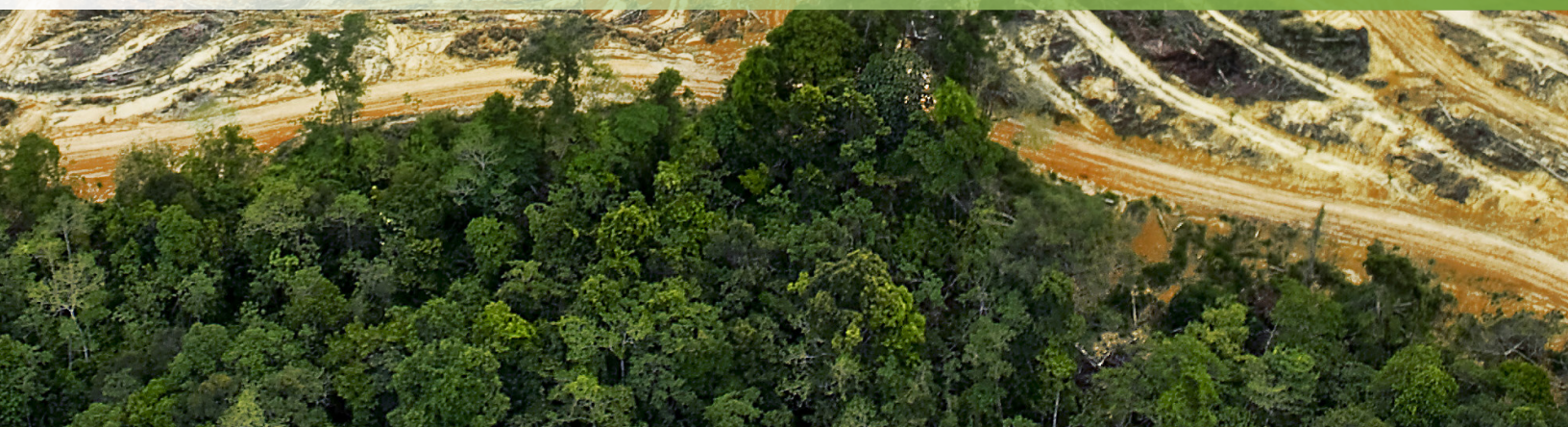
Ceres

The Investor Guide to Deforestation and Climate Change

JUNE 2020



ABOUT CERES

Ceres is a sustainability nonprofit organization working with the most influential investors and companies to build leadership and drive solutions throughout the economy. Through powerful networks and advocacy, Ceres tackles the world's biggest sustainability challenges, including climate change, water scarcity and pollution, deforestation, and inequitable workplaces. For more information, visit www.ceres.org.

Support for this guide was provided by the Norwegian International Climate and Forest Initiative (NICFI), the Gordon and Betty Moore Foundation, the David and Lucile Packard Foundation, and Erol Foundation.

Investor Reviewers

Adam Kanzer
BNP Paribas Asset Management

Michelle Edkins and Hilary Novik-Sandberg, BlackRock

Jimmy Yan
NYC Comptroller

The use of the BNP Paribas Asset Management, Blackrock, and the NYC Comptroller logos and/or the feedback provided by these firms does not represent an investment endorsement or recommendation and does not reflect any policies or positions of BNP Paribas Asset Management, Blackrock, or the NYC Comptroller.

Additional input provided by Stu Dalheim, Calvert Research and Management; Lauren Compere, Boston Common Asset Management; Julie Gorte, Impax Asset Management; Frank Sherman and Natalie Wasek, Seventh Generation Interfaith Coalition for Responsible Investment; Yasmine Svan, Legal and General Investment Management; and Jessye Waxman, Green Century Capital Management.

Data Partners

Toby Gardner and Javier Godar, Stockholm Environment Institute through its Trase project
Florence Pendrill and Martin Persson, Chalmers University of Technology
Thomas Kastner, Senckenberg Biodiversity and Climate Research Centre

Scientific Advisory Committee

Our thanks to the following individuals who generously shared their time and expertise to review the data and information in this guide for methodology and transparency of messaging, and to the Meridian Institute for facilitating the review process.

Justin Adams, Tropical Forest Alliance
Ameer Azim, Climate Advisers
David Cleary, The Nature Conservancy
Stephen Donofrio, Forest Trends/Supply Change
Jamison Ervin, United Nations Development Programme, New York Declaration on Forests Global Platform Secretariat
Morgan Gillespy, CDP
Matthew Hansen, University of Maryland
Diane Holdorf, World Business Council for Sustainable Development
Michèlle Koper, Navigant a Guidehouse Company
Jeff Milder, Rainforest Alliance
Isabel Nepstad, Independent Consultant
Michael Obersteiner, International Institute for Applied Systems Analysis (IIASA)
Matt Ramlow, World Resources Institute, GHG Protocol
Rosa Maria Román-Cuesta, Center for International Forestry Research (CIFOR)
Martha Stevenson, World Wildlife Fund
Viera Ukropcova, CDP
Lini Wollenberg, CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)/ Gund Institute for Environment
Heather Wright, Moore Foundation
Michelle Zollinger, Quantis

Authors

Meryl Richards
Nako Kobayashi
Julie Nash
Rebecca Stern
Peyton Fleming

Thanks to Hugh W. Brown Jr., Ana Orians, Cambria Arvizo, Sarah McCracken and George Grattan for providing support for this project. Design by Maura Conron. Photo by Mattias Klum, National Geographic.

Table of Contents

Introduction

As a major driver of climate change, global deforestation has significant financial implications for investors.

Even as the COVID-19 pandemic throttled the global economy, deforestation continued largely unchecked in many parts of the world. Every day, vast swaths of tropical forests are razed for production of agricultural commodities such as soybeans, palm oil and beef that eventually make their way to grocery shelves worldwide. Clearing and burning forests emits staggering amounts of greenhouse gases (GHGs) and reduces the land's ability to store carbon. Protecting and restoring forests and other natural ecosystems are second only to eliminating fossil fuel use as a solution to climate change.

In addition to increasing investors' exposure to the systemic risk of climate change, deforestation poses additional salient risks. It accelerates global biodiversity loss and disruption of local and global precipitation patterns – something Brazil's Amazon region is already seeing with reduced rainfalls and shorter growing seasons. It also drives animals closer to human contact which can increase the occurrence of animal-borne infectious diseases.

Given these wide-ranging material impacts, investors should recognize and act on deforestation with the same vigor and urgency they bring to other drivers of climate change. Just as investors engage fossil fuel companies to reduce their carbon footprints, they should also engage companies in a wide range of industries that source agricultural and forest commodities – food and consumer products, auto components, textiles and apparel, among others – to eliminate deforestation from their commodity supply chains.

The stakes – and opportunities – are enormous. Companies that fail to reduce emissions from deforestation will face reduced market access, reputational risks, legal sanctions and other forms of financial exposure due to increasingly stringent policies, regulations and consumer expectations as the world shifts to a low-carbon global economy. Eliminating deforestation from supply chains is an achievable way to significantly reduce corporate greenhouse gas emissions and the systemic burden of climate change. Investors can use their influence as shareholders to engage with companies on deforestation as a way to mitigate portfolio-wide climate risks.

And now is the time. The Amazon is approaching a disastrous tipping point where vast areas of rich tropical forest are being transformed into degraded savannah and scrubland. Progress in limiting global temperature rise to 1.5 degrees Celsius – the goal of the Paris Climate Agreement – is behind schedule, and a huge shift in wide-ranging human activities is needed immediately. Eliminating deforestation is a linchpin of this shift. Simply put, we cannot avoid potentially catastrophic climate warming without eliminating deforestation.

This guide – the result of extensive input from investors and deforestation experts – gives investors a framework to help them understand and engage on deforestation-driven climate risks across their portfolios. It is especially intended for investors – in particular, engagement specialists – who are relatively new to deforestation and may be engaging on climate risk but not deforestation risk. The guide will help them understand the drivers of deforestation risk and prioritize company engagements based on industries, geographies and sourcing patterns. It also outlines key expectations that investors should be looking for in corporate climate and deforestation commitments and example questions for company and sector engagements. Lastly, the guide provides concrete next steps investors can take to address deforestation risk.

PART 1
Deforestation and its Effects on Climate Change

Human use of land has a unique role in climate change. Collectively, agriculture, forestry and other land uses are the second-largest source of greenhouse gas emissions behind the energy sector. At the same time, land is also the largest potential solution to climate change because of the twin opportunities to both reduce emissions from land use practices and remove additional carbon from the atmosphere by sequestering it in trees and soils. Lastly, land provides the basis for human livelihoods and well-being through food and fresh-water supplies, climate and disease control and natural disaster mitigation. These ecosystem services are already compromised due to the effects of a 1 degree Celsius (1.8 Fahrenheit) rise in global temperatures and will be further undermined as temperatures continue to increase.[1]

To manage climate risk, investors have historically focused on sectors such as energy and industrials due to their significant contribution to GHG emissions from fossil fuel extraction and consumption. However, a growing number of investors are awakening to the large climate risk inherent in land use practices, and the even larger opportunity to mitigate climate change by changing them. There are many land-based climate solutions, but preventing destruction and degradation of forests and promoting forest restoration will have the largest impact in mitigating climate change.

GHG emissions from deforestation

Forests store large amounts of carbon in trees and soils. If the carbon in a single square kilometer of tropical forest was emitted as carbon dioxide (CO_2) it would be equivalent to the CO_2 emissions from the annual energy usage of 12,000 U.S. homes.[2] When forests are converted to agriculture, mining or other land uses, felled trees are burned or left to decompose. The carbon in those trees is emitted mostly as CO_2 and burning emits other GHGs such as nitrous oxide and methane. Carbon-rich forest soils are then plowed to plant crops or pastures, releasing even more GHGs into the atmosphere.

While maintaining healthy forests globally is critical to mitigating climate change, the majority of deforestation and most of the net GHG emissions from deforestation occur in the tropics. This is because tropical forests (1) currently face the highest pressure for large-scale conversion to agriculture and (2) store large amounts of carbon—much more than temperate forests.[3]

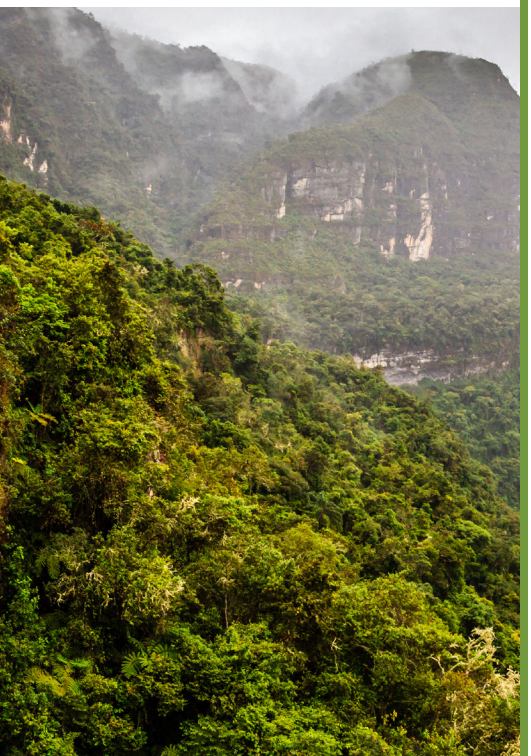
Tropical deforestation has a number of drivers. The largest share is due to forest clearance for agriculture and tree plantations. Tree plantations are human-planted forests that produce timber or wood pulp for paper, and often store less carbon than natural forests. A smaller proportion of tropical deforestation is due to mining, urbanization, energy infrastructure and natural forest fires. This guide focuses on GHG emissions from deforestation due to expansion of agriculture and forest commodities, which are the most likely to show up in the portfolios of institutional investors. This **commodity-driven tropical deforestation is responsible for approximately 2.6 gigatons of CO_2 emissions annually—or 5 percent of global GHG emissions.**[4]

While the contribution of deforestation to GHG emissions has the largest and most direct impact on the climate, deforestation contributes to climate change in three other ways as well. First, deforestation not only releases carbon already stored in trees and soils, it also eliminates the future potential of the forest to sequester additional carbon. Intact tropical forests have absorbed a significant share of human-caused CO_2 emissions in recent decades, though their future potential as carbon sinks is uncertain (see box on Loss of Forest Carbon Sinks below).[5]

Second, deforestation contributes indirectly to climate change by replacing a sink of GHGs with new GHG sources. Agricultural activities that replace forests emit additional GHGs such as methane from livestock and nitrous oxide from fertilizer use.

