of being linked to illegal deforestation.

Figure 10 | Relative amount of tropical forest loss driven by commercial agriculture across case study countries in Latin America and the Caribbean and the minimum extent of clearing that was illegal



Sources: Forest loss data from GFW (2020, using Hansen et al. [2013]); agro-conversion estimates compiled by Forest Trends (2021) from multiple sources, including GFW (2020, using Curtis et al. [2018]); export/domestic consumption estimates compiled by Forest Trends (2021) from multiple sources, including Pendrill et al (2020) and UNComtrade; illegality data estimates compiled by Forest Trends (2021).

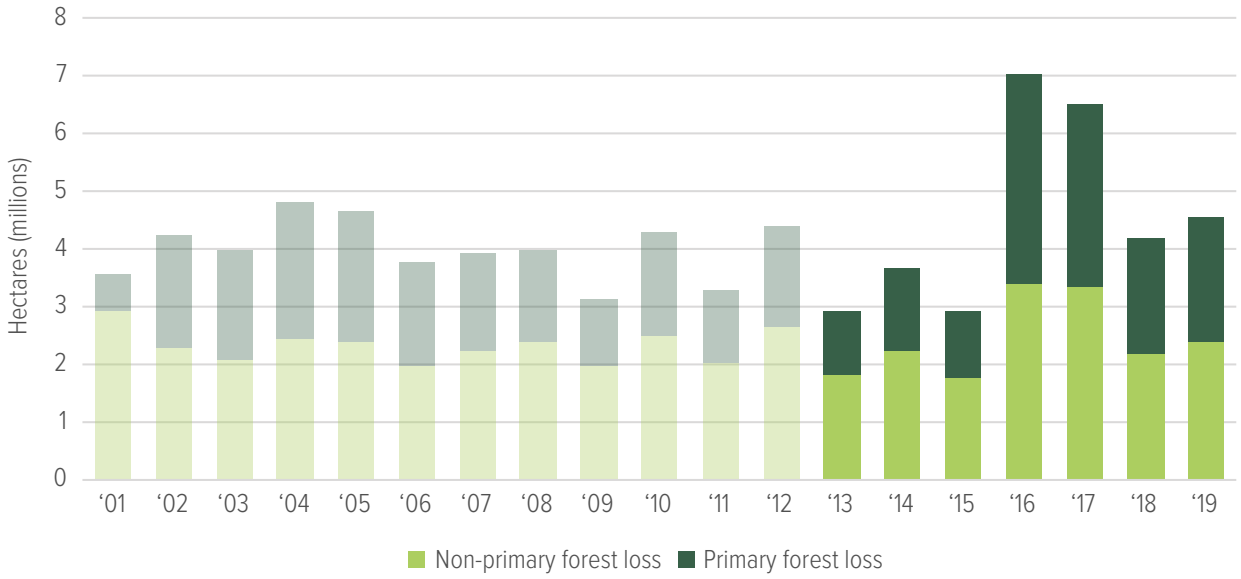
Figure 11 | Distribution of forest loss across tropical Latin America and the Caribbean



Source: GFW (2020, using Hansen et al. 2013).

Latin America lost 34 Mha of forest between 2013 and 2019 (GFW 2020, using Hansen et al. 2013; Figure 8). This is a 31 percent increase on the forest loss that occurred in the preceding seven year period (e.g., 26 Mha, based on GFW 2020).

Figure 12 | Annual forest loss in Latin America and the Caribbean, 2001 to 2019. This report covers the period highlighted (2013-2019)



Sources: Forest loss data from GFW (2020, using Hansen et al. [2013]), compiled by Forest Trends.

Commercial agriculture was the dominant driver of forest loss across LAC, mainly for beef and soy (at least 26 Mha between 2013 and 2019, see country studies in Annex 1). Forest Trends estimates that at least 23

Mha, or 88 percent of these forests were cleared in violation of the producer country's own laws and regulations (Figure 10). The forest loss from commercial agriculture in LAC is estimated to have generated at least 15 Gt of CO_2e during this reference period (GFW 2020, using Harris et al. 2021). Most production on the land cleared of forests was destined for domestic markets, but 6 Mha of this cleared land (24 percent) was likely for the production of agro-commodities for export markets, generating 3.5 Gt CO_2e of emissions. While trends vary among the LAC countries, the overall pattern is driven by Brazil which alone constitutes almost two-thirds (60 percent) of all tropical forest loss across LAC during the study period.

BRAZIL

Brazil, with nearly 500 Mha of forest, dominates the tropical forests of Latin America. Under the National Plan to Combat Deforestation, and policies and initiatives like the 2006 moratorium on soy producers clearing forest in the Amazon, and a similar cattle moratorium in 2009, Brazil successfully reduced its rate of deforestation. Unfortunately, this success has been reversed, and the Government of Brazil reports that the annual rate of primary forest loss in 2020 was 26 percent greater than 2012 (PRODES 2020). Brazil lost over 20 Mha of forest cover between 2013 and 2019, more than one-quarter of all forest loss across all the tropics. The main driver was commercial agriculture, responsible for 88 percent of Brazil's forest loss.

Like the rest of Latin America, the major agricultural commodities responsible for deforestation in Brazil are beef and soy. Pasture drove 74 percent and soy drove 20 percent of forest loss in Brazil, but the dynamics are complex: soy often displaces pastures, moving livestock expansion further into the Amazon (MapBiomas 2020). While Brazil dominates, these patterns of direct and indirect loss were common across Latin America. Trase (2020a) estimates that pasture for livestock was responsible for 81 percent of deforestation in the Brazilian Amazon, and over 95 percent of the deforestation in the Paraguayan Chaco.

Across the region, forest clearance for commercial agriculture is occurring in violation of national laws and regulations (Figure 10). Almost all agro-conversion in Brazil is illegal, evidenced primarily by a lack of proper permits allowing forest clearing, but also by fraudulent land titles and non-compliance with the Forest Code requirements. Brazil's data on illegality in agro-conversion has been well documented through independent analyses of commercial agriculture's lack of compliance with national legislative frameworks relevant to forest clearing (Rezende de Azevedo et al. 2019; Rajão et al. 2020; Trase 2020b).

Across the rest of Latin America, such systematic analyses are rare, but a review of the literature suggests that, like Brazil, illegality is likely high across all countries, with estimates ranging from 97 percent in **Mexico** and 89 percent in **Colombia**, down to at least 50 percent in **Peru** and 49 percent in **Paraguay**. However, as these estimates are based only on limited, albeit well documented, evidence of illegalities, it is likely that more comprehensive reviews would indicate even greater levels of illegality, making these estimates conservative.[12]

Recently the region has seen a worrying weakening of national laws, policies, and institutions that protect forests. Brazil has been worst affected, with laws that gave impunity for deforestation in legal reserves and areas of permanent preservation, and amnesty for land seizures. Since Bolsonaro came to power, the dismantling of environmental protections has accelerated, including the elimination of key environmental positions, the militarization of environmental investigations, and the marginalization of civil society (Rajão et al. 2020; Carrero et al. 2020).

[12] For example, Forest Trends knows of no review of tax evasion associated with forest clearing but knows that tax evasion is a common problem in the region. It is possible that in Latin America, like in Indonesia (where a comprehensive review was undertaken), operators have failed to pay taxes on conversion timber harvested during land clearing.

Soy and beef linked to deforested land in the six Latin American case studies (Annex 1) have a combined value of US$24 billion in 2019. Given that Brazil has the highest amount of agro-conversion, and almost all this clearing is likely illegal, Brazil also comprises the highest proportion of all forest risk commodities exported, valued at over US$19 billion for 2019. The biggest producers are responsible for almost all of Brazil's forest loss: 2 percent of producers are responsible for 62 percent of all deforestation (Rajão et al. 2020), almost all of it likely illegal. More recently, Brazil's agro-exports are increasingly heading to China, which has strengthened Brazilian producers' demands to end the zero deforestation requirements for soy in the Amazon.

The gains originally made before 2016 in reducing deforestation meant that Brazil may have done more than any other country to address the climate crisis – at its peak, Brazil likely reduced emissions by more than 1.3 Gt of CO_2e per year. By comparison, in their best year, the US, Japan, and the EU together only reduced emissions by less than a quarter of what Brazil accomplished. Unfortunately, these gains are now being lost, and emissions from deforestation are on the rise again.

THE ANDEAN-AMAZONIAN STATES

In **Bolivia**, at least 80 percent of forest loss is driven by commercial agriculture (GFW 2020; FAO FRA 2020; Müller 2013), while in Peru, there is a mixed picture of large-scale and smallholder agriculture, with coffee, cocoa, and palm oil responsible for most agro-conversion (Zegarra Méndez & Gayoso 2015; Augusto 2020; Government of Peru 2016). In Colombia, land grabbing under the guise of cattle ranching is the primary driver (responsible for 60 to 65 percent of deforestation according to the Ministry of the Environment), with illegal coca farming accounting for a further 20 to 22 percent (Minambiente 2017). High levels of illegality reflect weak rule of law, corruption, failure to implement Free Prior and Informed Consent (FPIC), and intimidation of environmental defenders. The likely trend is for commercial agriculture to increase as a driver of deforestation in these countries, given national strategies to promote livestock (Bolivia) or palm oil (Peru), incentives for farmers to grow cash crops such as cocoa and coffee, rocketing land prices, and the growth of illicit coca cultivation (Colombia).

Forest loss in Bolivia spiked in 2019, 80 percent higher than the next highest year on record, due to fires that devastated huge areas, especially the Chiquitano dry forest in the province of Santa Cruz, a hub of commercial agriculture. The Chaco forest also experienced large-scale conversion to pasture. The legal framework protecting the forests was eroded by laws that favored agri-business, waiving fines for illegal deforestation and allowing controlled burns in lowland forests. The Law of the Rights of Mother Earth, which boosted Bolivia's environmental credentials in 2010, was not followed up with implementing environmental legislation nor the repeal of contradictory laws, and appears now to have been little more than window-dressing (Romero-Muñoz et al. 2019; Villavicencio Calzadilla & Kotzé 2018). A World Resources Institute (2016) report found that deforestation rates were 2.8 times lower within "tenure-secure" indigenous lands — lands that are legally recognized by the government and protected from external threats and competing claims — than outside of them. By giving indigenous groups legal rights to the lands they occupy, Bolivia could avoid 8 to 12 Mt of greenhouse gas emissions each year.

Brazil was not alone in reporting a rising rate of forest loss due to commercial agriculture; deforestation in **Colombia** has increased in areas previously isolated by the civil war, and the Gran Chaco dry forests have experienced intensive conversion, in part as a leakage effect of zero deforestation commitments in the Brazilian Amazon.

Colombia's transition to peace led to an increase in deforestation in former FARC-controlled areas[13] where forest cover had previously given a strategic advantage to the rebel groups. Now criminal gangs work together with FARC splinter groups to seize land and/or extract extortion money from farmers for each hectare deforested. Land grabbing has driven 60 to 65 percent of deforestation. Most of Colombia's deforestation is located in the Amazon region (68 percent in 2020), and the majority is converted to pasture (IDEAM 2020; González et al. 2018), with livestock moved onto cleared land as a way of signaling ownership. The expansion of pasture is not export-oriented, however, as almost all beef is consumed on the domestic market. The root cause of much deforestation is land speculation, with the price of land rocketing as much as 300 percent in some areas (Volckhausen 2019).

Smallholders in the Peruvian Amazon grow both subsistence and cash crops, and census data shows nearly half a million farmers living in the Amazon. It is estimated that roughly 68 percent of farming in the Amazon is illegal, with farmers illegally occupying public lands (Gonzalo 2020).

THE SOUTHERN CONE

Paraguay and **Argentina** each lost over 1 Mha of forest between 2013 and 2019, and commercial agriculture was responsible for 89 percent and 71 percent, respectively. The semi-arid lowlands of the Gran Chaco which contain South America's second largest forest, stretching across Argentina, Bolivia, Paraguay, and Brazil, have been the site of aggressive agricultural expansion. The forest is first cleared for cattle ranching then sold or rented out for more lucrative soy production. Thus, soy is the indirect driver of land-use change, pushing cattle ranching further into frontier areas and driving up local land prices, which in turn, incentivizes the clearing of surrounding forest. In Argentina, there is a legal requirement to zone land based on its conservation value, but by 2018, this process had been completed for only 19 percent of the country's land area. An analysis of deforestation in 2017 found that 65 percent took place in zones where deforestation was prohibited or on land that was not zoned (Greenpeace Argentina 2018; Gutman 2018).

Paraguay and Argentina are among the top five global exporters of soybeans. Paraguay sold 6.8 Mt in 2019 and soy accounts for 50 percent of its exports. Nearly all of Paraguay's soy exports come from the east of the country, the heavily deforested Atlantic Forest, which experienced most of its forest loss before the Zero Deforestation Law of 2004. The law applies only to the Atlantic Forest and led to a sharp increase in conversion in the Gran Chaco instead. For decades, Paraguay has had huge land inequality, with just 1.6 percent of the population owning 80 percent of all agricultural land. While landlessness and poverty are forced upon people evicted from their land, the landowning elite export beef and soy overseas. Beef accounted for 25 percent of Paraguay's export revenue in 2019, mostly destined for Chile and Russia, and none of the export has a zero deforestation commitment. Leather from deforested land, home to the Totobiegosode Indigenous Peoples, is reportedly exported to Italy for use in luxury cars, such as BMWs and Range Rovers (Earthsight 2020). The Gran Chaco is the ancestral territory of many indigenous peoples, most notably the Ayoreo, whose territory extends over 11 Mha. Despite Paraguay's constitutional recognition of the right to communal land ownership, the Inter-American Court of Human Rights has made three judgments criticizing violations of the land rights of indigenous peoples and the deforestation of customary lands. Paraguay's remaining forests are at high risk of further rapid deforestation given the weakening of forest protections introduced in 2017.

[13] *Fuerzas Armadas Revolucionarias de Colombia* or "The Revolutionary Armed Forces of Colombia." Most commonly known as FARC, the acronym in Spanish.

CENTRAL AMERICA

In **Mexico**, commercial agriculture is the driver of 68 percent of forest loss, with a mix of large livestock farms and smaller rainfed or irrigated fields for crops and fruit. Agro-conversion is illegal where authorization has not been obtained for land-use change from the Ministry of the Environment and Natural Resources. Between 2005 and 2015, only 37,713 ha of land-use change from forestry to agriculture were authorized, equivalent to 3 percent of forest loss during this period, implying that 97 percent of agro-conversion is likely illegal. Nearly half (45 percent) of Mexico's exported deforestation risk is in beef (Pendrill et al. 2020). The number of cattle in Mexico nearly doubled over the period 2013 to 2018 and in deforestation hotspots such as Chiapas, cattle ranching is identified as the main driver of forest loss (Soberanes 2018). Beef exports from Mexico were valued at over US$1 billion in 2018, mostly going to the United States. Deforestation for avocados is another risk, located mostly in central and southern Mexico. For example, the avocado orchards of Michoacán state caused at least a further 10 percent of Mexico's annual forest loss and the destruction of much of the remaining habitat of the endangered monarch butterfly (GFW 2019).

Like Mexico, deforestation in **Honduras** is driven almost entirely by commercial agriculture. One of the growing causes of deforestation is coffee – in fact, Honduras is responsible for 32 percent of the world's embodied deforestation in coffee (Pendrill et al. 2020). Roughly 29 percent of the area under coffee cultivation is on land that was illegally converted from forest to agriculture (Carbon Fund 2018).