LOSS OF FOREST CARBON SINKS

Tropical forests help sequester carbon emissions from human activity and thus for a long time have been considered an important carbon sink. However, recent scientific evidence indicates that the ability of tropical forests to sequester carbon in trees is in decline, potentially due to the impacts of drought and heat. The Amazon rainforest, for example, may cease to sequester additional carbon after 2040. Because of this shifting dynamic, climate change impacts in the tropics may be even more severe than predicted, adding to the imperative to preserve existing tropical forests.[9]



Third, forests shape local and continental climates by driving movements of air, water and heat through evaporation and transpiration. Deforestation alters these dynamics in ways that can dramatically impact temperature and precipitation both locally and thousands of miles away.[6] For example, in parts of the Amazon, rainy seasons have been delayed by two weeks due to deforestation.[7] Such changes can create feedback loops whereby drier conditions jeopardize the health of forests and cause fires—both natural and manmade—to spread out of control, emitting GHGs and further exacerbating deforestation.

UNDERSTANDING GHG EMISSIONS FROM LAND

According to the 2019 IPCC Special Report on Climate Change and Land, 23 percent of global GHG emissions are from land. Of that, 11 percent of emissions are from deforestation and conversion of natural ecosystems to human uses. The remaining 12 percent are emissions directly from agricultural production such as livestock and fertilizers. Tropical deforestation contributes 7 percent of global GHG emissions,[8] and most of that—5 percent of global GHG emissions—is driven by production of agricultural and forest commodities (Figure 1).

For definitions of terms used in this guide, please see the appendix.

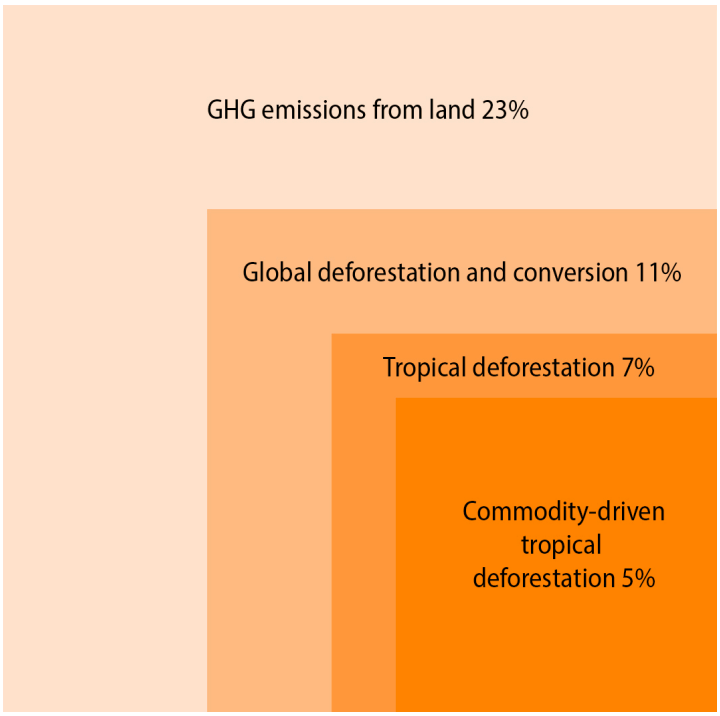


Figure 1
GHG emissions from land

Forests as a climate solution

IT WILL NOT BE POSSIBLE TO LIMIT THE AVERAGE GLOBAL TEMPERATURE RISE TO 1.5° CELSIUS WITHOUT HALTING DEFORESTATION.

Eliminating commodity-driven tropical deforestation could reduce global annual GHG emissions by 5 percent.[10] However, considering only emissions from deforestation underestimates the potential contribution of forests and other natural ecosystems to reduce greenhouse gases in the atmosphere. Restoring forests on previously deforested areas could sequester large amounts of carbon. Protecting and restoring other natural ecosystems such as grasslands, peatlands and coastal wetlands could also help mitigate climate change. Added together, **protecting and restoring forests and other natural ecosystems could provide 16-30 percent of the climate change mitigation needed to limit global warming to 1.5-2 degrees Celsius—the goal of the Paris Climate Agreement.**[11] That's nearly three-quarters the mitigation potential of all renewable energy technologies combined (Figure 2).

Avoiding catastrophic climate change will require reducing or sequestering a combined 1,580 gigatons of GHG emissions between 2020 and 2050 (Figure 2).[12] To meet this challenge, we must deploy an entire suite of climate solutions: climate-smart agriculture practices that maintain soil carbon and reduce emissions from livestock and fertilizers; agroforestry systems that incorporate trees within croplands and grazing lands; solar and wind energy as primary electricity sources; improved energy efficiency in factories and office buildings; alternatives to and proper management of CFCs and HCFCs used as refrigerants; electrification of vehicle fleets and efficient low-carbon aviation and shipping; and technologies such as clean cookstoves for the three billion people who currently cook over wood and charcoal. But forests and other natural ecosystems are a large—and previously overlooked—part of the solution. **When addressing climate risk in their portfolios, investors have an opportunity to elevate the role of forests and other natural ecosystems alongside solutions such as renewable energy that have historically been the focus of corporate and policymaker engagements.**

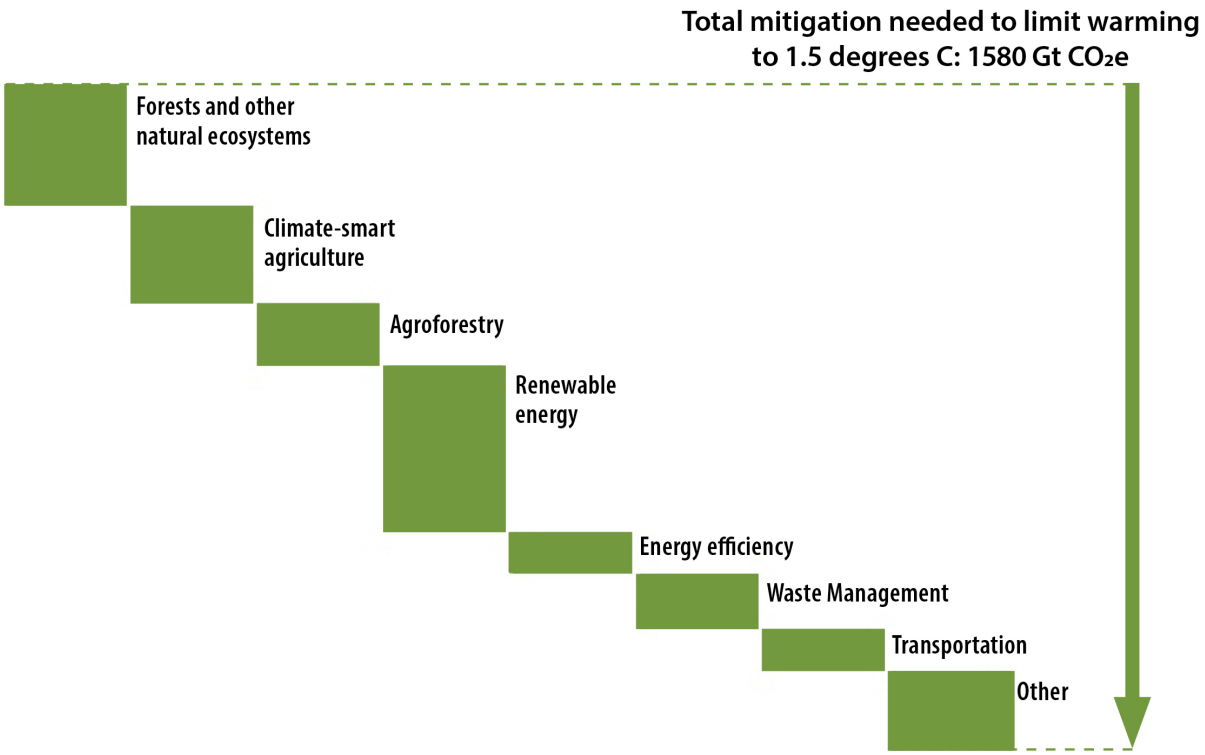


Figure 2 Comparison of climate solutions in terms of their potential to reduce GHG emissions and sequester carbon between 2020 and 2050. Data are from Drawdown Review 2020,[13] which provides individual estimates for 78 climate solutions. Solutions are grouped here according to how investors might assess their portfolios for opportunities and elevate solutions in investor-company dialogues. Please refer to the companion website.

PART 2
Material Risks of Deforestation

How deforestation fits into climate scenario analysis

Climate change is considered a systemic risk that poses wide-ranging vulnerabilities to businesses in all sectors. It also has the potential to trigger severe economic instability and collapses of entire industries. **As a key driver of climate change, deforestation exacerbates this risk.** Therefore, it is in the clear financial interest of investors – consistent with their fiduciary duty—to effectively manage climate-related risks by engaging with companies with deforestation exposure.

To better understand the material impacts of climate change, the Task Force on Climate-related Financial Disclosures (TCFD) recommends that companies and investors conduct climate scenario analysis. Scenario analysis provides a way to consider business risks and opportunities in a path leading to a particular outcome. To assess the potential impacts of climate change on a company's bottom line or on an investment portfolio, the TCFD recommends using a 2 degrees Celsius or lower transition scenario, in addition to two or three other relevant climate scenarios.

Through this exercise, investors can assess how their portfolio companies' current business operations and supply chains might perform in the short- and long-term under different future scenarios. The TCFD recognizes two core categories of climate risks: transition risk and physical risk.

Transition risk refers to financial impacts companies may face if they fail to adapt to foreseeable changes in regulation, laws, consumer behavior and market systems that will occur in the transition to a lower-carbon global economy.

Physical risk refers to ongoing and projected physical impacts of climate change on businesses. These may be driven by a single event such as an extreme drought, flood or fire, or they may be chronic changes caused by longer-term shifts in local and global precipitation, temperature and sea levels.

Companies and investors should account for deforestation and its associated GHG emissions in order to have a complete view of how climate change will affect businesses and portfolios. Companies sourcing agricultural and forest commodities have exposure to transition risks due to their deforestation-related GHG emissions, as well as high levels of physical risk that are exacerbated by deforestation.[14]

The following transition and physical climate risks related to deforestation should be considered in a company's climate scenario analysis (Table 1):

Table 1 How deforestation exacerbates climate risk

TRANSITION RISK	
OPERATIONAL	Companies may incur stranded assets if they are unable to function at current or projected capacity due to the risks mentioned below.[15] These risks may not come directly from changes to a company's own operations, but may result from suppliers being unable to produce sufficient volumes of inputs due to policy changes, consumers demanding less products linked to deforestation and other factors.
MARKET	Companies may lose contracts and see lower credit ratings if they are unable to shift practices to what is needed for a lower carbon economy, including eliminating deforestation.
REGULATORY	Policy mechanisms like carbon pricing, border carbon taxes and other climate change regulations will make deforestation a costly, if not impossible, practice due to it being a large source of GHG emissions.[16]
LITIGATION	Increasingly, legal actions are being taken against high emitting companies that may be responsible for escalating climate-related damages.[17]
REPUTATIONAL	Investors and consumers alike are increasingly demanding that companies align products and services with global emissions-reduction goals.[18] This could lead to reduced consumer demand for deforestation-linked products.
PHYSICAL RISK	
OPERATIONAL	Shifting production zones and more extreme weather events will lead to lower yields and stranded assets on company-owned plantations and crop fields.[19] Deforestation exacerbates these effects, making agricultural supply chains less resilient. Companies may need to invest in technologies and nature-based solutions to help producers adapt.
MARKET	Input costs will be increasingly variable and rise in the long-term due to the physical operational risks faced by upstream suppliers, leading to higher production costs.

The financial materiality of deforestation, beyond climate change impacts

Outside the context of climate scenario analysis, deforestation poses other significant and financially material risks that can affect a company's bottom line. Companies that fail to ensure that their products are not sourced with deforestation expose themselves to potential regulatory action, reduced market access and loss of customers in the near-term, as well as supply chain disruptions and increased production costs in the long-term. For more information on how deforestation activities have led to material impacts for companies, please see the Case Study Series: Business Risks from Deforestation.

Other salient risks from deforestation

Forests are a highly valuable form of "natural capital" and provide numerous benefits beyond climate change mitigation. The following are other salient issues stemming from deforestation that pose material risks for companies if left unmitigated:

Biodiversity

Tropical forests are extremely biodiverse. The Amazon alone is home to 10 percent of the world's species.[20] Recent research shows that preserving biodiversity and related ecosystem services is vital to limiting global temperature rise to 1.5 degrees Celsius.[21]

Water Security

Because forests play an important role in local, regional and global water cycles, deforestation in places like the Amazon could have impacts as far-reaching as devastating droughts in the Midwestern U.S.[22] Deforestation also reduces water availability and water quality which has implications for regional food security.

Human Rights

Deforestation may involve wrongful displacement of indigenous peoples and destruction of areas that provide cultural importance and resources such as food, fuel and medicine.[23] Research also shows that land managed by indigenous peoples may be more effective in storing carbon and mitigating climate change.[24]

Criminal Activity

Deforestation is often illegal and may represent criminal activity upstream in supply chains.[25] Supply chains with illegal deforestation place workers at risk and make businesses susceptible to potential litigation.

Natural Disasters

Because of the stability trees provide through their extensive root systems, forests also provide protection from natural disasters that are expected to escalate due to climate change.[26]

Zoonotic Diseases

Forest loss drives wildlife closer to people, increasing human exposure to animal-borne pathogens. Deforestation is closely associated with zoonotic emerging infectious diseases such as SARS, MERS, Ebola, and, potentially, COVID-19.[27/28] Deforestation and climate change may also exacerbate the spread of mosquito-borne diseases such as the Zika virus and malaria.

OPPORTUNITIES TO INVEST IN FORESTS AND OTHER NATURAL CLIMATE SOLUTIONS

While investors should prioritize addressing the *risks* posed by deforestation in their portfolios, there are also substantial *opportunities* to invest in conservation, restoration, and sustainable management of forests, farmlands, and wetlands. These so-called "natural climate solutions" represent an investment opportunity of potentially hundreds of billions of dollars over the coming decade, as carbon pricing enables new investment models that integrate production with conservation and restoration. Opportunities exist across asset classes: corporate or government green bonds; equity investments in innovative food companies that are reducing pressure on land; and real assets investments in forestry and agriculture that meet high sustainability criteria.

PART 3
Countries and Commodities of Risk

While most securities in investment portfolios are not directly responsible for deforestation, GHG emissions from deforestation are embedded in the supply chains of a wide variety of companies. Exposure to deforestation is related to the sourcing of specific agricultural and forest commodities from specific locations. Understanding key geographies and commodities of exposure enables investors to identify risks in their portfolio and engage strategically on deforestation as a driver of climate change. While these commodities and locations may change over time, some enduring patterns allow investors to hone in on risks within their portfolios and prioritize engagements.

The geography of tropical deforestation

A large proportion of the world's remaining tropical rainforests are concentrated in Brazil and Indonesia, which are also countries with large agricultural economies. As a result, approximately 60 percent of GHG emissions from commodity-driven tropical deforestation occurs in these two countries: 33 percent in Indonesia and 27 percent in Brazil. An additional 20 percent of deforestation-related emissions come from Malaysia, the Democratic Republic of the Congo, Mexico, Myanmar, Australia, India and Peru (Figure 3).[29] In the past 15 years, Argentina, Bolivia, Papua New Guinea and Paraguay have also at various times contributed between 2-3 percent of annual deforestation-related GHG emissions. For a full list of deforestation-related emissions by country, please see the companion website.

Brazil, where most of the Amazon rainforest is located, has already lost an area of forest the size of Poland to soybean fields and cattle ranches. Deforestation in the Amazon had been decreasing since the early 2000s, but recent trends are reversing this progress. 2019 saw the highest rate of deforestation since 2007-08,[30] with fires that darkened São Paulo with their smoke. And in the first four months of 2020, deforestation in the Amazon was already 55 percent higher than 2019, possibly due to reduced law enforcement during the COVID-19 pandemic.[31] Another region of Brazil, the Cerrado, is also a hotspot for deforestation and conversion of grassland ecosystems. This region has fewer legal protections and is not covered by existing moratoriums. Other South American countries such as **Colombia, Peru, Ecuador, Bolivia and Paraguay** are also countries of concern for commodity-driven deforestation, as well as **parts of Central America** and **southern Mexico**.

Figure 3a GHG emissions from deforestation and logging in South America, 2010-2018. Map created using data from Global Forest Watch

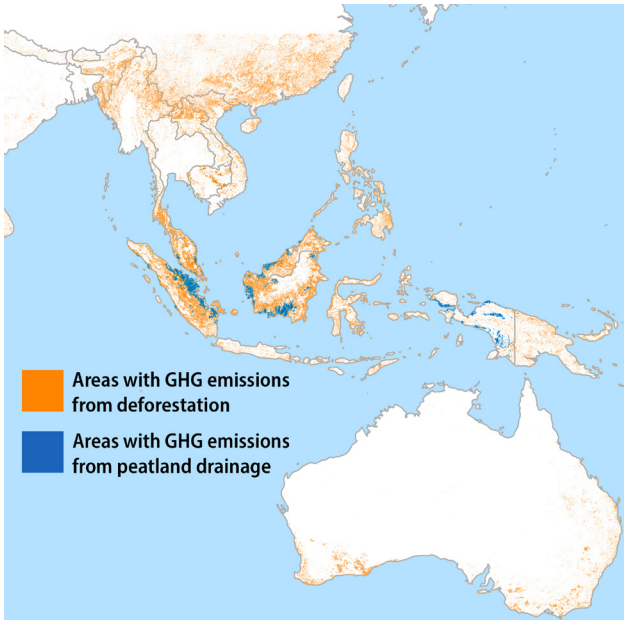


Figure 3b GHG emissions from deforestation, logging and peat drainage in Southeast Asia and Australia, 2010-2018. Map created using data from Global Forest Watch

Indonesia has historically had one of the highest rates of deforestation in the tropics, but progress has been made in the last few years to slow natural forest losses. In 2018, deforestation fell by 40 percent compared to the annual rate from 2002-2016.[32] However, Indonesia still has one of the highest rates of deforestation-related emissions, and hotter and drier weather in 2019 led to a particularly bad fire season and deforestation increases. Neighboring **Malaysia** also has high deforestation rates, with a 26 percent decrease in tree cover from 2000-2018.[33]

Deforestation in Indonesia and Malaysia—of which palm oil production is the largest driver—has a disproportionate impact on climate change because it often occurs on peatlands. Peatlands are water-logged soils that are mostly organic matter. These soils can store up to 10 times as much carbon as the trees that grow in them, but when they are drained to plant crops, that carbon is released as CO_2. Nearly one quarter of tropical deforestation-related GHG emissions are due to peatland drainage.[34] Peatland soils continue to emit CO_2 for decades after drainage, making them an enduring contributor to climate change. Once drained, they are also very susceptible to fire.

Most deforestation-related GHG emissions in Africa are due to smallholder subsistence farming rather than commercial farming, so these emissions do not usually show up in global supply chains.[35] There are a few exceptions, such as cocoa production in West Africa. Around two-thirds of all cocoa globally is produced in **Côte d'Ivoire** and **Ghana**, where it has historically been a driver of deforestation.[36]

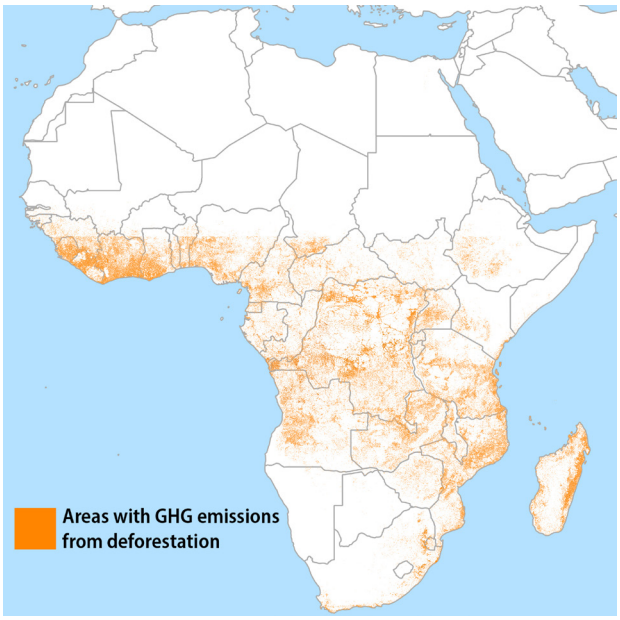


Figure 3c GHG emissions from deforestation and logging in Africa, 2010-2018. Map created using data from Global Forest Watch

TEMPERATE AND BOREAL FORESTS

While tropical forests face the highest pressures for large-scale conversion to agriculture, forests at boreal and temperate latitudes also face pressure from timber extraction and other forestry activities. Large swaths of these forests, especially in boreal regions such as northern Canada, are on frozen peatlands that, like their tropical counterparts, store large amounts of irrecoverable carbon.[37] These peatlands are threatened by melting and fires that have been exacerbated by temperature increases.[38] Investors can reduce these risks by encouraging companies sourcing timber and wood pulp (paper products) to strengthen their no-deforestation and forest management policies. For example, logging activities should be discouraged in intact, previously undisturbed forests.

Commodity drivers of deforestation

Beef and leather,[40] palm oil, soybeans, forest products such as timber and pulp, rubber, cocoa and coffee are all major drivers of deforestation that commonly show up in global supply chains (Figure 4). These commodities collectively account for 62 percent of tropical deforestation-related GHG emissions. Maize (9 percent) and rice (8 percent) are also significant drivers of deforestation in Indonesia, the Democratic Republic of the Congo and Brazil; however, these staple crops are primarily consumed domestically in these countries and are less likely to show up in the supply chains of multinational companies.[41] The remaining 20 percent of emissions are due to a wide variety of other commodities, each responsible for between 1-2 percent of emissions.