CONCLUSION

The countries selected for this analysis have the largest forest loss, but deforestation is a problem across LAC. An additional 3.3 Mha (11 percent of all loss across Latin America) was lost in the other 40 countries across the continent (Figure 11), where agriculture is also the main driver: mostly shifting agriculture in Nicaragua and Guatemala, while in Venezuela the conversion of forest lands was for the production of beef sold on the domestic market. The effects are extensive habitat loss, release of emissions, soil depletion, water scarcity, labor abuses, and landlessness.

In LAC, there is a high risk that commodities are grown on illegally deforested land. Brazil has set the standard by having a database of private property boundaries that makes it possible to use satellite observations to determine compliance with the Forest Code. In all other countries, determining illegality is complex, if not impossible. Forest Trends estimates are based on evidence from the documented illegalities contained in the country studies herein (Annex 1). Further research will undoubtedly reveal higher levels of illegality.

Indigenous peoples and local communities across Latin America have legal rights to manage more than 270 Mha of forest, almost 40 percent of the total forest area (and also claim significant areas that they do not yet have formal rights to), and yet they are often forced off their land by ranchers, land grabbers, and criminal gangs (Graesser 2015). Even in countries such as Bolivia and Colombia, where their constitutions enshrine customary rights, these rights are routinely ignored.

Insecure land tenure, land grabbing, and land speculation are at the heart of illegal deforestation in Latin America. Threats and intimidation often accompany land clearance, and the arrival of cattle is a precursor to fencing off pastures and claiming land titles. Illicit crops, such as coca, are also a major factor, especially in Central America, Colombia, Bolivia, and Peru.

There is a risk that environmental laws will continue to be weakened in the face of pressure from agribusiness and large landowners, as has been the case in Brazil (the Forest Code of 2012 and Law 13,465 of 2017) and

Bolivia (Supreme Decree 3973 and Law 1098). Furthermore, the COVID-19 pandemic has been used as an opportunity to weaken forest protections. In Peru, environmental monitoring was put on hold and reports of land invasions went uninvestigated while extractive industries were promoted. In Colombia, community consultation guidelines were weakened and between March and May 2020 in Brazil, 195 Executive Acts bypassing or dismantling environmental regulations were signed (Dil et al. 2021). As demonstrated by the challenges to preventing forest loss in Latin America, forest protection requires strong standards of environmental and social protection, and companies need enhanced environmental and human rights due diligence.

5 Africa Regional Summary

KEY STATISTICS

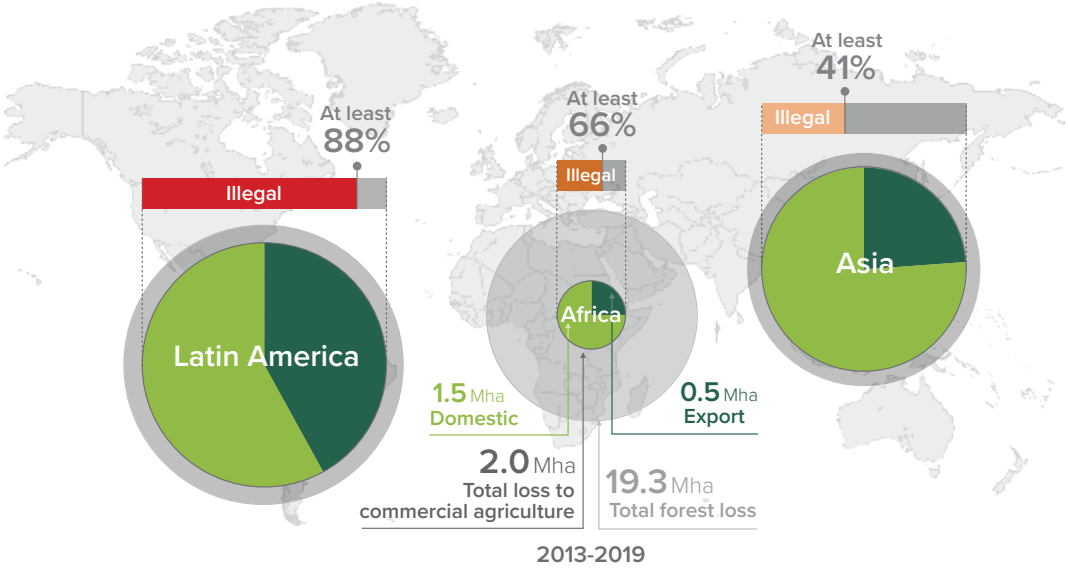
Tropical forest loss in Africa, 2013-2019:

25% of all forest loss across the tropics

11.5 Gt of CO_2e Total gross emissions from tree cover loss

19.3 Mha total loss of tropical forests → of which **10%** due to commercial agriculture → of which at least **66%** likely illegal; **4%** likely exported

Figure 13 | Amount of tropical forest loss (Mha) driven by commercial agriculture, by domestic consumption versus export of commodities and minimum proportion of clearing that was likely illegal, Africa highlighted



Notes: Amount of tropical forest loss driven by commercial agriculture is represented by dark grey circles. The green pie charts represent the minimum proportion of clearing that was likely illegal, with domestic consumption depicted in light green and production destined for export in dark green.

Forest/Forest cover: Forest areas with greater than 50 percent tree cover that are greater than five meters tall.

Forest loss/Deforestation: Complete removal of forest cover (areas with at least 51 percent of tree cover).

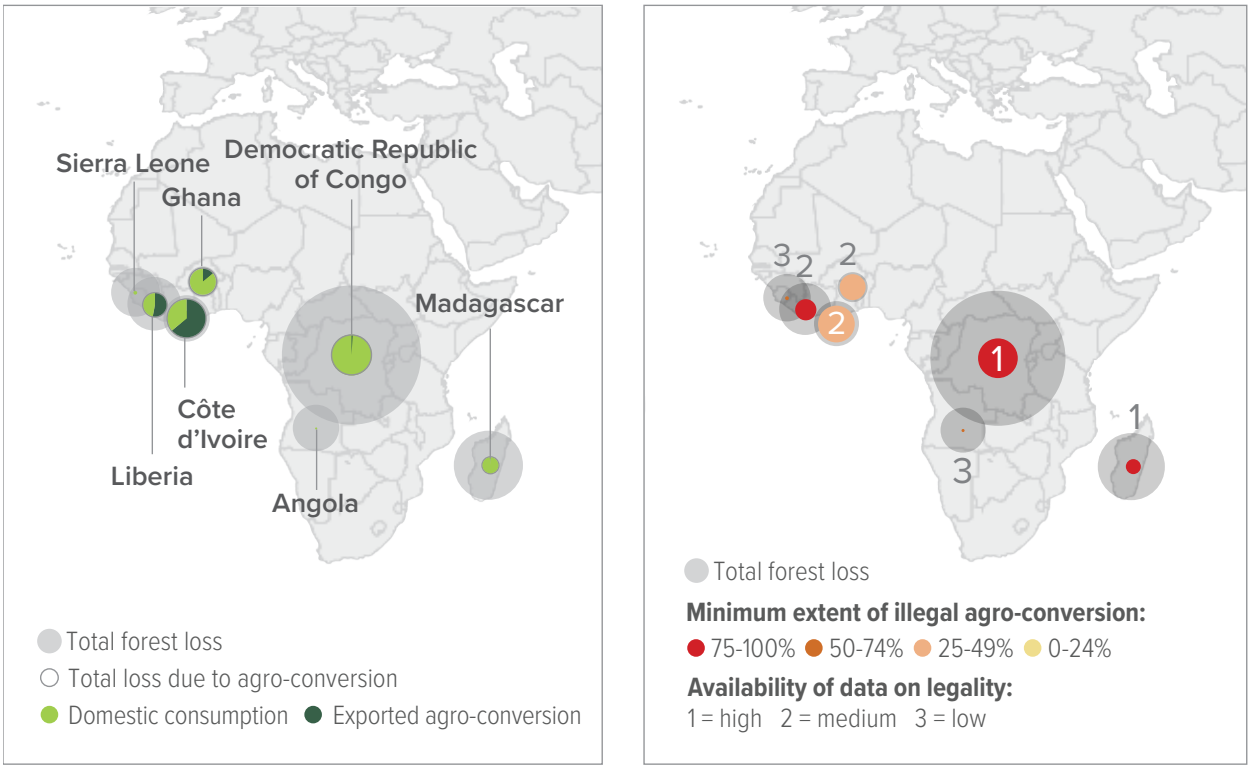
Illegal deforestation: Conversion of forests that takes place in contravention of a country's legislative framework (e.g., their laws and regulations) at the time the deforestation took place. Breaches of international or customary law were not included unless they are integrated into national legislation.

BOX 3

Africa: Key Findings

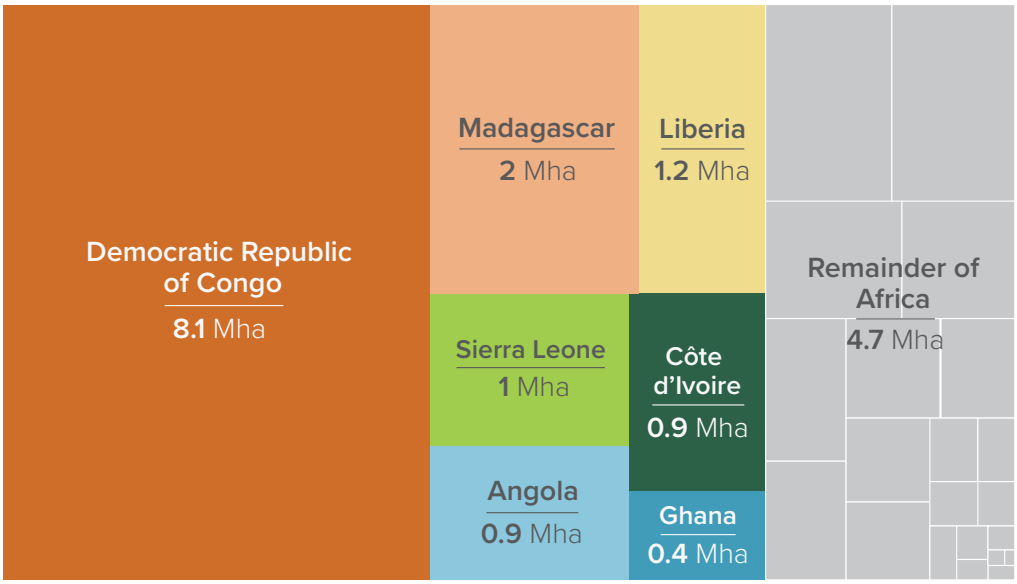
- Between 2013 and 2019, commercial agriculture in Africa was likely responsible for the clearance of more than 2 Mha of forest (Figure 13).
  - At least 66% of agro-conversion was likely illegal.
  - Given that 26% of the production linked to this agro-conversion was exported, there is a risk that international buyers are linked to the loss of 0.5 Mha of forest and are at high risk of being linked to illegal deforestation.

Figure 14 | Relative amount of tropical forest loss driven by commercial agriculture across the case study countries in Africa and the minimum extent of clearing that was illegal



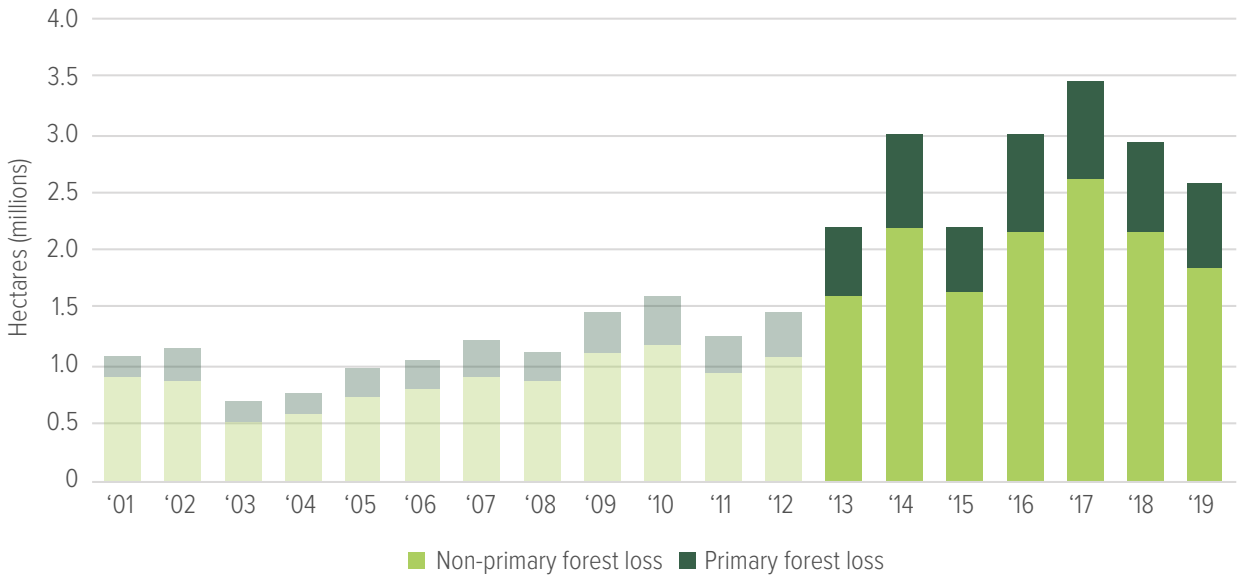
Sources: Forest loss data from GFW (2020, using Hansen et al. [2013]); agro-conversion estimates compiled by Forest Trends (2021) from multiple sources, including GFW (2020, using Curtis et al. [2018]); export/domestic consumption estimates compiled by Forest Trends (2021) from multiple sources, including Pendrill et al (2020) and UNComtrade; illegality data estimates compiled by Forest Trends (2021).

Figure 15 | Distribution of forest loss across tropical Africa



Source: GFW (2020, using Hansen et al. 2013).

Figure 16 | Annual forest loss in Africa, 2001 to 2019. This report covers the period highlighted (2013-2019)



Source: Forest loss data from GFW (2020, using Hansen et al. [2013]), compiled by Forest Trends.

Unlike other major tropical regions, commercial agriculture in Africa is not the dominant driver of forest loss (Figure 3, Detailed Findings). The exception is certain parts of West Africa, where the cultivation of export-oriented cocoa encroaches increasingly into protected areas, and where the remaining closed canopy forest fragments are increasingly isolated within a mostly degraded landscape. In East Africa, the deforestation of the dry forests is characterized by small-scale clearance conducted by extended families who cut the trees in labor intensive ways, mainly to produce fuel, food crops for sale in the local market, and for personal consumption (Rudel 2017). By far the largest losses of forests across the continent are in Central Africa, mostly in the Congo River Basin,

which alone comprised 56 percent of tropical Africa's forest loss between 2013 and 2019 (Figure 15; Figure 16; GFW 2020, using Hansen et al. 2013). However, the tropical forests of the Congo Basin are mainly threatened by logging concessions that reportedly cover more than 50 Mha and cut a network of roads into the forest, opening it up to smaller-scale farming, mining, and further artisanal logging.

Across Africa, national laws for the protection of forests and forest peoples are weak and the application of the law is often weaker. Logging and agricultural concessions in several countries are accused of violations of national laws and regulations (Figure 14, right), including expansion into protected areas, taking the land without informed consent, extending the concession beyond the agreed boundaries, breaching environmental regulations, failing to pay taxes and other fees, failing to compensate those affected by the clearing, and human rights abuses.