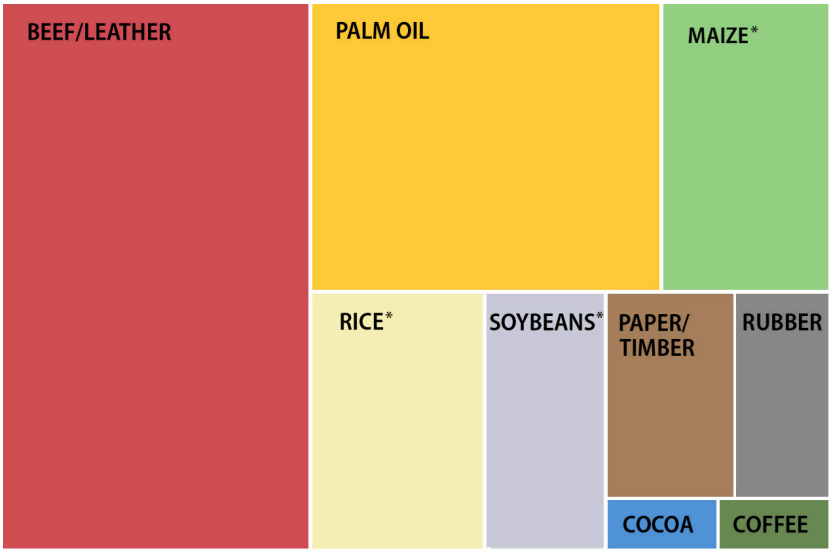


Figure 4 Distribution of tropical deforestation-related GHG emissions between globally-traded commodities. *Maize and soybeans are often grown on the same land during different seasons in Brazil; emissions have been divided between the two crops. *Maize and rice are primarily consumed domestically. Data from Pendrill et al. (2019).[39] A complete data table with all commodities is available on the companion website to this guide.

Many of these commodities are also produced primarily for domestic consumption, with a few exceptions such as sugar cane and wheat of which 30-40 percent of emissions are embedded in exports.[42]

GHG emissions from soybean cultivation are likely to be higher than the data show in Figure 4 because soybeans are also a major driver of conversion of savanna and grassland ecosystems in Brazil, which typically do not show up in deforestation estimates. The same is true of timber and pulp; the emissions represented in Figure 4 only reflect tree plantations, such as removing natural forests and replacing them with fast-growing tree species such as *Acacia* and *Eucalyptus*. Selective logging in natural forests does not result in sufficient loss of tree cover to be considered deforestation, but it does contribute to carbon losses from forest landscapes. While this carbon may be re-sequestered by tree re-growth, this process takes time—in many cases, more time than we have to avoid dangerous climate impacts.

Uncertainty in attributing deforestation to specific commodities

Attributing deforestation to specific commodities is complex and uncertain since there is often a lag time of one or two years between the deforestation event and when the crop is planted. Additionally, deforested land is often converted to an intermediate use before the final use. For example, deforestation in Brazil is oftentimes driven by land speculation, where buyers purchase the land, set fire to the forest to convert it to pasture and then quickly sell it to a soy producer at an increased price.[43] For this reason, robust corporate no-deforestation policies should apply to *all* commodities sourced by a company and specify cut-off dates—the date after which deforestation renders an area non-compliant with the policy. By strengthening policies in this way, companies send market signals discouraging speculative deforestation. For details on the methodology used to attribute deforestation to specific commodities, please see Pendrill et al. (2019) and the website that accompanies this guide.

PART 4
Assessing Portfolio-wide Deforestation Risk and Prioritizing Engagements

Translating deforestation-driven climate risk at the security/company level requires understanding a company's exposure to deforestation. To assess these risks and prioritize company engagements, investors should analyze their exposure based on the sectors and industries represented in their portfolios, as well as the geographic location of the securities in those sectors and industries. Once potential companies have been identified, investors should consider their commodity sourcing patterns to highlight specific risks and actions companies are taking to mitigate those risks (Figure 5).

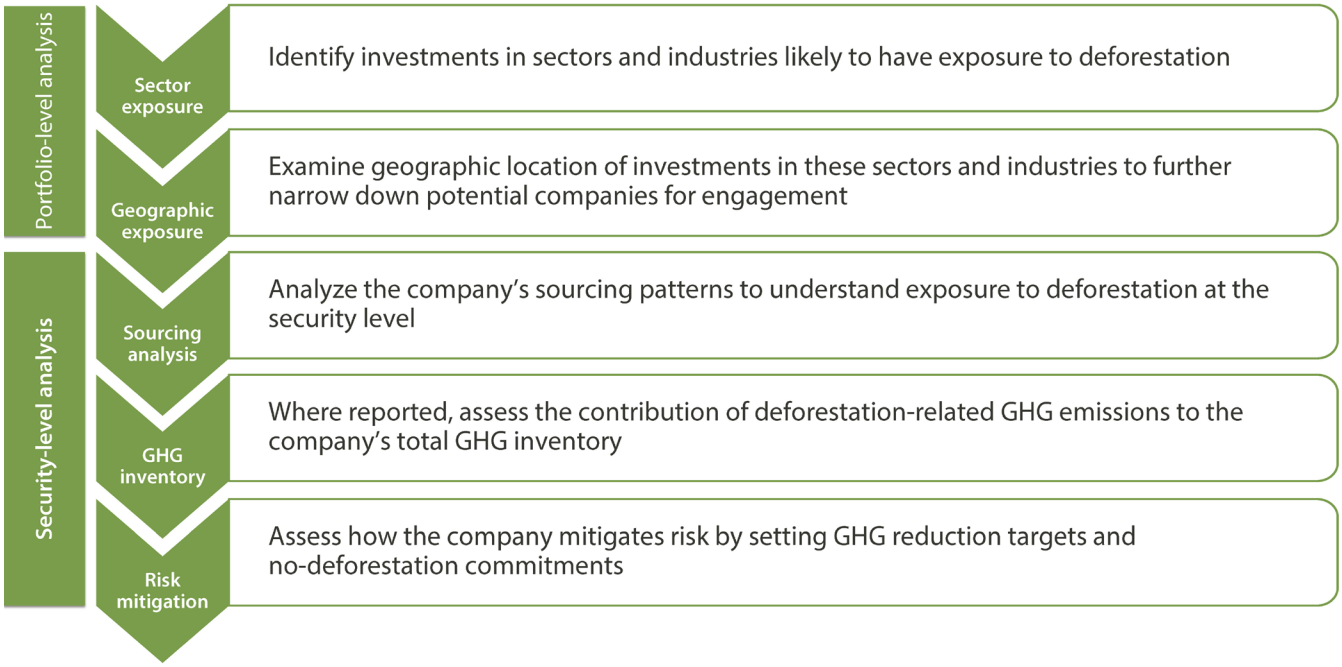


Figure 5 Framework for assessing deforestation-driven climate risk

Portfolio-level analysis

Sector exposure to commodity-driven deforestation

Companies in many sectors and industries are exposed to deforestation through their sourcing of commodities that are drivers of deforestation (Table 2). Consumer staples are exposed to nearly every commodity associated with deforestation. Within this sector, the food products and food & staples retailing industries are likely to have high exposure due to the prevalence of all forest risk commodities across their supply chains. However, deforestation exposure is not unique to these food industries. Palm oil is also used widely in soaps, detergents and makeup, creating exposure in household products and personal products industries.

The consumer discretionary sector has several industries that are exposed to deforestation due to their reliance on leather, rubber, timber and paper. Textiles, apparel and luxury goods are exposed to deforestation from cattle due to leather sourcing as well as wood pulp used to make fabrics. Hotels, restaurants & leisure companies are exposed through food sourcing for restaurants.

In the materials sector, containers and packaging and paper and forest products are exposed to deforestation associated with forest plantations, as well as additional emissions from forest degradation due to logging. Finally, the financial sector is exposed to deforestation risk through financing of the industries described above.

The number of different commodities sourced by an industry is indicative of the breadth of potential exposure of individual companies within the industry, but it is not numerically proportional to the exposure of companies within that industry. Deforestation risk depends on the particular commodities and the volume of those commodities being sourced since some commodities are bigger drivers of deforestation than others. Deforestation risk further depends on the geographies from which companies are sourcing their commodities and the company's approach to managing deforestation in their supply chains. Assessing these components of deforestation risk generally requires company engagement. Guidance on this is described under company/security-level analysis.

Table 2 Sector and industry exposure to commodities associated with deforestation using the Global Industry Classification Standard (GICS®)

Sector	Industry	Commodities associated with deforestation
Consumer staples	Food Products	**Beef**, **cocoa** and **coffee** are relatively easy to spot in grocery products, but **palm oil** and **soybeans** may be hidden in processed products. **Palm oil** and its derivatives are widely used in food processing and show up in products such as bread, pastries, cereal, peanut butter, chocolate and margarine. **Soybeans** are made into soybean oil for cooking and are consumed by pigs and poultry as soy meal, so emissions from soy-related deforestation are embedded in those products.
	Household Products; Personal Products	**Palm oil** and its derivatives are widely used in soaps, detergents and makeup. **Cocoa** butter is also used in personal care products.
	Food & Staples Retailing	Food distributors and retailers source **all food commodities** associated with deforestation, as well as **paper** products for packaging and shipping.
Consumer discretionary	Textiles, Apparel & Luxury Goods	Footwear and luxury goods companies source **leather** and **rubber.** Textiles and apparel industries use woven fiber from **wood pulp**, often sourced from deforested areas, into rayon, viscose and modal fabrics.
	Household Durables	Home furnishings use **leather** and **timber**.
	Hotels, Restaurants & Leisure	Hotels, restaurants and resorts source **paper** and **food commodities**, as well as timber used in furniture.
	Auto components	Tire manufacturers source over 70 percent of the world's **rubber**. **Leather** is also used in automobile interiors.
	Internet & Direct Marketing Retail	Internet and direct marketing retailers source products containing **all commodities** associated with deforestation, such as food products, footwear, apparel and furniture. They also use large amounts of **paper** packaging in their shipping operations.
	Multiline retail; Specialty retail	Retailers of shoes, apparel, office supplies, auto parts and home furnishings are exposed to deforestation through products using **leather**, **rubber**, **timber** and **paper**.
Materials	Containers & Packaging	Forest plantations for wood pulp (**paper** and **cardboard**) production, are a major driver of deforestation.
	Paper & Forest Products	Forest plantations for wood pulp (**paper** and **cardboard**) and **timber** are a major driver of deforestation.
Energy	Oil, Gas & Consumable Fuels	**Soybean oil** and **palm oil** are used for production of biodiesel.
Utilities	Independent Power and Renewable Electricity Producers	Biomass power plants burn **wood pellets**. Claims that this process is carbon neutral have been disputed by scientists.[44]
Financials	Banks	Finance institutions are exposed to deforestation through their financing of companies in all of the above industries.

Geographic portfolio exposure to commodity-driven deforestation

Identifying investments in key sectors that source commodities associated with deforestation is an important first step in assessing portfolio-level deforestation exposure. To further narrow securities for engagement, investors should examine the countries where they are invested in these industries.