THE CONGO BASIN

The equatorial forest of the Congo Basin is the world's second largest area of contiguous tropical rainforest. The Congo River watershed spans 3.7 million square kilometers (km2), most of which remains forested. The forest is home to more than 600 tree species and 10,000 animal species. The presence of elephants, gorillas, and large herbivores shapes the distinctive forest structure, as their grazing allows the trees to grow taller and at a lower density than in the forests of Southeast Asia and the Amazon (Butler 2020). It is also home to the world's most extensive peatland complex, covering 14.5 Mha. The deep peat layers have been building up for nearly 11,000 years beneath waterlogged swamp forest and now harbor 30 Gt of carbon – nearly a third of the world's tropical peatland carbon (Dargie et al. 2017).

The **Democratic Republic of Congo (DRC)**, home to 59 percent of the Congo Basin's rainforest, lost 5 percent of its forest, or 8.1 Mha, between 2013 and 2019, accounting for 11 percent of all forest loss across the entire tropics over that time (Figure 15). GFW (2020, using Curtis et al. 2018) identifies subsistence agriculture as the main driver of deforestation (99 percent), but the story is more complex. Logging is taking place on an industrial scale, and logging roads are opening the forest for conversion to agriculture. At least 10.7 Mha of logging concessions cover 7 percent of DRC's forests (Global Witness 2018b; Egunda Ikala et al. 2018) and Chatham House estimates 99 percent of timber production is illegal (Hoare 2015). In many cases, migrants move in when logging opens up the forest, often seeking to escape hunger or conflict (Turubanova et al. 2018; Lescuyer 2014).

The major crops cultivated in cleared forest areas are cassava, rice, maize, and plantain, all staple foods that are grown for subsistence but also for domestic markets (Pendrill et al. 2020). Distinguishing between subsistence and commercial agriculture is complicated, especially when many of the openings created by deforestation events are small and little data exists on where the crops are destined to be consumed. Demand from domestic markets is growing and influencing small farmers' decision-making as to which commodity crops to plant (Ordway et al. 2017).

Large-scale commercial land uses reportedly cause a small proportion of the deforestation, but where it occurs, it has both direct and indirect effects. A study by Molinario et al. (2020) found an increased likelihood of forest loss within a five-kilometer radius of commercial agriculture. The government's plan to grant large concessions under the National Agricultural Investment Plan for 2013 to 2020 ran aground when the first agro-industrial park at Bukanga Lonzo, Bandundu province was closed after a few short years following allegations of fraud and corruption (Mousseau 2019).

The pattern is similar across the rest of the Congo Basin. In the **Republic of Congo** and **Gabon**, large-scale

commercial agriculture and associated exports are rare, due to high transaction costs and a perceived high-risk investment climate (Austin et al. 2017). However, extensive logging operations – many illegal – create a network of roads, which makes the area accessible to small-scale farmers, further degrading the forest so it becomes dry and prone to fire. The few plantations that do exist are reportedly beset by human rights abuses. **Cameroon's** Société Sud Hevea Cameroun is one such example: it is part owned by the president's family and was reportedly established without FPIC from local communities. Management also allegedly used force to remove the local communities, including indigenous Baka people, from the land (Greenpeace Africa 2018; Rainforest Foundation 2016).

Across the Congo Basin, conflicts over the land and use rights of the forest areas have been relatively well documented, as have instances of illegal deforestation associated with corruption and forced displacement of local communities.

WEST AFRICA

Deforestation in West Africa is dominated by smallholder farmers encroaching into the last remaining areas of forest, primarily to cultivate cocoa, although large-scale, export-driven oil palm plantations are increasingly important drivers in **Liberia**. Migration of poor and often landless rural families into degraded forest, thinned by years of over-intensive logging, often leads to the conversion of forests to agriculture. Deforestation is intrinsically linked to non-compliance with national laws and regulations, where concessions are accused of non-payment of taxes, extending concessions beyond permitted boundaries, and a failure to compensate affected parties as required. Human rights abuses and child labor remain a particular problem. The countries that do not have FPIC enshrined in law have been reported to have the most extensive instances of land acquisition by force and intimidation.

Côte d'Ivoire has lost approximately 90 percent of its forests since its independence in 1960, and it lost almost 1 Mha between 2013 and 2019, which accounts for 5 percent of forest loss across tropical Africa during that time. Deforestation in **Ghana** has been so extensive that the country could soon lose all of its forests outside of protected areas; almost 0.5 Mha was lost, accounting for 2 percent of all forest lost in Africa between 2013 and 2019. The governments of Côte d'Ivoire and Ghana identify agriculture as the main driver of deforestation, citing traditional cash crops such as cocoa, cashews, rubber, coffee, palm oil, fruit, and cotton, most of which are grown for export (REDD+ 2017). Indeed, Côte d'Ivoire and Ghana are the world's leading cocoa (Theobromo cacao Mavlaceae) growers, together contributing 60 percent of world production.

In Côte d'Ivoire, up to 40 percent of the nation's cocoa was illegally sourced from inside national parks and protected areas (Higonnet et al. 2018), with one study concluding that 74 percent of protected areas in Cote d'Ivoire had been converted to cocoa (Bitty et al. 2015). **Sierra Leone** lost 1 Mha of forests between 2013 and 2019, contributing 5 percent of Africa's total tropical forests loss. Cocoa and coffee are the country's main agricultural exports, but cocoa reportedly embodies only 1 percent of deforestation (Pendrill et al. 2020). Sierra Leone's increase in deforestation is reportedly due to slash and burn agriculture, firewood and charcoal production, mining, and timber production. Cocoa is also significant in **Nigeria**, where it is the third largest export. The Omo Forest Reserve, in Nigeria's southwest state of Ogun, lost 7 percent of its tree cover between 2001 and 2018 due to illegal cocoa farming (Sunday 2019).

Liberia is the one outlier – at least 14 percent of its deforestation is driven by commercial agriculture concessions, rather than subsistence agriculture, indicating a level of foreign investment in agricultural commodities that is unusual in the rest of West Africa. Liberia lost 1.2 Mha of forest between 2013 and 19,

Voluntary Commitments for Zero Deforestation and Child Labor

In 2017, major companies committed to zero deforestation cocoa under the Cocoa & Forests Initiative (Higonnet et al. 2018), while others also made commitments of a 70 percent reduction in the use of child labor by 2020 (Fountain & Huetz-Adams 2018). Most companies acknowledge the difficulty they have had making significant progress towards achieving these commitments. Deforestation for cocoa continues to be reported as highly associated with human rights abuses, child labor, and use of hazardous pesticides. Cocoa expansion combined with low productivity and price crashes have increased demand for labor at lower wages. An estimated 2.1 million children work in cocoa fields in Côte d'Ivoire and Ghana (Fountain & Huetz-Adams 2018). Cocoa farmers earn an average of US$0.78 a day, significantly below the living wage of US$2.51, and typically lack the bargaining power needed in a sector dominated by multinational companies (Fountain & Huetz-Adams 2018). However, child labor and deforestation pose a significant reputational risk to companies sourcing cocoa from West Africa.

accounting for 6 percent of all of Africa's forest loss during this time. Illegalities in the oil palm concessions include a lack of FPIC (as required by law) and the intimidation of community members, and it is feared that the concessions may contribute to renewed conflict or a return to armed fighting a decade after the civil war ended (Global Witness 2011; UN Panel of Experts 2013).

EAST AFRICA

East African forests are diverse and include transboundary ecosystems, such as montane forests, miombo woodlands, coastal forests, and mangroves (Mwangi et al. 2018). The forests of East Africa contribute significantly to the local economy and livelihoods of rural and poor communities. Most deforestation is driven by subsistence agriculture, though growing urban demand for charcoal and fuelwood is also a factor. Madagascar has experienced the most deforestation (2 Mha) during this period, losing 17 percent of its 2000 forest cover and contributing to 11 percent of forest loss across all of tropical Africa. In Madagascar, all agro-conversion is illegal, but the law is rarely enforced. Like other countries in East Africa, small-scale farming and fuel wood collection drove most of its deforestation (UN-REDD Programme 2016). Extended periods of acute drought in the south of the Madagascar have led to increased numbers and a greater permanence of migrants moving up the west coast, settling, clearing forest for subsistence, and working on new cash crop projects that take advantage of the influx of labor to clear new areas of forest. The rainforests in eastern Madagascar are under increasing pressure from agriculture and mining, with protected areas threatened, and growing lawlessness related to the extraction of natural resources (Whyner 2021).

Deforestation is high in areas with weak management and poor tenure security, such as open access land in Tanzania (0.5 Mha of forest loss between 2013 and 2019) and communal lands in Kenya (less than 10,000 ha of forest loss between 2013 and 2019). In Uganda (less than 40,000 ha of forest loss between 2013 and 2019), deforestation is highest in private forests, with less deforestation in government-managed public forests, especially in protected areas (Mwangi et al. 2018). These fragmented forests are at risk of further degradation without locally adapted policies that respond to the specific needs of diverse governance and community-level drivers present in the region.

CONCLUSION

Between 2013 and 2019, Africa was responsible for 25 percent of global tropical deforestation, with Central Africa responsible for 56 percent of Africa's forest loss, followed by West Africa (22 percent) and East Africa (20 percent). Most of the deforestation in Africa was reportedly for subsistence agriculture, although a few outliers exist, such as Liberia, where at least 14 percent of forest loss was driven by oil palm and timber concessions.

It is likely that the deforestation driven by commercial agriculture and logging is underestimated across Africa. During the reference period of this report, many countries saw a dramatic jump in the reported levels of forest loss, and there is no obvious reason why subsistence farming would drive such an increase, given that population size and diet has not increased at the same pace. Global Forest Watch itself (Curtis et al. 2018) also recognizes that it likely underestimates the role of commercial agriculture because of, for example, the difficulty in distinguishing among drivers of small patches of forest loss, especially when there is a lag between clearing and the planting of cash crops. It may be that many farmers grow crops for themselves and also for some small income. Regardless, it is known that extensive commercial logging causes forest degradation across Africa and deforestation often follows in its wake. At present, the race for timber is at the heart of deforestation in Africa, with palm oil and cocoa for export driving deforestation in parts of West Africa.

Across the board, agro-conversion is intrinsically linked with illegalities, whether it be by large concessions or smaller forest clearings for cash crops destined for domestic markets or longer international supply chains. Government regulations are weak and effective enforcement is hampered by inadequate resources (both financial and human), corruption, and the sheer geographic scale of Africa's forest areas. In most countries, FPIC, international law, and customary land rights are not enshrined in national legislative frameworks, exposing indigenous peoples and local communities to increased risk of dispossession and eviction from their land. Agricultural supply chains face reputational risks of being associated with land grabs and human rights abuses.

With improved transportation networks and enhanced security, it is likely that commercial agriculture will increase, and thus the risk of deforestation and associated illegalities will also increase. Nearly three times as much forest has been lost in the last seven years compared to the first seven years of the century and, if governments and businesses continue to act with impunity, this trend will continue.

6 Asia-Pacific Regional Summary

KEY STATISTICS

Forest loss in tropical Asia-Pacific,[14] 2013-2019:

31% of all forest loss across the tropics

14.6 Gt of CO_2e Total gross emissions from tree cover loss

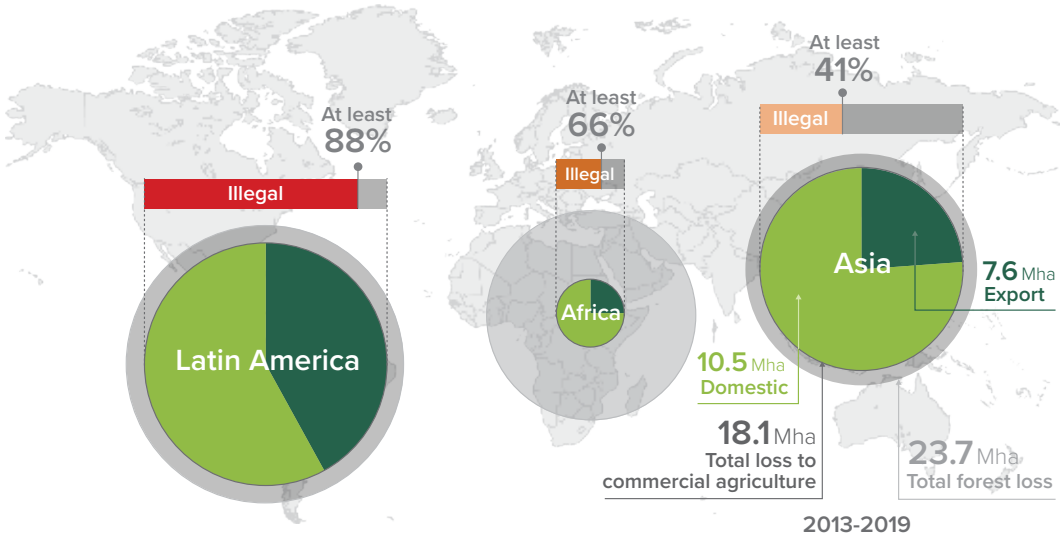
23.7 Mha total loss of tropical forests

of which **76%** due to commercial agriculture

of which at least **41%** likely illegal

at least **42%** likely exported

Figure 17 | Amount of tropical forest loss (Mha) driven by commercial agriculture, by domestic consumption versus export of commodities and minimum proportion of clearing that was likely illegal, Asia-Pacific highlighted



Minimum extent of illegal agro-conversion: 75-100% 50-74% 25-49% 0-24%

Notes: Amount of tropical forest loss driven by commercial agriculture is represented by dark grey circles. The green pie charts represent the minimum proportion of clearing that was likely illegal, with domestic consumption depicted in light green and production destined for export in dark green.

Forest/Forest cover: Forest areas with greater than 50 percent tree cover that are greater than five meters tall.

Forest loss/Deforestation: Complete removal of forest cover (areas with at least 51 percent of tree cover).

Illegal deforestation: Conversion of forests that takes place in contravention of a country's legislative framework (e.g., their laws and regulations) at the time the deforestation took place. Breaches of international or customary law were not included unless they are integrated into national legislation.

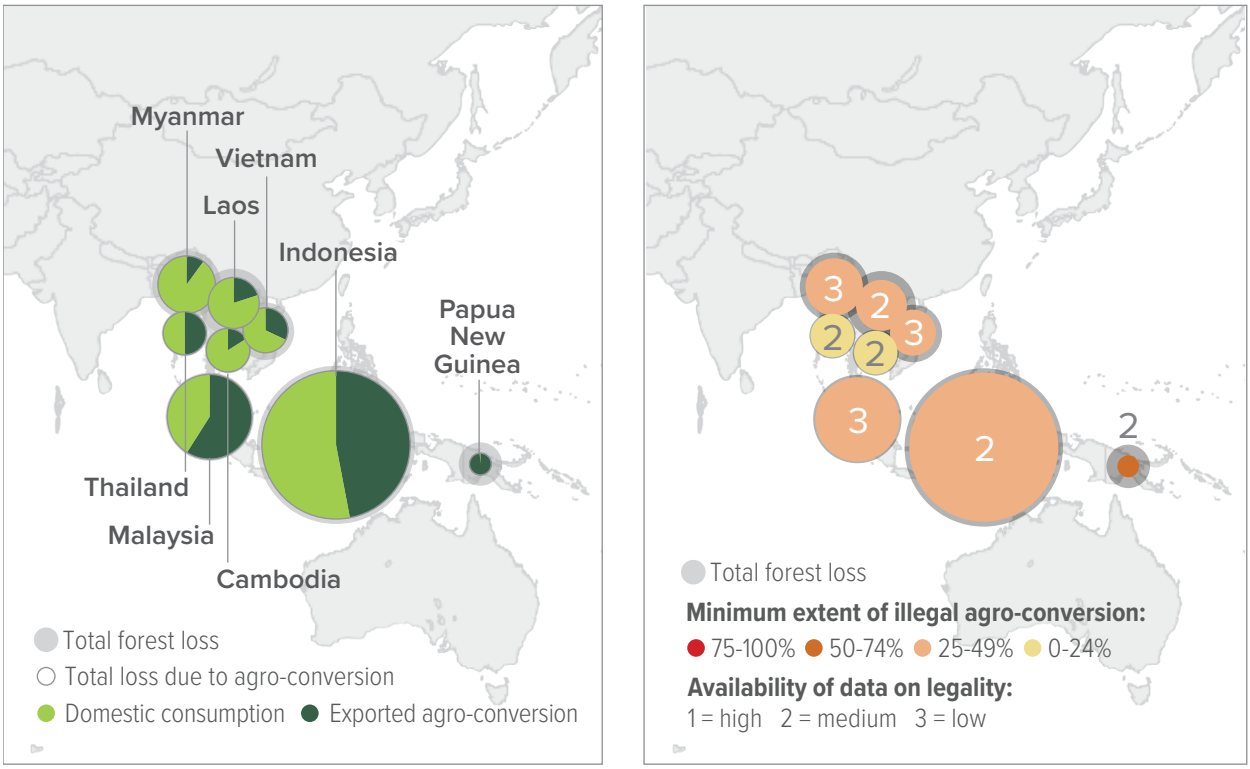
[14] 23 countries in Tropical South Asia, Southeast Asia, and Oceania.

BOX 2

Asia-Pacific: Key Findings

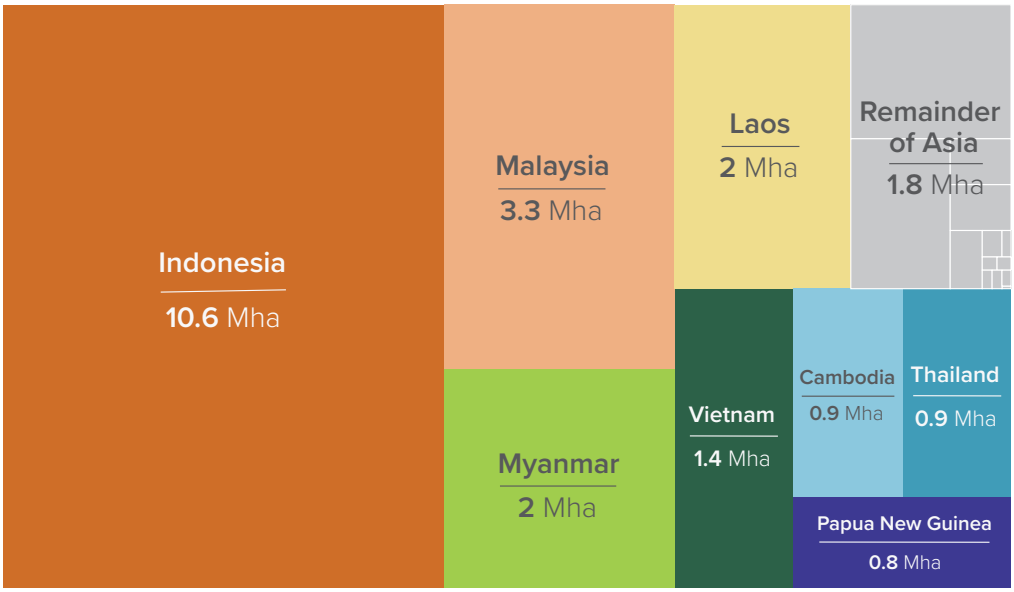
- Between 2013 and 2019, commercial agriculture in Asia-Pacific was likely responsible for the clearance of more than 18 Mha of forest (Figure 17).
  - At least 41% of agro-conversion was likely illegal.
  - Given that 42% of the production linked to this agro-converion was exported, there is a risk that international buyers are linked to the loss of 7.6 Mha of forest and carry a high risk of being linked to illegal deforestation.

Figure 18 | Relative amount of tropical forest loss driven by commercial agriculture across the case study countries in Asia-Pacific and the minimum extent of clearing that was illegal



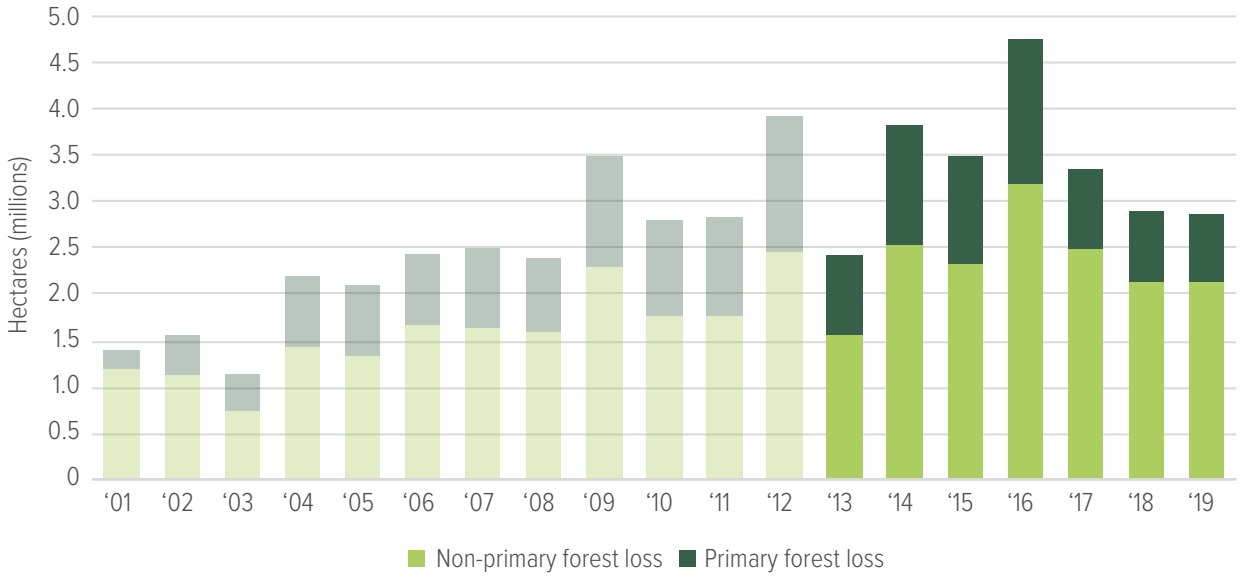
Sources: Forest loss data from GFW (2020, using Hansen et al. [2013]); agro-conversion estimates compiled by Forest Trends (2021) from multiple sources, including GFW (2020, using Curtis et al. [2018]); export/domestic consumption estimates compiled by Forest Trends (2021) from multiple sources, including Pendrill et al (2020) and UNComtrade; illegality data estimates compiled by Forest Trends (2021).

Figure 19 | Distribution of forest loss across tropical Asia-Pacific



Source: GFW (2020, using Hansen et al. 2013).

Figure 20 | Annual forest loss in Asia-Pacific, 2001 to 2019. This report covers the period highlighted (2013-2019)



Source: Forest loss data from GFW (2020, using Hansen et al. [2013]), compiled by Forest Trends.

The Asia-Pacific region was responsible for approximately one-third (31 percent) of all forest loss across the tropics between 2013 and 2019. More than three-quarters (76 percent) was reportedly driven by commercial agriculture, mainly oil palm and pulp plantations, but also cash crops like coffee and chocolate. Approximately 42 percent of the production linked to the agro-conversion was likely for export, and Forest Trends estimates that at least 41 percent of the loss was in violation of local laws and regulations governing forest clearing (Figure 17). The actual amount of illegal deforestation, however, was difficult to determine due to a lack of sector-wide compliance reviews, and thus a lack of publicly available data on rates of illegality (Figure 18).

SOUTHEAST ASIA

Southeast Asia's rainforests are as rich in biodiversity as any other tropical forest, but they are uniquely dominated by a family of tree species of high commercial value (*Dipterocarpacae*). No other tropical forest is comparable. For example, the island of Borneo alone exported as much timber in the 1980s and 1990s as all of South America and Africa combined (Curran et al. 2004). This high density of high value trees has created incentives for plantation or agricultural concessionaires to clear forests to gain revenue before any initial investments in planting are made, even when degraded forests were readily available for planting. This economic incentive has helped drive deforestation, especially of primary forests, across Asia-Pacific. While the situation in each Southeast Asian country varies, the overall regional trends are driven by **Indonesia**, which alone constitutes almost half (45 percent) of all tropical forest loss across Asia during the study period (Figures 19 & 20).

Having lost more than 10.6 Mha of forest, Indonesia was responsible for 14 percent of all forest loss across the tropics, ranking second overall (after Brazil). These losses have been tied to billions of dollars in economic losses, such as those resulting from the El Niño drought-linked forest fires that created massive haze events. Despite these large losses, Indonesia has made great progress in reducing the amount of deforestation since the start of the 21st century, with the Letter of Intent between the governments of Indonesia and Norway, the creation of the Peat Restoration Agency (Badan Restorasi Gambut or BRG), and a 2016 moratorium on the clearing of certain peatlands and areas of primary forest – and augmented by declining rubber and palm oil prices. Because so much of Indonesia's forests are on peatlands – more than any other country in the world – reducing its deforestation has had a dramatic impact on its greenhouse gas emissions. In 2019, Indonesia received almost US$160 million in compensation from the UN Green Climate Fund and the Government of Norway for reducing deforestation and emissions between 2014 and 2017. In 2020, there was concern about the sustainability of such progress after the announcement of government programs designed to counter economic slowdowns caused by the COVID-19 pandemic. Indonesia's Omnibus Law on Job Creation, passed in October 2020, for example, weakens environmental protections and laws related to land use and consultation (Siscawati 2020).

During the study period, Forest Trends estimates that 89 percent of Indonesia's forest loss was driven by commercial agriculture, almost half for oil palm plantations, the rest for pulp, rubber, rice, and a host of other cash crops. Of particular concern is the recent announcement of a 700,000 ha Food Estate project and a 9 Mha agricultural reform program, 4.1 Mha of which is to be "de-designated" from the protected Forest Estate.

A review by Indonesia's Supreme Audit Agency concluded that 81 percent of oil palm concessions violated one or more laws or mandatory management standards. A similar review has not been conducted for Indonesia's other agricultural sectors – or at least not published – but there is evidence of widespread illegality across these sectors as well. Examples of illegality include operating in protected areas, outside concession boundaries, or without permits, and clearing peat forest protected by the peatland moratorium.

NGOs, like the Anti Forest Mafia Coalition, have prepared numerous reports on illegality in the commercial agriculture sectors, and in 2018, Greenpeace severed its five-year relationship with Sinar Mas/Asia Pulp & Paper due to concern about fires in oil palm and pulp plantations. Indigenous Adat communities report widespread violations of legal requirements for compensation and benefits sharing, not to mention FPIC. This leads to conflict between communities and companies; the Government of Indonesia (2020) reports that 27 percent of pulp plantations do not have active management, often because of conflicts with locals. Furthermore, corrupt politicians have used concession permits to improve their chances in local elections, and companies are avoiding deforestation taxes and other fees.

Given these reported violations, it is clear that illegality linked to agro-conversion is widespread. Almost half of Indonesia's production of these commodities are exported. Exports linked to deforestation include 12 Mt of palm oil (worth US$6 billion in 2019 alone), US$3 billion worth of pulp, and US$2 billion of paper.

Similar dynamics occur across **Malaysia** at a smaller scale; 3.3 Mha of forest was lost between 2013 and 2019, or 4 percent of all forest loss across the tropics (fourth overall). Almost all of this forest loss was reportedly driven by commodities, two-thirds by oil palm. Pulp plantations, rubber, rice, and other crops comprised the rest. Patterns were similar across Peninsular and Bornean Malaysia. Logging concessions have been granted during the COVID-19 pandemic, reportedly in violation of FPIC requirements.[15] Like Indonesia, reports of illegality related to forest clearing are widespread, but there have been no legal reviews of the sector (other than a review by the Sabah Forestry Department that found only two-thirds of 37 Forest Management Units, allocated to more than 1.8 Mha, could meet even the minimum standards. Four had to be terminated altogether). Given that commodities drive almost all deforestation, a comprehensive review would help evaluate the actual rate of illegality across the sector. Regardless, in 2019, Malaysia exported at least US$6.5 billion in palm oil, US$9.6 million in pulp, and US$726 million in rubber, all linked to deforestation, much of it potentially illegal.

MEKONG

The Mekong countries lost 7.2 Mha of forest between 2013 and 2019, or 30 percent of all of Asia-Pacific's forests, of which 69 percent was likely driven by commercial agriculture.

Myanmar lost almost 2 Mha of forest, almost 5 percent of its forest cover between 2013 and 2019. Forest Trends estimates that 68 percent was driven by expansion of commercial agriculture. Over the past twenty years, agricultural licenses have reportedly been used to gain access to conversion timber, often without any intention of developing an agricultural concession, and the issuing government agencies use legal loopholes and exemptions to bypass the legal intent. The Government has allocated over 2.1 Mha in agricultural concessions by 2013, but less than half were being cultivated a few years later, suggesting that conversion timber and land grabbing were likely the real motivation. In the Tanintharyi Region, 1.9 Mha have been allocated to palm oil plantation companies, while Mon, Tanintharyi, and Kayin account for 68 percent of the area under rubber.

The main crops embodying deforestation are rice, maize, pulses, and beans, grown mostly for the domestic markets. Specific cases of illegality have been documented, such as clearing more than the maximum permitted area, failing to start cultivation within the legally required timeframe, or the payment of bribes, but no formal review has been published. A comprehensive compliance audit of the sector would help to establish the actual rate of compliance with national laws and regulations. Even before the coup in February 2021, buyers reported difficulties undertaking due diligence to ensure no illegally harvested wood products enter their supply chains, and the same will hold true for efforts to assess and mitigate the risk of buying commodities associated with illegal deforestation.

Cambodia has experienced vast and rapid destruction of its forests: reduced from 73 percent of the country's area in 1965 to 46 percent by 2020. Forest Trends estimates that 89 percent of forest loss between 2013-2019 has been driven by commercial agriculture, both large and small-scale. From 2001, the Cambodian Government granted up to 2.6 Mha for large scale agriculture for export, but reversed course in 2012, when it put a moratorium on new Economic Land Concessions (ELCs) and partially revoked poorly performing

[15] More details on FPIC requirements in Malaysia and other countries that have incorporated it into law can be found in Annex 2.

ones, reducing their total extent to 1.2 Mha. Forest cover in ELCs had been reduced to 16 percent by 2017, but forest everywhere in Cambodia is under threat, even in protected areas. For example, 70 percent of the Snoul Wildlife Sanctuary was illegally converted to rubber plantations (Warren-Thomas et al. 2015).

Agriculture by smallholders is also a major cause of forest loss, largely driven by the migration of land-poor farmers from the lowlands to the peripheral uplands (Ingalls et al. 2018). More forest has been cleared for rice, cassava, soy, beef, and maize than for rubber, and 16 percent of commodities embodying deforestation are exported (Pendrill et al. 2020). Illegality is high for any commodity produced in ELCs as these are widely recognized to be "mechanisms for the Cambodian ruling elite to enable land grabbing, clear-cutting and selling of high value timber," and only a few are compliant with requirements to have Environmental Impact Assessments (Beauchamp et al. 2018; Open Development Cambodia 2020). Converting forest to agriculture is also used to gain land title in the forest frontier areas of Cambodia – timber extraction subsidizes new crops, and planting demonstrates active use of land that is required to gain title. The primary objective is to sell the land rather than to farm it. There has been a rush of seizures of public forest land, and speculation by powerful outsiders has driven the purchase of public forest and turned it into private agricultural land (Mahanty & Milne 2016).