Most GHG emissions from tropical commodity-driven deforestation occur in emerging economies such as Indonesia, Brazil and Malaysia. Investors may therefore have significant exposure through their investments in these emerging markets. However, due to global trade of forest-risk commodities, emissions are also embedded in the supply chains of companies in *developed* markets, as well as *other* emerging market economies where deforestation is less prevalent. All told, up to 39 percent of deforestation-related GHG emissions are driven by international trade. The top six economies—the United States, European Union, Japan, China, India and Pakistan—collectively "import" about 17 percent of global GHG emissions from tropical commodity-driven deforestation through their use of commodities produced on deforested land (Figure 6).[45]

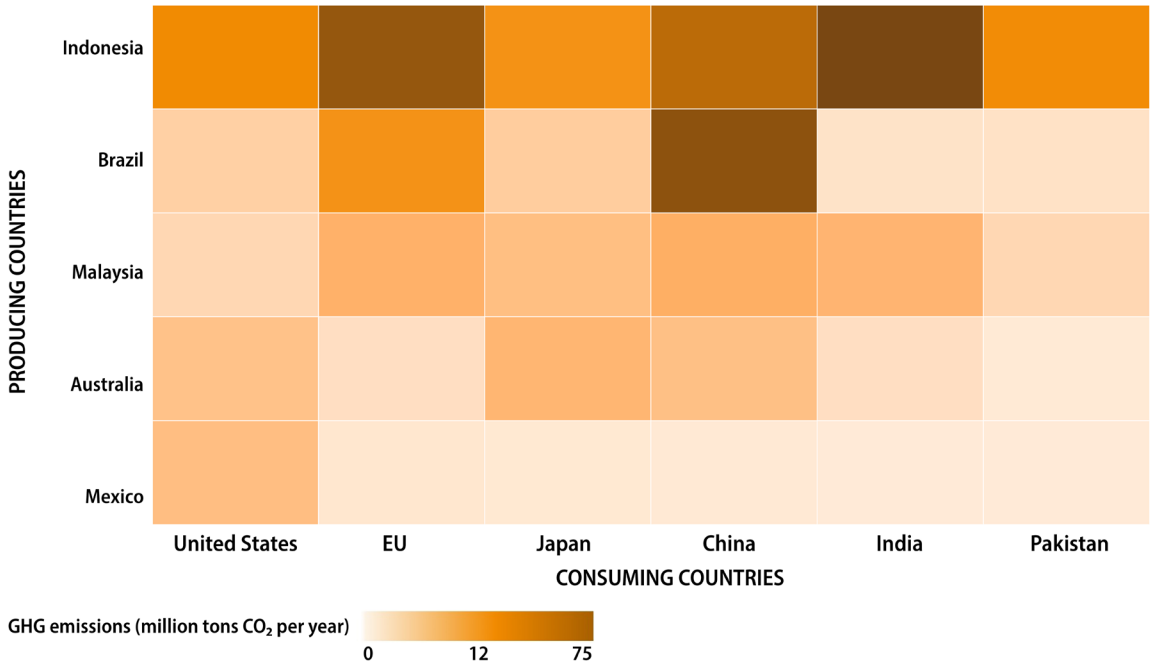


Figure 6 Heatmap showing flow of deforestation-related GHG emissions from producing to importing countries, covering 50 percent of emission flows embedded in trade. The importing country is not necessarily the country of final consumption, but rather where the agricultural or forest commodity is used for manufacturing. Data from Pendrill et al. (2019).[46] Data table available on the companion website.

The balance of exposure between emerging and developed economies varies by commodity. Beef from tropical countries with high deforestation is primarily consumed domestically. Exposure to beef-related deforestation in the food products, food retail and hotel industries is more likely to be concentrated in emerging economies. The same holds true for timber and pulp products from tropical countries. (Developed economies may be exposed to emissions related to forest degradation in northern latitudes, but that data is not represented or used in this report.) Deforestation-related emissions from other commodities such as soybeans and palm oil are primarily exported, and are more likely to be embedded in products sourced by companies in developed markets.

Deforestation driven by domestic consumption, as well as exports to other emerging markets, may still be a source of exposure for equities listed in developed markets. Companies based in the U.S. and EU have manufacturing operations all over the globe, and produce food, beverages and other products for consumption in emerging markets. For example, while most chocolate produced in Brazil is consumed domestically, the Brazilian chocolate market is dominated by multinational companies such as Nestlé and Mondelez, which are headquartered in Switzerland and the U.S., respectively. Data on the location of company headquarters and operations may be available in 10-K filings.

Company/security-level analysis

Once priority companies have been identified for engagement, investors can scrutinize the exposure of each company in three ways: analyzing the company's sourcing patterns; examining the company's GHG inventory; and evaluating the company's deforestation mitigation strategy.

Sourcing analysis

In the previous section, we described how to assess portfolio-level exposure based on production and trade patterns of forest-risk commodities. At the security level, investors can further assess company-specific risks based on the countries—and even locations within those countries—from which companies source particular commodities.

Commodities that drive deforestation-related emissions differ widely between countries. Information on these commodity-country combinations can be used to conduct an initial screening for deforestation exposure at the security level by examining from where companies are sourcing their commodities and comparing it against the countries in which each commodity is a driver of deforestation (Figure 7). For example, companies sourcing beef and soybeans from Brazil or palm oil from Indonesia are likely to have deforestation exposure; these commodity-country combinations are collectively responsible for about 37 percent of GHG emissions from tropical commodity-driven deforestation.[47] Companies sourcing soybeans from Brazil are far more likely to be exposed to deforestation than companies sourcing soybeans from the United States.

Many companies, especially in the food and beverage sector, include a list of key commodities they source in their 10-Ks and other financial filings. This data may also be available in sustainability reports and other public sustainability disclosures such as CDP reports, as well as in materials that Ceres provides to its investor network members.

While some companies disclose more detailed sourcing information—such as from what countries and in what volumes they source these commodities—this information is not widely available. Disclosures are often limited to direct (tier 1) suppliers that provide raw materials and inputs and fail to include indirect (tier 2) suppliers—from whom their suppliers purchase raw materials and inputs—that are also sources of exposure. Investors should consider seeking this tier 2 data to better understand a company's sourcing patterns.

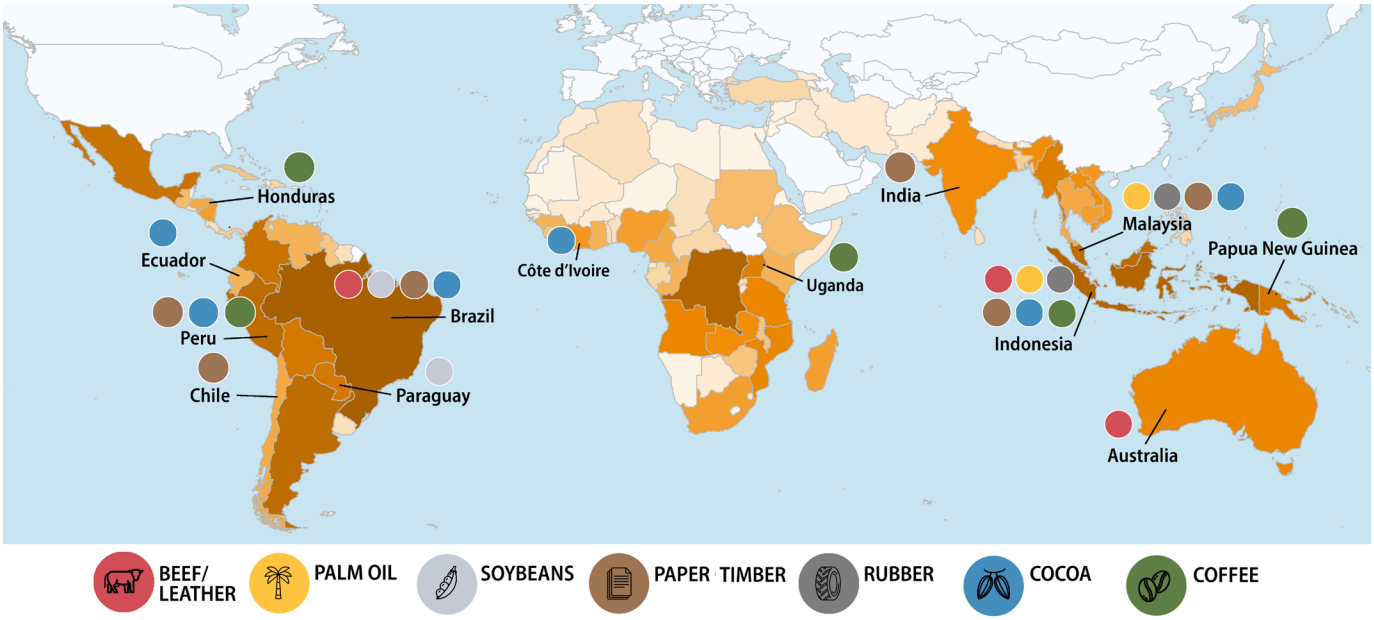


Figure 7 Geography of deforestation-related GHG emissions due to each of the major commodities that are drivers of deforestation. Countries are shaded according to the total deforestation-related GHG emissions occurring in that country. Commodity icons are shown for each country that contributes at least 5% of the total tropical deforestation-related emissions for that commodity. Data from Pendrill et al. (2019). [48]
Data table available on the companion website to this guide.

ENGAGEMENT OPPORTUNITIES TO REDUCE DEFORESTATION ON THE GROUND

Investors should urge companies that source commodities from high-risk countries to adopt and implement a robust no-deforestation commitment and engage constructively with suppliers before moving sourcing away from these regions. While moving sourcing away from high-risk areas reduces company exposure to deforestation risk, it doesn't always reduce deforestation on the ground because producers involved in deforestation may simply find less scrupulous buyers—sometimes called "leakage markets"—for their products. Engagements with traders and banks are a potentially effective tool to address leakage markets.

Within supply chains, deforestation exposure is often concentrated with traders, meatpackers (beef) and refiners (palm oil). Most traded commodities are handled by a relatively small group of traders, many of whom are active in several commodities and in multiple countries. For example, of the 2,500 traders exporting forest-risk commodities from Latin America, just three-dozen account for over half of those exports.[49] Because of their major role in supplying commodities to thousands of companies, engagements with traders are an especially effective way to reduce demand for commodities from deforestation-sensitive areas. More information on this activity can be found in Ceres' Engage the Chain website.

A banking engagement strategy is another way for investors to address leakage markets. Key players in leakage markets, especially in the palm oil industry, tend to be debt-financed by banks.[50] A 2019 study by Boston Common Asset Management found wide-ranging disparities in how 58 banks were managing climate risk associated with deforestation and biodiversity loss. Only 16 percent of the banks required clients to adopt no-deforestation policies and even fewer had expanded policies covering all soft commodities beyond palm oil. The data showed a systematic reluctance by banks to demand higher client standards.[51]

GHG inventory analysis

In line with recommendations of the Task Force on Climate-related Financial Disclosures, company disclosure of GHG emissions has become a core baseline expectation of global investors. In theory, a company's GHG inventory should be a key source of information to understand its exposure to potential deforestation risk. A full GHG inventory, including emissions from deforestation, would allow a company and its investors to determine if deforestation-related emissions are a material risk. However, most company GHG inventories that are reported to CDP and other organizations are inadequate for this purpose. **Corporate accounting and disclosure of GHG emissions from deforestation is currently extremely poor.** As a result, analysis of a company's sourcing patterns, as described in the previous section, is currently a more accurate way to gauge exposure. Nonetheless, it will be useful for investors to understand where to look for GHG emissions from deforestation and conversion in a company's GHG inventory, and how reporting expectations on these emissions are changing.

Most companies use the framework of "scopes," developed by the GHG Protocol,[52] to track and report GHG emissions (Figure 8). Scope 1 emissions are from sources owned or controlled by the company. Scope 2 are emissions released in generating electricity, heating or cooling used by a company. Scope 3 are other indirect emissions from a company's supply chain, including emissions from agricultural and forest products. For most companies—packers and processors, traders and distributors, food manufacturers and retailers—GHG emissions from agricultural production, deforestation and conversion fall under scope 3. These emissions would fall under scope 1 for companies owning or controlling agricultural and forestry operations. This is especially relevant for the palm oil industry, which tends to be vertically integrated; traders and distributors of palm oil generally own plantations as well as sourcing product from independent producers.