Like Cambodia, **Laos** has promoted the agricultural concession model for economic development, with corresponding high levels of deforestation. Laos has lost nearly 2 Mha of forest between 2013 and 2019, and commercial agriculture has been a major driver, causing 56 percent of Laos' forest loss during this time. Non-compliance with national laws and regulations are estimated at 98 percent of all concessions and leases, based on a review of legal compliance with six fundamental aspects of the legal framework (Hett et al. 2020). Many aspects of illegality are documented, such as corruption and bribery in granting concessions, size exceeding maximum limits, lack of environmental impact assessment, failure to pay compensation due to villagers, and clearance of forests beyond concession boundaries. Illegality of smallholder agro-conversion is not well documented and requires further research. Forest Trends conservatively estimates that 49 percent of agro-conversion is illegal, based on land leases and concessions, which account for roughly half of Laos' forest loss. This assumes a "best case scenario," in which all the deforestation occurring outside these concessions and leases is legal. In reality, it is likely that at least some – albeit a presently unknown amount of – agricultural land formerly zoned as forestland was illegally converted.

Rice is the main deforestation risk commodity, but it is consumed domestically. Among the other commodities embodying deforestation, such as maize, sugar, and coffee, exports are low, with about 20 percent of production likely exported overall.

Vietnam is unusual in the region with a net increase in its forest area to 14.6 Mha in 2020, according to government definitions. Forty-seven percent of the country is now covered in forest, up from 13.4 Mha in 2010 (FOA FRA 2020). Despite this overall net increase, Vietnam still suffered a gross loss of 1.4 Mha of forests between 2013 and 2019 (GFW 2020). Vietnam's forest sector was reformed and decentralized shortly after its move to a market-oriented economy, and by 2015 the state claimed ownership of 45 percent of the country's forest, down from 80 percent in 2000 (Open Development Mekong 2020). Wood plantations (mainly Eucalyptus and Acacia varieties) were a large driver of deforestation in the 1990s, while native varieties have been promoted more recently by the government. The area of land planted with rubber expanded between 2013 and 2019, increasing by over 140,000 ha (FAOSTAT 2020). The Central Highlands have suffered rapid deforestation during this period, partly the result of large government-backed programs to support migration from the lowlands. The migrants work on coffee and cassava plantations (probably legally de-zoned forestland), and in turn displace the ethnic minority groups who move into the forest and clear it for agriculture (probably illegal because they do not have land title certificates), making plantations indirectly responsible for further deforestation.

OCEANIA

Papua New Guinea (PNG) had over 40 Mha of forest in 2019, covering 79 percent of the country. But 2 percent of its forest cover was lost between 2013 and 2019. Forest Trends estimates that 30 percent of this forest loss was driven by commercial agriculture, but agricultural permits are being used to fraudulently gain access to high-value conversion timber. Two types of permits, Forest Clearance Authorities (FCAs) and Timber Authorities (TAs), allow clear cutting of forest for plantations, but in many cases, crops are never planted because the loggers' primary purpose is to export timber they would not otherwise be able to obtain logging permits to access. High levels of illegality are likely, given that many of the FCAs and TAs are issued on the same sites as Special Agriculture Business Leases (SABLs), which were mostly found to be illegal themselves after a 2012 investigation by a Commission of Inquiry. Despite government promises to revoke all SABLs, logging on these areas continued under the FCAs and TAs. Investigations by Global Witness found evidence of widespread illegality; communities, who hold collective title, had not given their consent for their land to be leased, and witness statements described threats and intimidation, pollution of water sources, and forest clearing beyond the concession boundaries.

A high proportion of logs currently being exported out of PNG were harvested under agricultural permits. In 2019, US$472 million of palm oil and US$7 million of rubber were exported, and there is a high risk that these exports were grown on illegally cleared land. As elsewhere in the Asia-Pacific region, buyers have struggled to implement enhanced due diligence to ensure that purchased timber and commodities were not contaminated by a link to illegal deforestation.

CONCLUSION

More than three quarters (76 percent) of deforestation in Asia-Pacific was driven by commercial agriculture. Palm oil, pulp plantations, rice, beef, and rubber are the top commodities linked to deforestation. Across the region, there are widespread cases of illegal agro-conversion but almost no publicly available compliance audits that systematically evaluate illegality. Given the lack of data, Forest Trends could only confirm that at least 41 percent of agro-conversion is illegal. However, this is likely a conservative figure, because in other areas where comprehensive audits have been completed, non-compliance was found to be significantly higher (e.g., in the oil palm sector in Indonesia, greater than 80 percent of agro-conversion was found to be non-compliant).

Palm oil is the biggest forest risk commodity in Asia-Pacific. Between 2013 and 2017, it was linked to more than 2.3 Mha of deforestation in the eight case studies reported here (Pendrill et al. 2020). Southeast Asia has 80 percent of the world's palm oil plantations – 38 percent of production in Indonesia was linked to deforestation, and 68 percent in Malaysia (Descals et al. 2020; Meijaard et al. 2020). While Indonesia's Supreme Audit Agency ruled that 81 percent of oil palm concessions broke the law or failed to comply with mandatory standards, in Malaysia no such review has been conducted and it is not possible to estimate how much clearance for palm oil has been illegal. However, both Indonesia and Malaysia have mandatory sustainable palm oil standards and "No Deforestation, No Peat, No Exploitation" (NDPE) policies are being implemented on 72 percent of their palm oil refining capacity (Chain Reaction Research 2020). In recent years, the deforestation for oil palm appears to be decreasing. However, demand for vegetable oils is predicted to rise, reinforcing the need to redouble efforts to halt forest clearance for oil palm (Descals et al. 2020).

Pulp plantations are also plagued with accusations of illegality, including widespread violations of indigenous

peoples' rights. Abuse of indigenous and local communities' land rights and land conflicts were found in all the country case studies (Annex 3). Indonesia has experimented with the Jurisdictional Approach to more sustainable and equitable land use and this approach is seen as an opportunity to clarify rights and tenure, resolve disputes, and enforce sustainability requirements (Seymour & Harris 2020; Colchester et al. 2020). Subnational initiatives such as this show promise at a time when national environmental legislation is weakened in the name of COVID-19-related economic stimulus.

Asia-Pacific accounted for over half (53 percent) of all exported agricultural conversion between 2013 and 2019, giving consumer countries leverage and the opportunity to limit the import of commodities grown on deforested land. Given that so many agricultural commodities produced in Asia-Pacific are linked to agro-conversion and carry a high risk of contamination with illegal clearing, consumer countries must practice enhanced due diligence commensurate with this risk if they do not want to be complicit in the production and distribution of illicit goods.

7 Conclusion

In summary, the evidence presented in this report reveals an ugly truth: illegal agro-conversion and the subsequent illegality of agricultural commodities produced on that converted land remains a global problem that has been getting worse.

While some geographies have taken tentative steps forward, others have experienced backsliding. To date, the overall picture is that reaching zero agro-conversion is getting harder, not easier. The average annual rate of tropical forest loss reportedly increased from about 7.3 Mha per year in the first 12 years of this century to more than 10.9 Mha per year more recently (GFW 2020; using Hansen 2013). Forest Trends found that 60 percent of this tropical forest loss (more than 6.5 Mha per year) was driven by commercial agriculture, an increase of more than 28 percent in the average annual rate of agro-conversion over the previous period (5.1 Mha per year), even though the proportion of deforestation attributable to agro-conversion decreased somewhat (Forest Trends 2014). At least 69 percent of agro-conversion (at least 4.5 Mha per year) was conducted in violation of national laws and regulations, an increase of 28 percent in annual rate (from 3.5 Mha per year from 2000 to 2012).

This rate of forest loss need not and must not continue. There is already enough land in agricultural production worldwide to provide a healthy diet to a growing human population for decades into the future (EAT 2019); the services forests provide to people are too valuable and irreplaceable to keep sacrificing (Dasgupta 2021); and countries cannot meet global climate goals without dramatically reducing deforestation (Griscom et al. 2017).

While the findings of this report seem dire, there is hope for successful governance and rule of law in the land sector. Hope comes from many directions and proves what is possible, from Brazil's success in the 2000s reducing deforestation and Indonesia's more recent progress resulting in significant international compensation for its emissions reductions, to the continued leadership from some corners of industry and an increasing global political focus on natural climate solutions.

These examples are good reminders that successful governance and rule of law in the land sector are hard-won but possible on national scales. However, the commercial agriculture sector in the tropics still needs to undergo a serious transformation towards legality. In a forthcoming report, Forest Trends will propose a path forward for curbing illegal land-use change and advancing forest country objectives for zero deforestation. In the meantime, this report shows that too much of the world's agricultural production and trade carries a high risk of including illicit harvests, leaving companies and their customers complicit in tropical forest loss and trafficking in illegal products.

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Acronyms

BRG	Badan Restorasi Gambut (Peat Restoration Agency, Indonesia)
CAR	Cadastro Ambiental Rural (Rural Environmental Registry of Brazil)
CO_2	Carbon dioxide
CO_2e	Carbon dioxide-equivalent (all gases)
DRC	Democratic Republic of Congo
ELC	Economic Land Concession (Cambodia)
EU	European Union
FAO FRA	Food and Agriculture Organisation of the United Nations — Global Forest Resources Assessment
FCA	Forest Clearance Authority (Papua New Guinea)
FPIC	Free, Prior, and Informed Consent
FRC	Forest Risk Commodity
GAIN	Global Agricultural Information Network of USDA
GHG	Greenhouse gas(es)
GFW	Global Forest Watch
Gt	Gigaton
ha	Hectare
IDEAM	Institute of Hydrology, Meteorology and Environmental Studies (Colombia)
KPK	Komisi Pemberantasan Korupsi (Corruption Eradication Commission of Indonesia)
ILO C169	International Labour Organization (ILO) Convention 169
LAC	Latin America and the Caribbean
m3	cubic meter
Mha	Million hectares
Mt	million metric tonnes
NDPE	No Deforestation, No Peat, No Exploitation
PRODES	Programa de Cálculo do Desflorestamento da Amazônia (deforestation monitoring service, Brazil)
PNG	Papua New Guinea
REDD+	Reducing Emissions from Deforestation and forest Degradation plus the sustainable management of forests
SABL	Special-purpose Agricultural and Business Leases (Papua New Guinea)
TA	Timber Authorities (Papua New Guinea)
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
USDA	United States Department of Agriculture

Glossary

>50% canopy: Tree cover of 51 percent or more is the threshold used in this report to define forest areas to keep a focus on well forested landscapes that provide important ecosystem services locally (e.g., pollination, maintaining water cycles, etc.) and globally (especially as carbon sinks helping mitigate climate change).

>50% tree cover loss: The loss of more than 50 percent of forest canopy.

Agribusiness: Large-scale agricultural businesses and their supply chains.

Agro-commodities: Commercially produced agricultural commodities, including crops, livestock, and products from tree plantations.

Agro-conversion: Loss of forest driven by commercial agriculture.

Amazonia: Brazil's Legal Amazon (see below).

Biodiversity hotspot: Region meeting two criteria of containing 1) at least 1,500 endemic vascular plants and 2) 30 percent or less of its original natural vegetation. Thirty-six biologically rich, threatened regions are globally recognized as biodiversity hotspots and comprise 2.4 percent of the Earth's surface (Conservation International 2020).

Brazil's environmental debt: Areas defined under the Brazil 1965 Forest Code as Legal Reserve and Riparian Preservation Areas that were deforested illegally before 2008 and would have required restoration at the landowner's expense (Soares-Filho et al. 2014).

Caatinga: Semi-arid biome in Northeastern Brazil, bordered by the Amazon, Cerrado, and Atlantic Forest biomes.

Central Africa: Countries of Angola, Burundi, Cameroon, the Central African Republic, Chad, Democratic Republic of Congo (DRC), Equatorial Guinea, Gabon, Rwanda, and the Republic of Congo.

Cerrado: Wooded savanna covering 12 vegetation types in Central Brazil and parts of Bolivia and Paraguay. It borders the Amazon, Caatinga, Atlantic Forest, and Pantanal biomes.

Chaco: Sparsely populated, hot, and semi-arid lowland forest ecosystem of the Río de la Plata basin, divided among eastern Bolivia, Paraguay, northern Argentina, and a portion of the Brazilian states of Mato Grosso and Mato Grosso do Sul. Second largest forest system in South America, after the Amazon.

Chiquitano: Dry forests of Bolivia and Brazil with trees that lose their leaves during the dry season and are generally resistant to flooding and fire.

Congo Basin/Congo River Basin: Countries of Cameroon, the Central African Republic, the Democratic Republic of Congo (DRC), Equatorial Guinea, Gabon, and the Republic of Congo.

CO_2e emissions: This report quantifies the amount of greenhouse gas emissions (expressed in mega-tonnes (Mt) of carbon dioxide equivalent emissions) caused by tree cover loss, as reported by Global Forest Watch (2020, using methodology from Harris et al. 2021).

Commercial agriculture: Large- or small-scale, including crops, pasture (mainly cattle), and monoculture tree plantations. Excludes subsistence farming.

Community forestry: Forest operations where the local community plays a significant role in land use decision-making and forest management. Communities may, depending on national legislation, possess a bundle of rights (usually access, use, management, or full ownership) to land under community forestry.

Concession: A grant of land or property by a government or some other controlling authority to another legal entity (usually a large company) in return for payment or services. Sometimes concessions are allocated through a competitive process, such as auctions.

Conversion timber/wood: Timber generated during the conversion of natural forest areas to non-forest or plantation use, such as the clearance of a forest to make way for commercial agriculture.

Deforestation: Complete removal of forest cover, which is defined in this Glossary as the removal of at least 51 percent of forest cover.

Deforestation alert: A report on a disturbance in the forest canopy that indicates a likely deforestation event.

Embodied deforestation: The amount of deforestation linked to the production of a given amount of an agricultural commodity.

Endemic species: Plants and animals that are naturally found in only one geographic region on Earth.

Environmental Impact Assessment: A regulatory process used to predict the environmental consequences of a plan, policy, program, or project, and develop a time-bound plan with specific objectives to mitigate these consequences.

Forest/Forest cover: Forest areas with greater than 50 percent tree cover that are greater than five meters tall.

Forest degradation: The process of human-caused loss of forest biomass, resources, and environmental services without a complete loss of forest cover.

Forest loss: The complete removal of forest cover (which is defined as forest areas with greater than 50 percent tree cover).

Fraud: In law, the act of intentionally deceiving someone in order to gain an unfair or illegal advantage (financial, political, or otherwise). Countries usually consider such offenses to be criminal or a violation of civil law.

Free, Prior, Informed Consent (FPIC): The right of communities (particularly of indigenous peoples) to give or withhold their "consent" for any action that would affect their lands, territories, or rights (including those that affect customary ownership, occupation or other use). "Free" indicates that consent cannot be given under force or threat. "Prior" indicates that relevant information must be provided with enough time to review it before consent is decided. "Informed" means that the information provided is timely, detailed, emphasizes both the potential positive and negative impacts of the activity, and is presented in a language and format understood by the community. "Consent" refers to the right of the community to agree or not agree to the project before it commences (UNDRIP 2013).

Gross deforestation: Loss of forest cover, without consideration of regrowth or reforestation.

Illegal deforestation: Conversion of forest that takes place in contravention of a country's legislative framework (laws, regulations, instructions, and any other legal instrument that penalizes non-compliance) at the time the deforestation took place. For purposes of this report, conversions that were "legalized" after the fact (through amnesties, legal amendments, for example), after prosecution, or by paying a fine, are not considered to have been conducted in compliance with the rule of law. This report does not include breaches of international

law or customary law unless they are included in national statutory or case laws. This definition encompasses two general categories: illegalities in licensing and illegalities in forest clearance.

Land grabs: As defined by the Tirana Declaration, large-scale land acquisitions that are one or more of the following: in violation of human rights, particularly the equal rights of women; not based on FPIC; not based on a thorough assessment, or in disregard of, social, economic, and environmental impacts, including the way they are gendered; not based on transparent contracts that specify clear and binding commitments about activities, employment, and benefit sharing, and/or; not based on effective democratic planning, independent oversight, and meaningful participation (Taylor 2012). Three categories of land grabs have been identified: 1) Tainted lands is a term employed by the UN Special Rapporteur on the Right to Food to describe land obtained "through corrupt means, such as bribing public officials or community leaders…, or failing to ensure the land was acquired by the seller through legal and transparent means"; 2) forced eviction is defined broadly by the UN Committee on Economic, Social and Cultural Rights as "the permanent or temporary removal against their will of individuals, families and/or communities from the homes and/or land which they occupy, without the provision of, and access to, appropriate forms of legal or other protection;" and 3) project-induced displacement refers to communities and individuals being forced out of their homes, and often their homelands, for the purposes of economic development.

Large-scale commercial agriculture: Corporate- or family-owned holdings that are far above the national average in size (only 3 percent of farms are larger than 10 ha worldwide) and employ a waged labour force (Lowder et al. 2016).

Legal Amazon: Brazilian states of Rondônia, Acre, Amazonas, Roraima, Pará, Amapá, Tocantins, Mato Grosso, and Maranhão west of 44º W. It includes three biomes: all of Brazil's Amazon biome, 37 percent of the Cerrado, and 40 percent of the Pantanal.

Legal Reserve (Brazil): As defined in Federal Law 12.651/2012, "areas located within a property or rural possession, defined under Art. 12, with the function of ensuring sustainable economic use of the natural resources of rural property, assisting the conservation and rehabilitation of ecological processes and promoting the conservation of biodiversity, as well as sheltering and protecting native wildlife and flora." All Brazilian rural property owners are required to keep a certain percentage of their land in forest cover or its native vegetation. These Legal Reserves should not be less than 80 percent of the total area of the property in the Amazon biome, 35 percent in the Cerrado, and 20 percent in other biomes. They must also be included in Brazil's Rural Environmental Registry (CAR).

Net deforestation: Gross deforestation minus the area in which regrowth/reforestation has occurred.

Pantanal: Wetlands biome in Brazil's Mato Grosso and Mato Grosso do Sul, bordering on Cerrado, Atlantic Forest, Chaco, and Chiquitano.

Permanent Preservation Areas (Brazil): As defined in Federal Law 12,651/2012, "a protected area covered or not by native vegetation, with the environmental function of preserving water resources, landscapes, geological stability and biodiversity, facilitating gene flows of fauna and flora, protecting the soil and ensuring welfare of human populations," which must be demarcated within all rural properties in Brazil and included in the Rural Environmental Registry (CAR).

Program to Calculate Deforestation in the Amazon (PRODES, Brazil): The government satellite monitoring program that produces data that are considered Brazil's official national statistics on deforestation. PRODES Amazon monitors clear cut deforestation between August 1 to July 31 each year in the Brazilian Legal Amazon. PRODES Cerrado monitors deforestation in the Cerrado biome, but excludes the areas overlapping the Legal Amazon. PRODES Amazon detects deforestation of areas larger than 6.25 ha in forests classified as primary

forest. PRODES Cerrado detects the deforestation of primary forest, savannas, and grasslands (or classified as such since 2000) from areas larger than one ha.

Plantation timber/wood: Forest products obtained from areas established by planting and/or artificially seeding, as opposed to those originating from natural forests.

Quilombola: Descendants of Afro-Brazilian slaves in Brazil.

Tree Cover Loss: Stand level replacement of vegetation greater than five meters tall.

Tropical forest: All forest found in tropical areas. Tropical forests represent less than 15 percent of the Earth's terrestrial surface yet support more than half of the planet's species. They also play a disproportionately large role in determining climate due to the vast amounts of carbon and water they store and exchange with the atmosphere (Reed et al. 2020).

Appendices

Appendix 1 Methodology

This study estimates illegal deforestation for purposes of commercial agriculture in the tropics, and associated exports of key agricultural commodities from 2013 to 2019. More specifically:

- The amount of tropical forest loss that was driven by agricultural commodities, linked to illegal clearing, and exported. All findings were then converted into estimates of greenhouse gas emissions.
- The amount of exports that are linked to deforestation and are at risk of contamination by illegal clearing. Data from 2019 was used to calculate the volume and value of exports of the ten major agro-commodities linked to deforestation and/or risk contamination by illegality: beef and leather, palm oil, soy, pulp and paper, rubber, cocoa, coffee, and maize.

PART 1
Estimating illegal deforestation for commercial agriculture and associated trade

To estimate tropical deforestation driven by the illegal clearing of forest lands for commercial agriculture and then calculate associated trade of agricultural commodities, Forest Trends followed the following steps:

Step 1: Estimating tropical forest loss, 2013–2019 (Variable A)

Collecting the most recent data available from 2013 to 2019 on area of forest lost in tropical countries was the first step in estimating the area of tropical forest lost due to illegal commercial agriculture.

"Forests" were defined as lands having more than half of their area covered by vegetation taller than five meters.[16] This focuses findings on well forested landscapes (like primary forests) that provide important local and global ecosystem services. "Deforestation" was defined as the complete loss of trees in a forested area. Deforestation and forest loss are used interchangeably.[17] The report also covers all forest types found in tropical countries, not only tropical rainforests but others such as the dry forests of the Brazilian Cerrado or the Gran Chaco of South America.

[16] There are more than 800 definitions of forests in the literature (Harris et al. 2016). For example, FAO FRA (2020) coverage of Brazil defines forests as having at least 10 percent tree cover, and Pendrill et al. (2019) use a 25 percent threshold. Plantations were included in Forest Trends' definition as their loss has impacts on many ecosystem services that will not be replaced for years (e.g., as a carbon sink that will not recover until the plantation begins to mature).

[17] This study also defines deforestation differently from others. For example, FAO FRA (2020) defines deforestation "as the conversion of forest to other land uses (regardless of whether it is human-induced)." Curtis et al. (2018), in contrast, define deforestation as the permanent conversion of forest by humans to agriculture, mining, energy infrastructure, and urbanization, although they exclude shifting cultivation (subsistence agriculture). Their definition aims to differentiate deforestation driven by human causes from natural forest loss, and to differentiate temporary loss (to wildfire, for example) from permanent conversion (to commercial agriculture, for example). Forest Trends chose not to make such a differentiation in this study. Given that the final year of analysis is 2019, it is too soon to draw conclusions about the permanence of any forest loss. This is why deforestation and forest loss are used interchangeably in this report.

Figure A1 | Loss of tropical forests with over 50 percent tree cover, 2013-2019

Notes: Green shading indicates forest cover in 2010. Red shading indicates forest loss since 2013.
Source: GFW 2020, using Hansen et al. 2013

The amount of forest loss for each tropical country was obtained from the Global Forest Watch (GFW 2020) database of annual change in tree cover between 2013 and 2019, inclusive for all forests with greater than 50 percent canopy cover – both primary and secondary forests and plantations (Figure A1). Plantations were 8 percent of all forest loss over this period.

The GFW data is based on the methodology of Hansen et al. (2013), which measures tree cover loss at approximately 30 by 30 meters of resolution, generated "using multispectral satellite imagery from the Landsat 5 thematic mapper (TM), the Landsat 7 thematic mapper plus (ETM+), and the Landsat 8 Operational Land Imager (OLI) sensors…[T]he satellite images were assembled and a supervised learning algorithm was applied to identify per pixel tree cover loss."

Forest Trends corroborated overall results by substituting it with FAO FRA (2020) forest loss data. FAO FRA reports deforestation annually since 2015, and every five years before that. Thus 60 percent of forest lost from 2010 to 2015 was used to estimate loss for 2013 to 2015. (Note: For the few countries where FAO FRA does not report deforestation, net change in forest cover was used instead.)

Step 2: Estimating percentage of forest loss linked to commercial agriculture (Variable B)

The second step was to estimate the percentage of tropical forest loss that was driven by commercial agriculture during the reference period (2013-2019).

The study defines "commercial agriculture" as crops, pasture (mainly cattle), and monoculture tree plantations, whether large- or small-scale, but excludes land used for subsistence farming.

The study used the GFW (2020) database, which uses the methodology of Curtis et al. (2018) for drivers of forest loss in each country. However, for the countries most affected by deforestation, Forest Trends conducted 23 country studies (Annexes 1-3). This is because Global Forest Watch may underestimate the importance of commercial agriculture as a driver of tropical forest loss (Box A1). It was also important to recognize that all forest monitoring systems have challenges based on data availability, scale of applicability, scope, and methodology. Thus, for those countries that comprised at least 85 percent of all tropical forest loss, [18] Forest Trends reviewed the literature and spoke to experts to obtain more accurate estimates of national drivers of deforestation. These country case studies include the 23 countries – 21 countries[19] with the most forest loss and Honduras and Ghana (selected for further commodity analysis). The 101 countries that comprise the "rest of the world" made up the remaining 13 percent of tropical forest loss.[20]

[18] According to FAO, these countries comprise 87% of all of the tropical forest loss from 2013 to 2019.
[19] Papua New Guinea was included in the report to maintain consistency and allow comparision with Forest Trends' 2014 report "Consumer Goods and Deforestation."
[20] According to FAO, (which differs from GFW in definition of both forests and deforestation) the countries categorized in this study as the "rest of the world" comprise 29% of all of the tropical forest loss during 2013-2019.

BOX A1

Challenges in Using Forest Monitoring Data

The GFW and Hansen methodologies aim to provide an unbiased proxy for tropical deforestation using a globally consistent forest definition and methodology (Harris et al. 2018). Over time, satellite imagery has drastically improved abilities to monitor changes in forest cover, but such changes complicate evaluating temporal (longitudinal) trends.

In 2015, GFW began to use "images from Landsat 8, a new generation of the satellite launched by NASA in 2013. The sharp new Landsat 8 images, combined with Landsat 7, helped re-calibrate the mapping algorithms to be more sensitive to change." (Potapov et al. 2015) GFW was able to combine new algorithms to revise data, using images obtained back to 2011. These advances improved, for example, detection of clearing of short cycle plantations and, in Brazil, rotation in forest plantations and clearing of the Cerrado. On the whole, the changes increased the amount of deforestation detected compared to previous analyses, but "the reprocessing of 2011 and 2012 involves different data and techniques than those from the original 2001-2010 data, and therefore users should be cautious when comparing across those time periods" (Potapov et al. 2015). This also means that caution should be used if comparing the results in this report (covering 2013-2019) to those of the initial Forest Trends (2014) report (which covered 2000-2012).

Differences between GFW/Hansen and FAO FRA

FAO Forest Resources Assessment (FRA) reporting is based on "the best available official statistics" submitted by sovereign governments and is not spatially explicit (FAO 2014), whereas GFW is based on analysis of satellite imagery (described above). Moreover, the two definitions of forest differ (Harris et al. 2016); GFW is expansive (as noted above, it covers all trees, including oil palm plantations, for example), whereas FRA's definition of forests includes land designated as "forest use," even if it is temporarily devoid of trees (e.g., areas recently logged or burned). Therefore, FRA requires permanent forest loss to be considered deforestation, whereas GFW focuses instead on tree cover loss (temporary or otherwise). "Critics of FRA claim that FAO's "net forest change" statistic provides an overly optimistic view of global forest trends, since loss of natural forests, rich in biodiversity and carbon, can be offset by expansion of tree plantation monocultures. Meanwhile, critics of GFW claim that satellite-based monitoring of "tree cover loss" creates an overly pessimistic view, since these data lump together permanent and temporary loss of tree cover within natural forests and tree plantations and do not take into account tree cover gain." (Harris et al. 2016)

Using GFW and Hansen data for this report means findings may be conservative

Overall, it is likely that in many areas in the tropics, the GFW estimate of the importance of commercial agriculture as a driver of tropical deforestation is generally conservative. There are four major caveats regarding the accuracy of GFW's measures of the drivers of deforestation used in this analysis:

(continued)

Challenges in Using Forest Monitoring Data *(continued)*

1) GFW's commodities category does not overlap completely with this report's focus on commercial agriculture. The GFW dataset assigns the dominant driver of forest cover loss at a 10-kilometer (km) resolution, classifying forest cover loss occurring in each grid cell as either commodity-driven deforestation, shifting cultivation, forestry, wildfire, or urbanization (Goldman et al. 2020). The definition for commodities includes all commodities, not just those from commercial agriculture. However, the non-agriculture component (e.g., mining), is likely a relatively small footprint compared to agriculture (e.g., in Indonesia, between 2001 and 2016, mining contributed only 2 percent of deforestation (Austin et al. 2019)). So, while the GFW commodities category may not overlap perfectly with commercial agriculture as defined in this report, any over-estimation is likely to be small.

2) GFW recognizes that the accuracy of their drivers-algorithm varies regionally (Table S6 in Curtis et al. 2018). For example, while 94 percent of the area classified as commodity-driven deforestation was reportedly accurate for Latin America, in Africa only 31 percent of the area classified as commodity-driven was accurate, mainly because the model misidentified 42 percent of the forest loss as due to shifting agriculture, rather than driven by commercial agriculture. The Hansen data also may underestimate the conversion of dry forest and woody savannah, like the Cerrado and Chaco in South America (Goldman et al. 2020). All this makes the GFW drivers database a conservative estimate of the importance of commercial agriculture in driving national patterns of deforestation.

3) Hansen data[t] may miss small openings caused by the production of commodities, like cocoa and coffee, which often occur on very small (<1 ha) farms (Goldman et al. 2020). This too may cause GFW to underestimate deforestation driven by commercial agriculture.

4) There is often a time lag between forest clearing and subsequent land use, as it takes time for planting and the growth of crops to become of a sufficient size to be detected using satellite imagery (e.g., Pendrill et al. (2019) and the examples therein of the lag between forest clearing and the establishment of crops, like soy in Brazil and oil palm plantations in Southeast Asia). This too may make the GFW drivers data conservative — with a longer time span, it may become clear that more forests have indeed been cleared for (as yet unplanted) commercial agricultural commodities.

Note: While not directly relevant to this study, the Hansen et al. data does not assess the area of forest degradation each year.

Key sources of information on drivers of deforestation for the country studies include national REDD+ reporting and Pendrill et al. (2019, updated with data to 2017), who used a "land-balance model that quantifies deforestation embodied in production of agricultural and forestry commodities at country level across the tropics." This data also combines forest loss and crop expansion data, which Pendrill et al. used to calculate the proportion of forest loss embodied in crops (covering 2013-2017), as a proportion of all forest loss (GFW 2020, using Hansen et al. 2013).