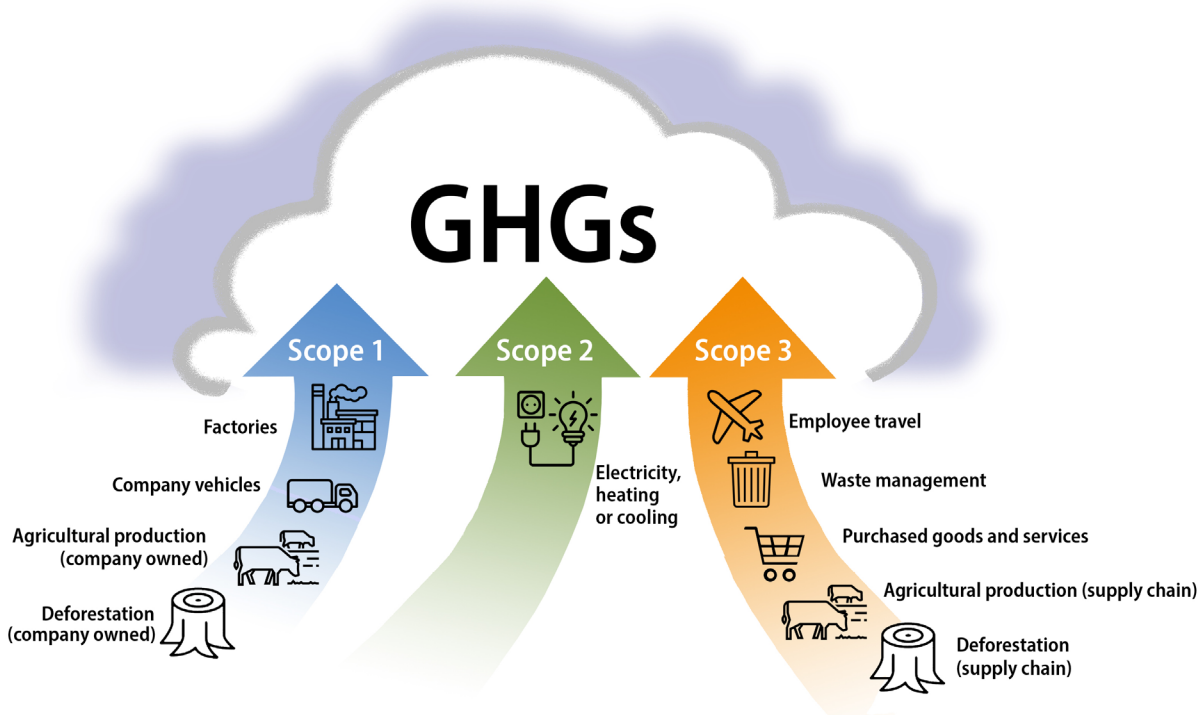


Figure 8 How deforestation-related GHG emissions show up in corporate GHG inventories and disclosures. For most companies, GHG emissions from agricultural production, deforestation and conversion would fall under purchased goods and services, with the exception of companies who own their own agricultural production operations.

Existing standards for corporate GHG emissions disclosures do not provide detailed guidance for companies to report emissions from deforestation and conversion. As a result, most companies do not include these emissions in GHG inventory reporting. And even when companies include these emissions, the calculations often rely on global or regional averages because they don't have sufficient visibility into their supply chains to estimate deforestation-related emissions embedded in their own sourcing. Part 5 further describes the importance of supply chain traceability and how to engage companies on this topic.

Standardized methods to appropriately account for land-based emissions will be included in forthcoming guidance from the GHG Protocol.[53] The World Wildlife Fund (WWF) is also developing sector-specific guidance for emissions from forests, land and agriculture as part of requirements for setting science-based GHG targets validated by the Science-Based Targets Initiative (SBTi).[54] (The SBTi is a partnership between CDP, the UN Global Compact and other groups.) Together, these actions will help shift industry standard towards inclusion of land-based emissions, including deforestation emissions, in science-based targets. They will also ensure more consistent accounting and disclosure of deforestation-related GHG emissions.

Assessment of broader climate risk mitigation by companies

Deforestation-driven climate risk is a function of a company's exposure to deforestation based on its commodity sourcing patterns and the way in which the company responds to manage exposure and mitigate risk. To address the systemic risk of climate change, all companies should have a broader climate strategy with ambitious greenhouse gas reduction targets for all of its emissions. For companies with direct exposure to deforestation, a robust no-deforestation commitment must be a part of the overall strategy a company employs to achieve its climate commitments. Investors can use the framework outlined in Part 5 to assess whether a company's climate and no-deforestation commitments and policies are sufficiently rigorous to reduce overall climate and deforestation risks.

PART 5
Evaluating Corporate Actions and Engaging with Companies

Effective corporate response to climate change and deforestation should have three components: ambitious, time-bound GHG reduction targets that include deforestation emissions; a no-deforestation policy with strong supply chain implementation; and transparent disclosure of progress – or lack of progress – on both no-deforestation and climate targets. A company's policies and implementation plan for eliminating deforestation from its supply chains must be a part of its overall climate strategy (Figure 9).

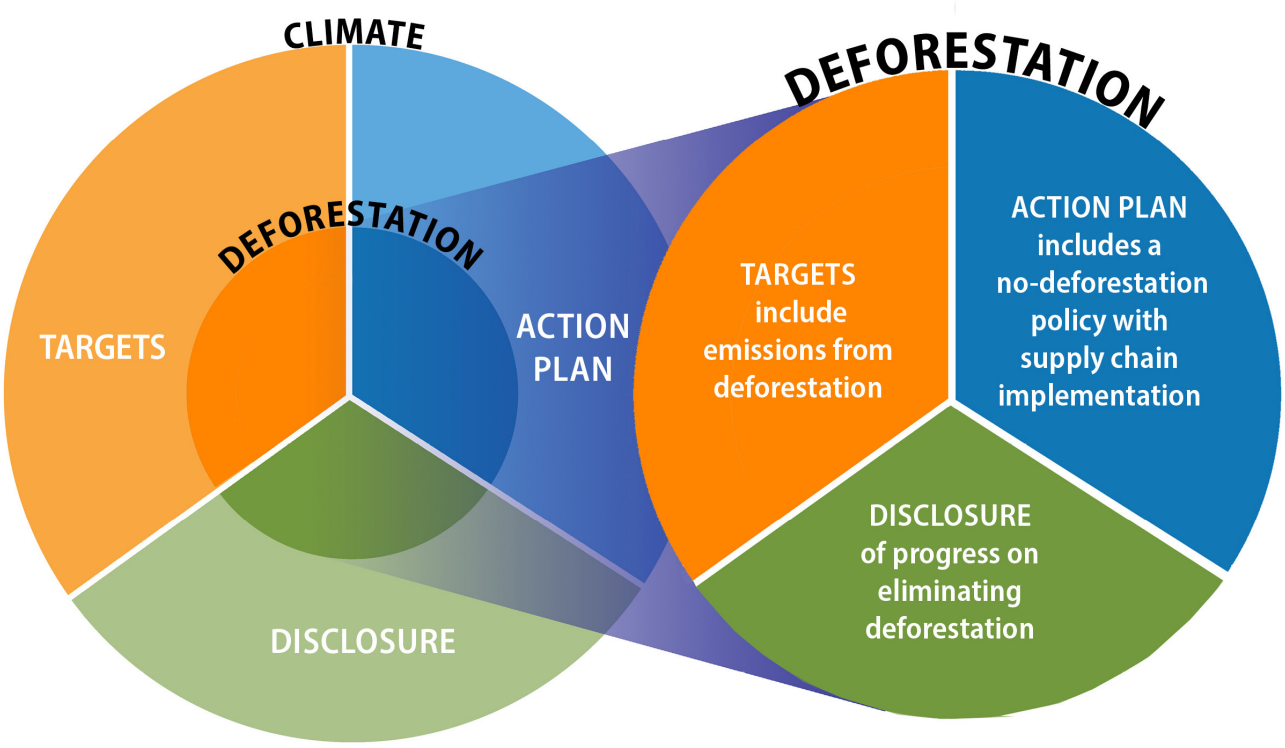


Figure 9 For companies with deforestation exposure, eliminating deforestation from supply chains should be a key component of corporate actions to address climate risk. Companies should: (1) include emissions from deforestation in their climate targets; (2) set and implement no-deforestation policies as part of their climate action plans; and (3) disclose on progress in eliminating deforestation and related emissions along with overall progress on climate targets.

The following pages outline specific policies and actions companies should use to reduce overall GHG emissions and eliminate deforestation in their supply chains. Investors can use this information to guide their engagements with companies, whether in specific dialogues, letters, meetings or shareholder resolutions focused on deforestation or climate change. The engagement framework and key performance indicators were developed in collaboration with Principles for Responsible Investment (PRI) and the investors participating in the Investor Initiative for Sustainable Forests.

Company climate targets

Setting and implementing ambitious GHG reduction targets are key to addressing climate risk.

Eliminate GHG emissions from commodity driven deforestation

Key elements

- ✓ Targets are science-based and in line with what is needed to limit warming to 1.5 degrees Celsius.
- ✓ Targets cover a company's full scope of emissions.
- ✓ Targets include emissions from land use change.

Science-based targets. A science-based target is a GHG emissions reduction target that aligns with what climate science says is necessary to limit global warming to 1.5 or well-below 2 degrees Celsius above pre-industrial levels. A company can ensure that its climate target aligns with global standards by seeking validation from the Science Based Targets initiative (SBTi). Investors can also engage companies to set interim reduction goals ahead of target deadlines to ensure they are on track.

Full scope of emissions. To be approved by SBTi, companies must set a target for scope 3 emissions if the company's scope 3 emissions represent more than 40 percent of its total emissions when calculated using standards set by the GHG Protocol. For food and beverage companies, scope 3 sources are typically closer to 90 percent of a company's total emissions, primarily from sourcing agricultural products.[55]

Emissions from land use change. The GHG emission inventory should include any emissions from agriculture and land use change associated with purchased raw materials, ingredients and services. This includes GHG emissions from deforestation and other land conversions, fertilizer use, emissions from livestock and rice production and other agricultural sources.

COMPANY CLIMATE TARGETS: KEY ENGAGEMENT QUESTIONS

- Does the company calculate scope 3 emissions including emissions from deforestation and land use change?
- Are the company's GHG reduction targets science-based and in line with a 1.5 degree scenario?
- Does the company have GHG reduction targets for scope 1, 2, and 3 emissions, including emissions from deforestation land use changes?

BOARD LEVEL OVERSIGHT

As part of their role as stewards of long-term company performance, corporate boards have a critical role to play in overseeing corporate sustainability strategies. The oversight should be closely aligned with company business models and operations. To fulfill this role, company boards should: include board members with sustainability expertise; establish committees with formal mandates focused on climate risks and opportunities; and create incentive structures linking executive compensation to performance on key sustainability commitments, including climate change and deforestation. For more details on this topic, please see the report, Climate Running the Risk: How Corporate Boards Can Oversee Environmental, Social and Governance (ESG) Issues.

Meeting climate targets requires addressing supply chain deforestation

Companies that source forest-risk commodities cannot meet full scope, science-based emissions reductions targets, as recommended in the previous section, without implementing comprehensive no-deforestation policies. Deforestation-related emissions contribute substantially to GHG emissions of companies that produce or source forest-risk commodities. Beef processors or palm oil traders may have deforestation-related emissions 8-10 times greater than their emissions from operations (scope 1) and electricity use (scope 2).[56] Emissions from deforestation are also significant for companies downstream in the supply chain. Mars Inc., a U.S.-based food manufacturer, for example, estimated that 29 percent of the company's total emissions are from deforestation and conversion associated with sourcing of raw materials from tropical countries.[57]

Sourcing decisions make a significant difference in a company's deforestation-related GHG footprint. Within key countries of concern, deforestation is often most prevalent within certain municipalities. For example, 40 percent of deforestation-related GHG emissions from Brazilian soy production come from just 1 percent of soy-producing municipalities (Figure 10).[58] Being able to trace a commodity beyond the country of origin allows companies to understand the actual GHG emissions associated with that commodity (see "Supply Chain Implementation" below). For example, the estimated total GHG footprint of a kilogram of soybeans varies dramatically depending on the deforestation in areas where it was grown. Eliminating deforestation could reduce the GHG footprint of soybeans by 39 percent on average (Figure 10). With this understanding, companies should engage suppliers in these crucial municipalities and work to enforce no-deforestation policies. By targeting efforts to address deforestation in this way, companies could dramatically reduce the deforestation-related GHG emissions from their sourcing.