Step 3: Estimating percentage of forest conversion driven by commercial agriculture that was likely illegal (Variable C)

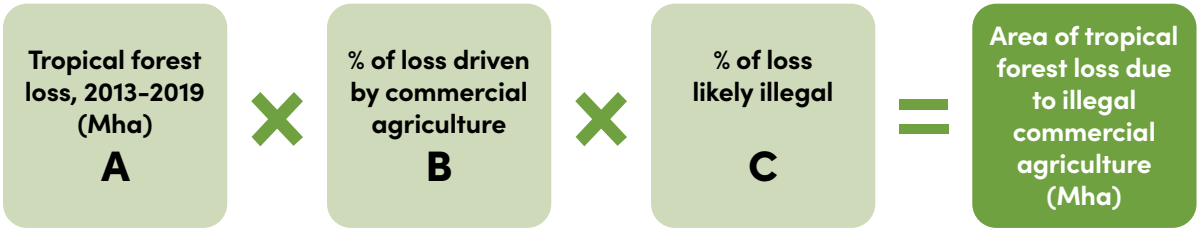
In this report, legality is framed in the context of recognizing each country's sovereign rights. "Illegality" is therefore defined as the conversion of forests that takes place in contravention of a country's legislative framework, including its laws, regulations, instructions, and any other legal instrument that penalizes non-compliance. International treaties are not included in this definition unless they have been incorporated into national law.

For each of the country studies, the literature was reviewed to evaluate compliance of forest clearing with the relevant legislative framework at the time the deforestation took place. Clearing was, therefore, considered illegal even if it was "legalized" after the fact by, for example, legal settlements, legal amendments, or amnesties (where a fine may be paid, etc.). While countries may have the sovereign right to retroactively legalize deforestation, it remains true that, at the time of forest loss, the clearing was not conducted in compliance with the rule with law and was, therefore, illegal.

Step 4: Calculating tropical forest loss driven by agro-commodities linked to illegal conversion

The product of Variables A, B, and C provided a best estimate of the area of tropical forest lost to agro-commodities linked to illegal conversion for each country (Equation 1).

Equation 1: Formula used to calculate area of tropical forest loss due to illegal conversion for commercial agriculture, 2013-2019



For the 23 countries that comprised 87 percent of all tropical forest loss, Forest Trends used the case studies (Annexes 1-3) to derive best estimates of Variables A, B, and C. The following data were used for the "rest of the world" not covered by the in-depth studies:

- Variable A: GFW (2020, using Hansen et al. 2013)
- Variable B: GFW (2020, using Curtis et al. 2018)
- Variable C: regional averages, depending on whether the country was in Africa, Asia (including Oceania), or Latin America (including the Caribbean)

Using sensitivity analyses on estimates of illegality

To test the implication of using regional averages for Variable C for the "rest of the world," Forest Trends conducted a sensitivity analysis by substituting a "best case scenario," where illegality was assumed to be 0 percent and a "worst case scenario," where illegality was assumed to be 100 percent. Given that the rest of the world comprised only 13 percent of tropical deforestation, it was assumed that there would not be much difference among the three scenarios.

This sensitivity analysis also allowed Forest Trends to examine the impact of the lack of data available on

compliance (Variable C) for many case study countries. In order to deal with insufficient evidence, countries were divided into three categories (Table A1):

- High quality estimates: Rigorous empirical evidence supports accurate and precise estimates.
- Medium quality estimates: Evidence is sufficient to support a range for the variable, but not a precise estimate.
- Insufficient data: Evidence is not sufficient to make any estimate.

Table A1 | Availability and quality of data for 23 country studies

	DATA QUALITY		
	High	**Medium**	**Insufficient**
Countries	Brazil, Colombia, Mexico, Democratic Republic of Congo, Madagascar	Argentina, Paraguay, Peru, Indonesia, Cambodia, Laos, Papua New Guinea, Thailand, Liberia, Côte d'Ivoire, Ghana	Bolivia, Honduras, Malaysia, Myanmar, Vietnam, Angola, Sierra Leone

Note: See the individual country studies (Annexes 1-3) for detailed explanations of available data.

Thus, for the sensitivity analysis, the study parameterized Variable C for each of the 23 in-depth country studies depending on their data quality (Table A2).

Table A2 | Treatment in sensitivity analyses of the 23 country studies depending on the quality of available data for estimating the risk of illegality linked to agro-conversion

	DATA QUALITY		
	High	**Medium**	**Insufficient**
SCENARIOS	**Treatment for estimating variables**		
Best case	Point estimate	Low end of range	0%
Best available evidence	Point estimate	Low end of range	Regional mean
Worst case	Point estimate	High end of range	100%

Note: See Annexes 1-3 for detailed explanations of point-estimates or ranges used for each country.

Step 5: Percentage of agro-commodities linked to deforestation that were exported (Variable D)

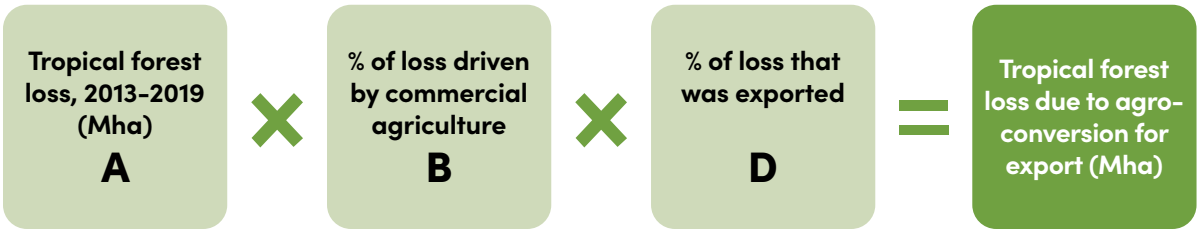
The primary source of data for Variable D was the Pendrill et al. (2019) analysis of embodied deforestation and country of consumption (domestic vs. export). For commodity-specific analysis in each country study, the proportion of production exported was calculated with production data from the United Nations Food & Agriculture Organization (UN FAO) and trade data from the UN's International Trade Statistics Database (UN Comtrade). For some countries where detailed and rigorous analyses of the proportion of deforestation driven by different crops were available, Pendrill et al. data was not used. Instead, the amount of deforestation

embedded in the trade was weighted by the size of each commodities' trade and its link to deforestation. For the "rest of the world," embedded deforestation was based on the database from Pendrill et al. (2019).

Step 6: Calculating tropical forest loss driven by agro-commodities for export

The product of Variables A, B, and D provides Forest Trends' best estimate of the area of tropical forest lost due to agro-commodity production for export markets (Equation 2).

Equation 2: Formula used to calculate tropical forest loss driven by exported agro-commodities, 2013-2019



Step 7: Estimating emissions from agro-commodity conversion (Variable E)

To estimate how forest loss translates into greenhouse gas emissions, this report estimated the amount of carbon dioxide-equivalent (CO_2e) emissions from forest loss, which is based on analyses by Harris et al. (2021).

PART 2
Estimating the quantity and value of exports from converted forestland

Forest Trends estimated the quantity and value of exports in 2019 for specific agricultural commodities that originated from converted forestland: beef and leather, palm oil, soy, pulp and paper, rubber, cocoa, coffee, and maize (Equation 3). Deforestation linked to this trade was tracked over the last 30 years (since ~1990), not just on land cleared of forests since 2013. Only the study countries that are major traders of these commodities are included (Table A3). The study then examines the risk that the deforestation was contaminated by illegal conversion.

Step 1: Estimating quantity and value of exports (Variable F)

For each relevant commodity and country, 2019 trade data was obtained from UN Comtrade.

Step 2: Estimating percentage of production coming from agro-conversion (Variable G)

The proportion of production for each commodity that originated from land cleared of forest was obtained from the literature (Variable B). Estimates of deforestation prior to 2013 were obtained from Forest Trends (2014). Given that this analysis does not include any forest clearing prior to 1990, the results can be considered conservative.

Step 3: Estimating the risk of agro-commodity contamination by illegal agro-conversion

Illegality was evaluated for the deforestation associated with the commercial agricultural commodities (Variable C). When production of a commodity is widespread across the country, Variable C (the estimate of illegality from above) was used. When a product is grown in a specific region (such as Paraguayan soy grown in the eastern Atlantic Forest region that has a Zero Deforestation Law) then the illegality estimate is commodity specific. Forest Trends (2014) and other literature provided estimates of illegality for land cleared prior to 2013.

Equation 3: Formula used to calculate tropical forest loss embodied in agro-commodity exports, 2013-2019

For each commodity, for each major producing country

Total volume or value of exports (tonnes or US$) **F** × **% of production from land converted from forests since 2000** **G** = **Total volume or value of exports linked to deforestation (tonnes or US$)**

Table A3 | Major traders of evaluated commodities

Soy	Beef & Leather	Palm Oil	Pulp & Paper	Rubber	Cocoa	Coffee	Maize
Brazil	Brazil	Malaysia	Malaysia	Indonesia	Côte d'Ivoire	Honduras	Argentina
Argentina	Argentina	Indonesia	Indonesia	Malaysia	Ghana	Côte d'Ivoire	
Paraguay	Paraguay	Peru		Cambodia		Vietnam	
Bolivia	Mexico			Laos			
				Vietnam			
				Democratic Republic of Congo (DRC)			

Appendix 2 Tropical countries by region, governance score (Forest Trends 2019), and date of ratification for International Labour Organization Convention 169 (ILO C169 - Indigenous and Tribal Peoples Convention, 1989 [No. 169]); case study countries highlighted

Latin America & the Caribbean		
Country	**Forest Trends governance score**	**Date of ratification of ILO C169**
Brazil	61.3	25-Jul-02
Argentina	53.8	03-Jul-00
Paraguay	59.5	10-Aug-93
Bolivia	80.6	11-Dec-91
Colombia	47.7	07-Aug-91
Mexico	56.3	05-Sep-90
Peru	46.7	02-Feb-94
Honduras	71.4	28-Mar-95
Aruba	25.4	
Anguilla	17.5	
Antigua and	34.9	
Bonaire		
Bahamas	34.3	
Saint Barthélemy	65.0	
Belize	40.4	
Bermuda	31.6	
Barbados	30.3	
Costa Rica	65.8	
Cuba	31.6	
Bermuda	30.3	
Barbados	65.8	
Costa Rica	30.3	02 Apr 1993
Cuba	65.8	
Curaçao		
Cayman Islands	28.7	
Dominica	37.3	25-Jun-02
Dominican Republic	59.9	
Ecuador	68.9	15-May-98
Guadeloupe		
Grenada	39.5	
Guatemala	65.1	05 Jun 1996
French Guiana	17.3	
Guyana	58.8	

Africa		
Country	**Forest Trends governance score**	**Date of ratification of ILO C169**
DRC	95.5	
Angola	84.9	
Madagascar	78.1	
Liberia	83.4	
Sierra Leone	77.9	
Côte d'Ivoire	67.7	
Ghana	48.8	
Burundi	93.1	
Benin	64.6	
Burkina Faso	64.3	
Botswana	28.7	
Central African Rep.	93.1	30-Aug-10
Cameroon	86.5	
Republic of Congo	90.5	
Comoros	81.6	
Cape Verde	38.8	
Djibouti	72.8	
Eritrea	94.2	
Ethiopia	80.6	
Gabon	73.8	
Guinea	83.1	02 Apr 1993
Gambia	65.7	
Guinea-Bissau	89.0	
Equatorial Guinea	90.6	
Kenya	68.6	25-Jun-02
Maldives	65.4	
Mali	79.9	15-May-98
Mozambique	81.6	
Mauritania	79.4	
Mauritius	21.2	05 Jun 1996
Malawi	69.9	
Mayotte		
Namibia	39.9	

(continued)

Asia-Pacific		
Country	**Forest Trends governance score**	**Date of ratification of ILO C169**
Indonesia	49.8	
Malaysia	29.4	
Myanmar	84.0	
Cambodia	81.3	
Vietnam	57.4	
Laos	77.7	
Papua New Guinea	69.9	
Thailand	44.1	
Bangladesh	78.6	
Brunei	32.1	
Bhutan	33.5	
Fiji	44.9	03-Mar-98
Micronesia (Federated	58.1	
India	51.0	
Kiribati	65.8	
Sri Lanka	55.8	
Macao	23.7	
Myanmar	84.0	
New Caledonia		
Nepal	64.3	14-Sep-07
Philippines	60.6	
Palau	51.5	
Singapore	6.3	
Solomon Islands	62.9	
East Timor	73.3	
Tuvalu	31.5	
United States Minor		
Vanuatu	46.0	

Tropical countries by region, governance score (Forest Trends 2019), and date of ratification for International Labour Organization Convention 169 (ILO C169 - Indigenous and Tribal Peoples Convention, 1989 [No. 169])
(continued)

Latin America & the Caribbean		
Country	**Forest Trends governance score**	**Date of ratification of ILO C169**
Haiti	88.7	
Jamaica	39.8	
Saint Kitts and Nevis		
Saint Lucia	31.5	
Saint Martin (French		
Montserrat		
Martinique	16.1	
Nicaragua	79.7	25-Aug-10
Panama	41.4	
Puerto Rico	36.3	
El Salvador	54.0	
Suriname	60.2	
Sint Maarten		
Turks and Caicos		
Trinidad and Tobago	51.4	
Saint Vincent and	33.9	
Venezuela	97.0	22-May-02
British Virgin Islands		
Virgin Islands, U.S.	15.6	

Africa		
Country	**Forest Trends governance score**	**Date of ratification of ILO C169**
Niger	77.1	
Nigeria	83.2	
Réunion	23.7	
Rwanda	39.1	
Sudan	93.8	
Senegal	49.3	
Somalia	99.6	
South Sudan	99.0	
Swaziland	67.7	
Seychelles	35.3	
Chad	93.5	
Togo	71.9	
Tanzania	68.0	
Uganda	72.6	
Zambia	67.6	
Zimbabwe	91.7	

Appendix 3 Worst-case, best evidence, and best-case estimates of percentage of forest loss due to commercial agriculture, illegal agro-conversion, and agro-conversion linked to exports

Estimates of forest loss due to commercial agriculture, agro-conversion that was likely illegal, and agro-conversion that was linked to exports are presented here under a best-case scenario, best-available-evidence scenario, and worst-case scenario. Colors indicate data quality: green represents high quality data, orange medium quality data and yellow is low quality data.

	Forest loss due to commercial agriculture (%) VARIABLE B			Agro-conversion that was likely illegal (%) VARIABLE C			Agro-conversion that was linked to exports (%) VARIABLE D
Country / Scenario	Best case	Best-evidence	Worst case	Best case	Best-evidence	Worst case	Best-evidence
Brazil	88%	88%	88%	95%	95%	95%	25%
Argentina	71%	71%	71%	65%	65%	100%	49%
Paraguay	89%	89%	89%	49%	49%	100%	69%
Bolivia	80%	80%	80%	0%	74%	100%	7%
Colombia	84%	84%	84%	89%	89%	89%	4%
Mexico	68%	68%	77%	97%	97%	97%	10%
Peru	66%	66%	66%	51%	51%	100%	11%
Honduras	51%	51%	51%	0%	74%	100%	55%
Indonesia	89%	89%	89%	47%	47%	81%	47%
Malaysia	91%	91%	91%	0%	37%	100%	59%
Myanmar	68%	68%	68%	0%	37%	100%	10%
Cambodia	89%	89%	89%	16%	16%	100%	16%
Vietnam	63%	63%	63%	0%	37%	100%	32%
Laos	56%	56%	56%	49%	49%	100%	20%
Papua New Guinea	30%	30%	30%	63%	63%	100%	99%
Thailand	86%	86%	86%	9%	9%	100%	50%
Democratic Republic of Congo	9%	9%	22%	99%	99%	99%	1%
Angola	2%	2%	2%	0%	71%	100%	0%
Madagascar	3%	3%	3%	100%	100%	100%	1%
Liberia	14%	14%	70%	85%	85%	100%	53%
Sierra Leone	4%	4%	4%	0%	71%	100%	2%
Côte d'Ivoire	62%	62%	62%	26%	26%	100%	64%
Ghana	77%	77%	77%	45%	45%	100%	14%
Rest of the Tropics*							
Latin America	15%	15%	15%	74%	74%	98%	17%
Asia	28%	28%	28%	37%	37%	98%	5%
Africa	1%	1%	1%	71%	71%	100%	10%

*For the "rest of the world," forest loss due to commercial agriculture per country is based on Global Forest Watch data (2020, using Curtis et al. 2018). Percent illegality is based on the average of the Forest Trends best-available-evidence estimates for high and medium data-quality countries in the region. Exports are based on Pendrill et al. 2020.