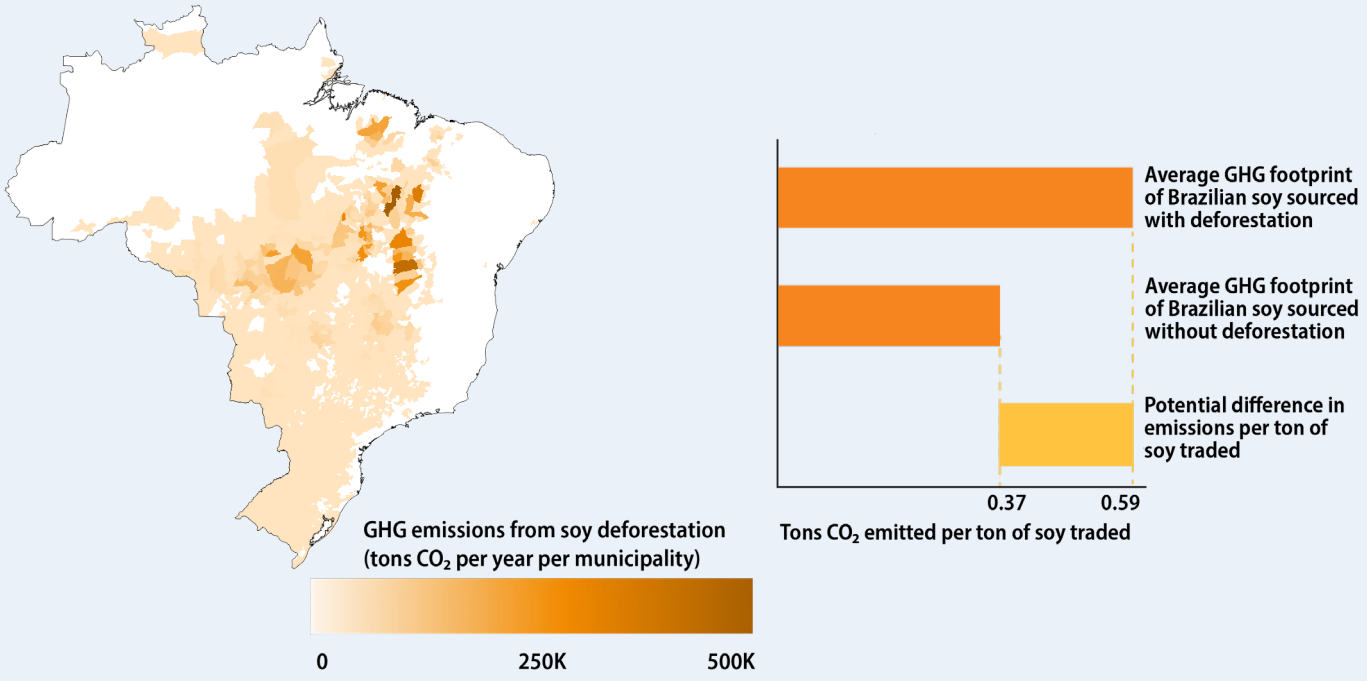


Figure 10 GHG emissions per ton of soy traded from Brazil. The map on the left shows GHG emissions due to deforestation per ton of soy for each soy-producing municipality in Brazil. The chart on the right shows the difference in the total GHG footprint (GHG emissions per ton of soy) of soy produced with and without deforestation. The "without deforestation emissions" are due to transport, processing, and crop management practices such as fertilizer application. Data from Escobar et al. 2020.[59]

No-deforestation policy

To effectively mitigate deforestation-driven risks, companies should have robust no-deforestation policies with sufficient breadth and detail to eliminate deforestation from their supply chains. Investors should also engage companies on setting interim goals ahead of commitment deadlines. These recommendations are aligned with the Accountability Framework's core principles of how companies should set, implement and monitor deforestation commitments.

No-Deforestation Policy

Key elements

- ✓ Policies should apply to all commodities and all regions where the company sources commodities.
- ✓ Policies should cover indirect suppliers as well as direct suppliers.
- ✓ Policies should be paired with time-bound commitments to eliminate deforestation.

Commodity coverage. No-deforestation policies should apply to all commodities sourced by a company. These policies should also include commodity-specific language, including a risk-based approach to expanding the policy beyond core raw materials. Policies should also cover all regions where commodities are being sourced or may be used for future sourcing.

Indirect supplier coverage. No-deforestation policies should cover entire supply chains including all indirect suppliers. Companies have more influence over direct (tier 1) suppliers and less influence over indirect (tier 2 and beyond) suppliers. However, in terms of material supply chain risks and overall GHG emissions, it is equally important for companies to understand and monitor indirect suppliers and where and how they are sourcing their commodities.

Time-bound commitments. Commitments to achieve deforestation-free supply chains should be linked to specific timeframes that are both achievable and contain sufficient urgency aligned with recognized global expectations. These commitments should also be quantifiable.

NO-DEFORESTATION POLICY: KEY ENGAGEMENT QUESTIONS

- Does the company have a no-deforestation policy that is publicly available?
- Does the deforestation policy cover all commodities, especially key commodities such as beef & cattle, soy, palm oil and pulp/paper?
- Does the policy apply to all geographies that the company sources from and all markets where the company operates?

NO-CONVERSION COMMITMENTS

Although the definition of deforestation is limited to the loss of natural forests, other carbon-rich ecosystems are often converted for agricultural uses. For example, companies may source soybeans from the Brazilian Cerrado, which consists of a mix of forests, woodlands and grasslands. It is challenging to distinguish forests from other types of vegetation in this region, both practically and legally. The Accountability Framework recommends that companies with an existing deforestation commitment replace it with a no-conversion commitment for the Cerrado. In the future, companies will be expected to adopt no-conversion policies and commitments for all supply chains to ensure complete coverage of regions where important ecosystems, both forests and others, are being lost. Companies without an existing no-deforestation policy should consider a no-conversion policy to ensure future compliance with industry expectations.

Supply chain implementation: Monitoring, evaluation and incentives

A no-deforestation policy is only effective if the company ensures implementation of the policy throughout its supply chains. Companies should implement no-deforestation commitments by developing mechanisms for monitoring and verifying supplier compliance with corporate policies, addressing non-compliance, and incentivizing agricultural practices that protect forests.

Supply Chain Implementation (Monitoring, Evaluation and Incentives)

Key elements

- ✓ Companies should be able to trace their raw materials throughout their supply chains to a level that assures compliance with no-deforestation policies.
- ✓ Companies should monitor and verify supplier compliance with their no-deforestation policy.
- ✓ Companies should develop a protocol for suppliers that are not complying with the deforestation policy.
- ✓ Companies should provide incentives to producers to protect forests.

Traceability to origin. Traceability, or the ability to track a commodity along a supply chain, allows a company to maintain transparency and ensure that its suppliers are complying with company polices. Primary processors and traders of commodities should be able to trace commodities from direct and indirect suppliers to the farm, estate, plantation, ranch, or forest management unit where they were produced (point of origin). Downstream buyers such as manufacturers and retailers should be able to trace commodities from direct and indirect suppliers to the point at which the company can assure compliance with its policies (point of control). Traceability is critical given that a commodity's emissions from deforestation may vary widely depending on where within a country it was produced (Figure 10).

Monitoring and verification of full supply chains. Companies should implement robust monitoring and verification processes to ensure suppliers are complying with its policies. For even the most downstream companies, monitoring and verifying supplier compliance to these policies is crucial. Simply put, complete scope 3 emissions disclosure, including deforestation emissions, cannot be calculated without full traceability.

- **Third party verification.** If possible, the verification process should be done by an independent third-party to ensure that sourced products adhere to the company's policies as well as broader industry and nonprofit standards
- **Grievance mechanisms.** A grievance mechanism is a formal, legal or non-legal complaint process that individuals, workers, communities and/or civil society organizations can use to report instances where certain business activities and operations negatively affected them. Effective grievance mechanisms are a crucial component of corporate human rights due diligence and can protect companies from reputational and litigation risks. Companies should develop and disclose a clear process for stakeholders to report deforestation, including disclosure of its process for investigating grievances.
- **Non-compliance protocols.** The verification process should include protocols for supplier non-compliance, including suspensions and facilitation of time-bound action plans to return suppliers to compliance.

Supplier/producer incentives. Companies should help suppliers transition away from deforestation by providing educational opportunities, technical training, financial support and other resources necessary to avoid further deforestation.

SUPPLY CHAIN IMPLEMENTATION: KEY ENGAGEMENT QUESTIONS

- Is the company working towards traceability to a commodity's point of origin for both direct and indirect suppliers?
- Does the company disclose supplier locations and if not, what are the challenges to providing this disclosure?
- Does the company have systems in place to monitor operations and suppliers for compliance with no-deforestation policies?

NET-ZERO VS. NO-DEFORESTATION AND THE ROLE OF FOREST RESTORATION

Companies differ in how they phrase their deforestation policies, but there is one word that makes a big difference: "net."

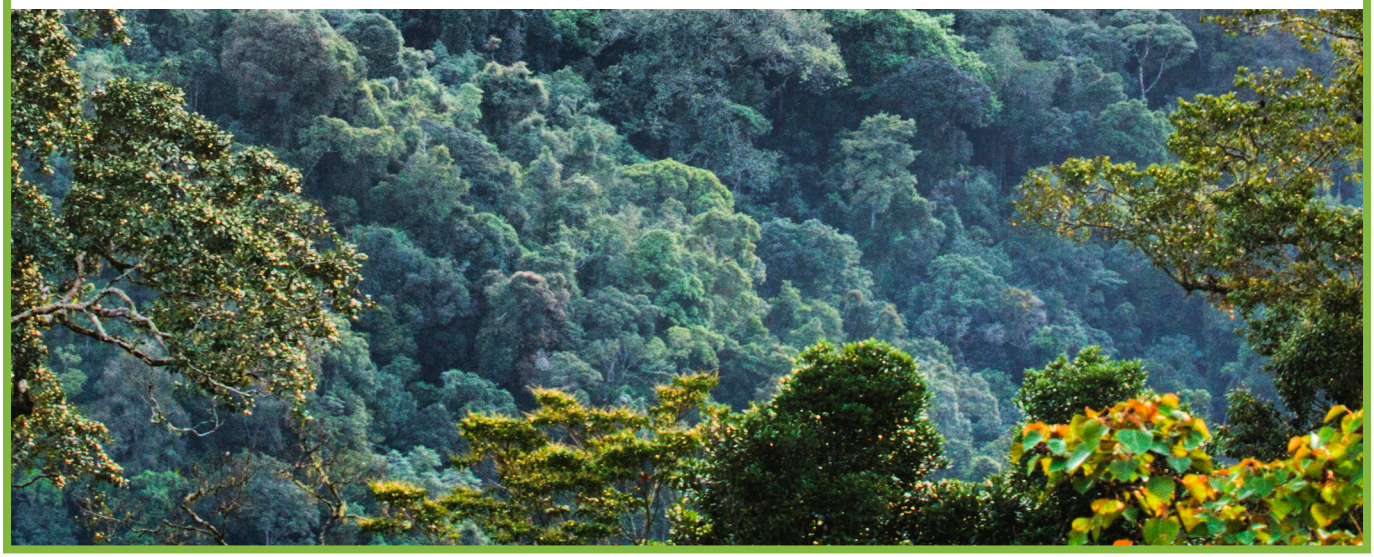
No-deforestation Does not allow for any deforestation in supply chains, whether legal or illegal. This is also referred to as "zero-gross" deforestation.

Net-zero deforestation Allows for deforestation as long as the same area of forest lost is reforested elsewhere.

No-deforestation is a more robust commitment because:

- Reforestation does not negate **reputational** risks that companies face by having deforestation exposure in their supply chains. Deforestation events can still be linked to their supply chains by monitoring organizations.
- Reforestation is not a substitute for protecting existing forests. Forests and other natural ecosystems store large amounts of "irrecoverable carbon"—carbon that is vulnerable to release upon land use conversion, and once lost, cannot be re-sequestered in time to avoid catastrophic climate change.[60]

When done in tandem with protecting existing forests, **reforestation is a critical part of the solution to climate change. But it must be done carefully.** Reforestation projects must respect the land rights and livelihoods of local people, especially indigenous communities. Moreover, reforestation efforts should aim to restore biodiverse natural forests, not create monoculture tree plantations.