Appendix 4 Tropical forest loss and emissions due to commercial agriculture, illegal agro-conversion, and export of production linked to agro-conversion

Country	Total Tropical Forest Loss VARIABLE A		Forest Loss Due to Commercial Agriculture VARIABLE B		
	Area lost (in Mha and %)	Emissions ($MtCO_2e$)	Area lost due to commercial agriculture (%)	Area lost due to agro-conversion (Mha)	Emissions ($MtCO_2e$)
Brazil	20.4 (27%)	12,931	88%	18.0	11,379
Argentina	1 (1%)	355	71%	0.7	252
Paraguay	1.1 (1%)	354	89%	1.0	315
Bolivia	2.5 (3%)	1,125	80%	2.0	900
Colombia	1.8 (2%)	1,032	84%	1.5	867
Mexico	1.6 (2%)	731	68%	1.1	497
Peru	1.5 (2%)	988	66%	1.0	652
Honduras	0.6 (1%)	285	51%	0.3	145
Indonesia	10.6 (14%)	6,843	89%	9.4	6,090
Malaysia	3.3 (4%)	1,774	91%	3.0	1,614
Myanmar	2 (3%)	1,075	68%	1.4	731
Cambodia	0.9 (1%)	567	89%	0.8	505
Vietnam	1.4 (2%)	1,082	63%	0.9	682
Laos	2 (3%)	1,024	56%	1.1	573
Papua New Guinea	0.8 (1%)	612	30%	0.2	184
Thailand	0.9 (1%)	507	86%	0.8	436
DRC	8.1 (11%)	5,275	9%	0.7	475
Angola	0.9 (1%)	376	2%	0.0	8
Madagascar	2 (3%)	1,093	3%	0.1	33
Liberia	1.2 (2%)	655	14%	0.2	92
Sierra Leone	1(1%)	485	4%	0.0	19
Côte d'Ivoire	0.9 (1%)	514	62%	0.6	319
Ghana	0.4 (1%)	253	77%	0.3	195
Other LAC	3.4 (4%)	1,976	15%	0.5	296
Other Asia	1.8 (2%)	1,108	28%	0.5	310
Other Africa	4.7 (6%)	2,821	1%	0.0	28
TOTAL	**76.9**	**45,841**	**60%**	**46.1**	**27,597**

Data on legality of agro-conversion is categorized by availability and data quality:

[1] = high, allowing national estimates of illegality;
[2] = medium, good data but not representative of all agro-conversion; and
[3] = low, insufficient information to make a reasonable national estimate, even of some sub-sector.

Variable calculations can be found in Appendix 1.

Agro-Conversion Likely to Be Illegal VARIABLE C				Agro-Conversion Linked to Exports VARIABLE D		
Data quality/ availability on illegality (1-3)	Agro-conversion likely illegal (%)	Minimum area likely illegal (Mha)	Emissions ($MtCO_2e$)	Production linked to exports (%)	Area linked to exports (Mha)	Emissions ($MtCO_2e$)
1	95%	17.1	10,810	25%	4.5	2,845
2	65%	0.5	164	49%	0.3	124
2	49%	0.5	154	69%	0.7	217
3	74%	1.5	669	7%	0.1	63
1	89%	1.3	772	4%	0.1	35
1	97%	1.1	482	10%	0.1	50
2	51%	0.5	333	11%	0.1	72
3	74%	0.2	108	55%	0.2	80
2	47%	4.4	2,862	47%	4.4	2,862
3	37%	1.1	594	59%	1.8	952
3	37%	0.5	269	10%	0.1	73
2	16%	0.1	81	16%	0.1	81
3	37%	0.3	251	32%	0.3	218
2	49%	0.5	281	20%	0.2	115
2	63%	0.2	116	99%	0.2	182
2	9%	0.1	39	50%	0.4	218
1	99%	0.7	470	1%	0.0	5
3	71%	0.0	5	0%	0.0	0
1	100%	0.1	33	1%	0.0	0
2	85%	0.1	78	53%	0.1	49
3	71%	0.0	14	2%	0.0	0
2	26%	0.1	83	64%	0.4	204
2	45%	0.2	88	14%	0.0	27
3	74%	0.4	220	17%	0.1	50
3	37%	0.2	114	5%	0.0	16
3	71%	0.0	20	10%	0.0	3
	69%	**31.7**	**19,110**	**31%**	**14.3**	**8,540**

Appendix 5 Amount and value of exports in 2019 linked to deforestation

This section outlines the amount and value of exports in 2019 linked to deforestation for the major producer countries for each of ten key agro-commodities.

Commodity / Country	Exports (t) VARIABLE F (volume)	Percent Displacing Forest VARIABLE G	Exports Displacing Forest (t) VARIABLE F (volume) x VARIABLE G	Value of Exports (US$) VARIABLE F (value)	Value of Exports Displacing Forests (US$) VARIABLE F (value) x VARIABLE G	Risk of Illegality (%)
SOY						
Brazil	86,257,817	49%	42,266,330	$34,143,807,081	$16,730,465,470	95%
Argentina	36,406,078	9%	3,276,547	$15,399,779,750	$1,385,980,178	65%
Paraguay	6,846,205	57%	3,902,337	$2,517,960,954	$1,435,237,744	100%
Bolivia	2,096,546	52%	1,090,204	$906,761,607	$471,516,036	74%
Total			**50,535,418**		**$20,023,199,427**	
BEEF						
Brazil	1,466,721	36%	528,020	$6,829,752,742	$2,458,710,987	95%
Argentina	696,654	14%	97,532	$3,182,591,774	$445,562,848	65%
Paraguay	298,197	45%	134,189	$1,081,656,371	$486,745,367	24%
Mexico	269,805	38%	102,526	$1,504,715,721	$571,791,974	97%
Total			**862,266**		**$3,962,811,176**	
LEATHER						
Brazil	458,024	36%	164,889	$1,379,585,563	$496,650,803	95%
Argentina	130,302	14%	18,242	$701,997,552	$98,279,657	65%
Paraguay	38,443	45%	17,299	$68,405,882	$30,782,647	24%
Mexico	59,374	38%	22,562	$577,048,923	$219,278,591	97%
Total			**222,992**		**$844,991,698**	
COCOA						
Ghana	880,684	13%	114,489	$2,400,471,201	$312,061,256	45%
Cote d'Ivoire	2,075,738	40%	830,295	$5,539,897,778	$2,215,959,111	100%
Total			**944,784**		**$2,528,020,367**	
PALM OIL						
Indonesia	31,949,015	38%	12,140,626	$16,235,334,628	$6,169,427,159	81%
Malaysia	17,282,965	68%	11,752,416	$9,547,187,841	$6,492,087,732	37%
Peru	84,700	44%	37,268	$53,917,344	$23,723,631	51%
Total			**23,930,310**			

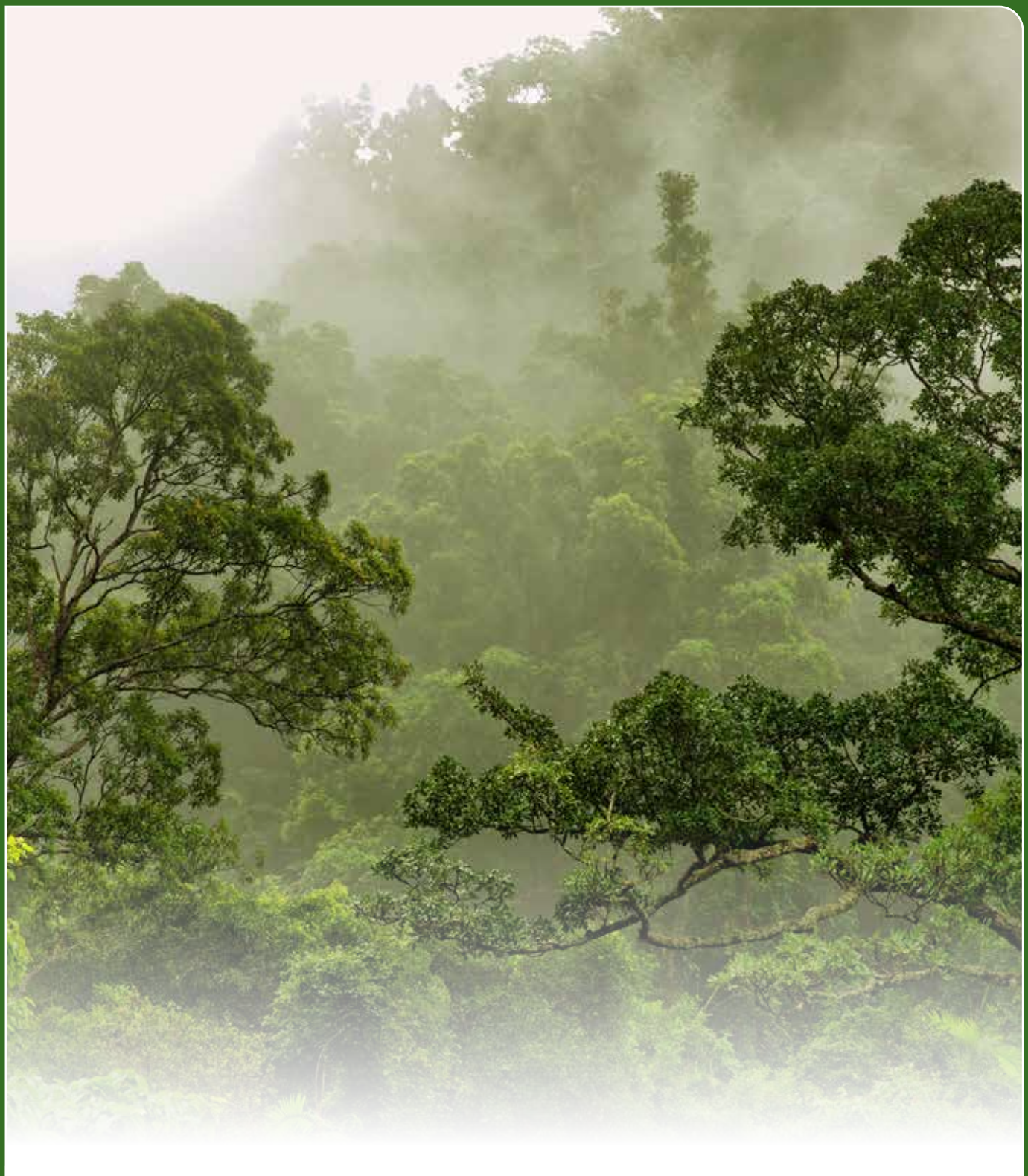
Commodity / Country	Exports (t) VARIABLE F (volume)	Percent Displacing Forest VARIABLE G	Exports Displacing Forest (t) VARIABLE F (volume) x VARIABLE G	Value of Exports (US$) VARIABLE F (value)	Value of Exports Displacing Forests (US$) VARIABLE F (value) x VARIABLE G	Risk of Illegality (%)
PULP						
Indonesia	5,609,279	100%	5,609,279	$3,474,161,516	$3,474,161,516	68%
Malaysia	41,739	14%	5,843	$70,665,651	$9,893,191	37%
Total			**5,615,122**		**$3,484,054,707**	
PAPER						
Indonesia	5,459,420	100%	5,459,420	$4,799,339,658	$4,799,339,658	68%
Total			**5,459,420**		**$4,799,339,658**	
RUBBER						
Cambodia	171,814	100%	171,814	$204,463,624	$204,463,624	16%
Laos	273,109	17%	46,429	$382,922,271	$65,096,786	49%
Vietnam	753,871	63%	474,939	$1,072,663,372	$675,777,924	37%
Malaysia	721,114	66%	475,935	$1,100,039,911	$726,026,341	37%
Indonesia	2,547,109	26%	662,248	$4,055,599,339	$1,054,455,828	47%
DRC	1,458	15%	219	$1,879,879	$281,982	99%
Total	**4,468,475**		**1,831,584**		**$2,726,102,486**	
COFFEE						
Cote d'Ivoire	45,465	13%	5,910	$73,811,041	$9,595,435	26%
Vietnam	1,422,377	15%	213,357	$2,456,928,976	$368,539,346	37%
Honduras	368957	29%	106,998	$1,031,639,781	$299,175,536	74%
Total			**326,265**		**$677,310,318**	
MAIZE						
Argentina	29,335,760	52%	15,254,595.20	$6,128,813,587	$3,186,983,065	65%
Total			**15,254,595.20**		**$3,186,983,065**	
GRAND TOTAL			**104,982,755.93**		**$54,918,051,424**	

Appendix 6 Comparison using two different global datasets

This table compares estimates of forest loss for each tropical country using the datasets of Global Forest Watch (2020) and the FAO Forest Risk Assessment (2020). Both define "forest" and "deforestation" slightly differently, as discussed in Appendix 1, Box A1.

	Global Forest Watch Data		FAO Forest Resources Assessment Data		
COUNTRY	Area of total forest loss (Mha)	Calculated percent of total forest loss across the tropics	Area of total forest loss (Mha)	Calculated percent of total forest loss across the tropics	Difference
Brazil	20.4	27%	12.4	19%	**-8%**
Argentina	1.0	1%	1.3	2%	**+1%**
Paraguay	1.1	1%	2.4	4%	**+3%**
Bolivia	2.5	3%	1.6	3%	**-**
Colombia	1.8	2%	1.2	2%	**-**
Mexico	1.6	2%	1.3	2%	**-**
Peru	1.5	2%	1.3	2%	**-**
Honduras	0.6	1%	0.2	0%	**-1%**
Indonesia	10.6	14%	5.1	8%	**-6%**
Malaysia	3.3	4%	0.3	0%	**-3%**
Myanmar	2.0	3%	2.1	3%	**-**
Cambodia	0.9	1%	1.7	3%	**+2%**
Vietnam	1.4	2%	0.1	0%	**-2%**
Laos	2.0	3%	0.2	0%	**-3%**
Papua New Guinea	0.8	1%	02	0%	**-1%**
Thailand	0.9	1%	0.4	1%	**-**
Democratic Republic of Congo	8.1	11%	7.7	12%	**+1%**
Angola	0.9	1%	3.9	6%	**+5%**
Madagascar	2.0	3%	0.1	0%	**-3%**
Liberia	1.2	2%	0.2	0%	**-2%**
Sierra Leone	1.0	1%	0.1	0%	**-1%**
Côte d'Ivoire	0.9	1%	0.8	1%	**-**
Ghana	0.4	1%	0.0	0%	**-1%**
Other Latin American & Caribbean tropical countries	3.4	4%	5.8	9%	**+5%**
Other Asian tropical countries	1.8	2%	0.3	0%	**-2%**
Other African tropical countries	4.7	6%	13.7	21%	**+15%**
TOTAL	**76.9**		**64.2**		
TOTAL for 23 case study countries	**67.0**	**87%**	**44.6**	**69%**	**-18%**

Source: GFW 2020 (using Hansen et al. 2013); FAO FRA 2020.



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