Disclosure of progress

Public disclosure of progress towards targets holds companies accountable to their commitments. By monitoring key climate and deforestation indicators for incremental progress, companies can make strategic adjustments to ensure they are reducing their risks.

Company discloses progress of eliminating deforestation and related emissions

Key elements

- ✓ Companies publicly and regularly disclose quantifiable progress to eliminate deforestation from their supply chains.
- ✓ Companies disclose quantifiable progress on GHG emissions reductions from land use change.

Quantifiable progress on eliminating deforestation. Few companies disclose quantitative progress toward eliminating deforestation from their commodity supply chains. As a result, it is difficult for investors to understand, analyze and mitigate risks within their portfolios. Given improving and increasingly accessible datasets and traceability tools, companies should report on the following metrics, which provide deep insights into corporate progress and impacts:

- **Percent of a commodity that is traceable.** Traceability reporting should include the percentage of a sourced commodity a company can trace to the product's origin or to a point at which the company can assure compliance with its policies.
- **Percent of suppliers in compliance.** Companies should disclose the percentage of their total suppliers that comply with their no-deforestation policies. They should also update these numbers to reflect recent suspensions due to non-compliance.
- **Percent of commodity in compliance.** Companies should disclose how much of their total supply of a commodity is in compliance with company policies and standards. This is particularly important when a company sources most of a commodity from just a few suppliers

Quantifiable progress towards GHG emissions reduction targets. Companies should disclose either percentage progress towards its full scope GHG emissions-reductions targets or percentage reductions from its baseline emissions on an annual basis.

DISCLOSURE OF PROGRESS: KEY ENGAGEMENT QUESTIONS

- Does the company disclose quantitative progress towards its no-deforestation and climate commitments on an annual basis?
- Does the company disclose progress on its no-deforestation and climate commitments in its own publications and third-party platforms such as CDP?
- Does the company disclose the percentage of its suppliers and percentage of the volume of commodities being sourced in compliance with its no-deforestation policy?

Company examples

Below are examples of companies working to address deforestation in their commodity supply chains and areas where they can further improve their commitments and actions.

Company climate targets
Mondelez, a US-based food company, reports annually to the CDP Climate questionnaire. According to its responses, the company has climate-related board-level oversight, including a Governance, Membership, and Public Affairs Committee on its Board of Directors that is responsible for overseeing sustainability as a part of its Snacking Made Right Impact Strategy. The company calculates the full scope of its GHG footprint on an annual basis, and in 2019, it included emissions from land use change in its emissions reporting to CDP. As of January 2020, Mondelez has a GHG reductions target approved to be aligned with a well-below 2-degree scenario by the SBTi. This target commits the company to reducing absolute scope 1, 2, and 3 GHG emissions by 10 percent by 2025, from a 2018 base year.

→ Mondelez can further strengthen its commitment by setting a target aligned with a 1.5-degree scenario.

No-deforestation policy
In its Sustainable Palm Oil Sourcing policy, consumer giant Unilever outlines specific plans for its palm oil supply chains, such as commitments to source palm oil with no deforestation, no peat developments and no conversion of High Carbon Stock (HCS) and High Conservation Value (HCV) forests. However, the company only commits to zero-net deforestation in its beef, palm oil, soy, and pulp and paper supplies by 2020.

→ Unilever can improve its no-deforestation policy by committing to zero-gross deforestation and disclosing a post-2020 plan.

Supply chain implementation
Wilmar, one of the world's largest palm oil plantation owners and processors, is working towards complete traceability to the mill level, including GPS coordinates for both direct and indirect suppliers and publicly disclosing the location of its refineries. In Malaysia and Indonesia, Wilmar has identified all supplying mills for its refineries and discloses information on the percentage of palm oil from each mill that is traceable to the plantation of origin. The company also has three monitoring and verifications programs that collect and assess data regarding supplier compliance with its No Deforestation, No Peat, No Exploitation (NDPE) policy. The company's Grievance Unit, Suspensions Committee and Verification Team work together to: assess any grievances regarding its NDPE policy; suspend contracts with suppliers when necessary; and develop time-bound action plans to return suppliers to compliance.

→ Wilmar could improve transparency by disclosing the percentage of palm oil suppliers covered by its monitoring and verification process.

Disclosure of progress
Nestlé has reported to the CDP Forests questionnaire annually between 2014 and 2017. While it declined to respond to CDP Forests in 2018 and 2019, the company continues to disclose its progress in its sustainability reporting, such as in its 2018 Creating Shared Value report. According to Nestlé's Implementing Responsible Sourcing report, it has achieved traceability for 54 percent of its palm oil supply to the plantation, 78 percent of its soy supply to the mill, and 32.5 percent of its meat, poultry and egg supplies to the farm level. Nestlé also discloses lists its Tier 1 suppliers and supplying mills for palm oil. As of 2017, 60 percent of its palm oil, 76 percent of its soy, and 99 percent of its meat supply was free from deforestation. Nestlé also responds to the CDP Climate questionnaire annually and reports on progress towards its SBTi-approved target.

→ To improve transparency, Nestlé should respond to future CDP questionnaires, provide specific details on the traceability of its beef supply and disclose the percentage of its suppliers that are in compliance with its policies.

PART 6
Engaging on Deforestation - Next Steps

The landscape of expectations and standards related to deforestation and GHG emissions disclosure is constantly evolving. As methods for emissions calculations and target-setting become clearer, and as the industry as a whole increasingly scrutinizes deforestation activities, what is expected of companies is likely to change. Within this context, investors can manage current and emerging risks by actively engaging portfolio companies to closely monitor and adapt to these changes.

Key steps investors can take

Determine portfolio exposure and risks related to deforestation	**Join collaborative shareholder engagements**	**Directly engage companies on goal setting and disclosing progress.**

The companion website to this guide includes an additional resources page that is updated frequently to reflect the most recent tools and resources investors can use to guide their engagements.

Ceres can support investors interested in engaging on deforestation
Ceres actively supports investors looking to drive corporate action on deforestation by: providing information on progress; helping investors define outcome-based metrics and other performance indicators that will strengthen corporate commitments; and supporting collective action 'asks' from investors to companies. Investors should also consider joining the Ceres networks below to help expedite corporate actions on broader environmental, social and governance (ESG) issues. To learn more about agricultural supply chain risks, visit Engage the Chain.

Ceres Investor Network on Climate Risk and Sustainability
This network is comprised of more than 130 institutional investors collectively managing more than $17 trillion in assets. It works to advance leading investment practices, corporate engagement strategies and policy solutions to build an equitable, sustainable global economy and planet. The network engages directly with portfolio companies on ESG risks and opportunities through investor engagement tactics via multiple working groups, including the Shareholder Initiative for Climate and Sustainability (SICS).

The Investor Initiative for Sustainable Forests (IISF)
A joint initiative led by Ceres and the Principles for Responsible Investment (PRI), which aims to transform industry practices to eliminate deforestation from cattle and soy supply chains.

Climate Action 100+
An investor-led initiative which engages the world's largest corporate GHG emitters, to take bolder actions on climate change. To date, more than 360 investors with more than $34 trillion in assets under management have joined the initiative. More than a dozen companies on the Climate Action 100+ list are in the food and beverage sector. A key investor priority is getting these companies to set robust scope 3 GHG reduction targets that include commitments to end deforestation in their supply chains. For details, visit Climate Action 100+.

APPENDIX

Definition of terms

Deforestation Loss of natural forest. This loss may be due to conversion to a non-forest use such as agriculture or tree plantations, or severe degradation, such as excessive logging. Deforestation may be both legal or illegal.

Conversion Change of a natural ecosystem to another land use, such as agriculture. Conversion includes deforestation, but also conversion of other natural ecosystems such as shrublands, grasslands and non-forested peatlands that are highly carbon-rich and biodiverse.

Natural forest A forest that possesses many or most of the characteristics of a forest native to the given site, including species composition, structure and ecological function.

Commodity-driven deforestation Deforestation that is followed by use of the land for agriculture or forest plantations. This includes some forest loss due to shifting agriculture by smallholders, which is excluded from some definitions of commodity-driven deforestation. We included it in the statistics presented here in order to give a complete picture of agriculturally driven deforestation, but note that these geographies and commodities are unlikely to have investor exposure.

Deforestation-related emissions Releases of carbon stored in trees and soils as CO_2 due to deforestation. Unless otherwise specified, the statistics in this report refer to net emissions, i.e. they consider the carbon stored in the replacing land use. They also include emissions from drainage of forested peatlands for conversion to agriculture. Most tropical peatlands are forested.

Forest-risk commodity A globally traded good or raw material whose extraction or production contributes significantly to deforestation and degradation.

Land use change Conversion of a piece of land's use by humans.

No-deforestation Commodity production, sourcing or financial investments that do not cause or contribute to deforestation. No-deforestation refers to no gross deforestation of natural forests. See Part 5 for further guidance on interpreting corporate no-deforestation commitments.

Tree plantation A human-planted forest that lacks key elements of a natural forest native to the area, such as species diversity (plantations are often composed of a single species), and may store less carbon.

The Accountability Framework provides more information on these and other terms commonly used in discussing deforestation.

Methodology

Estimates of tropical commodity-driven deforestation and associated emissions were calculated by a team of researchers at Stockholm Environment Institute's Trase Initiative, Chalmers University of Technology, and the Senckenberg Biodiversity and Climate Research Centre. The methodology used to provide estimates presented in this guide were reviewed by a technical advisory committee of experts in forests and climate change.

Calculations for this guide drew heavily from methods employed in two recent papers:

Pendrill, Florence, Martin U. Persson, Javier Godar and Thomas Kastner. (2019). Deforestation displaced: trade in forest-risk commodities and the prospects for a global forest transition. Environmental Research Letters 14(5). https://doi.org/10.1088/1748-9326/ab0d41

Pendrill, Florence, Martin U. Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt and Richard Wood. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002

Uncertainty associated with the data

The data and claims presented here related to the attribution of deforestation-related GHG emissions to countries, commodities and trade flows are based on multiple types of scientifically rigorous evidence with large sample sizes; yet, there is always inherent uncertainty embedded in the methods of any model. Overall, we present this data with a high level of confidence and describe remaining uncertainties in more detail following a methodological explanation on the companion website.

The uncertainty embedded in these data would not affect the claims and recommendations made in this guide. For example, areas of uncertainty described in more detail below would not affect the list of countries or tropical agricultural commodities that are major drivers of deforestation. Rather, they may influence the exact percentage or attribution level of deforestation for each commodity to some varying degree. In addition, while the specific list of lesser-known commodities that contribute to deforestation may be influenced by the methods applied, Ceres' overall recommendation of employing a cross-commodity approach would not change given these uncertainties.

A full description of the methodology underlying the data presented in this guide is available online on the companion website.

ENDNOTES

1. IPCC. (2019). Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems www.ipcc.ch/srccl
2. Guillaume, Thomas, Martyna M. Kotowska, Dietrich Hertel, Alexander Knohl, Valentyna Krashevska, Kukuh Murtilaksono, et al. (2018). Carbon costs and benefits of Indonesian rainforest conversion to plantations. Nature Commun 9:2388. https://doi.org/10.1038/s41467-018-04755-y. Per this source, Indonesian forests contain approximately 28,400 tons of carbon per square kilometer. We converted to home energy usage emissions using the EPA Greenhouse Gas Equivalencies Calculator.
3. Seymour, Frances and Jonah Busch 2016. Why Forests? Why Now? www.cgdev.org/sites/default/files/Seymour-Busch-why-forests-why-now-full-book.PDF
4. Pendrill et al. (2019) estimate 2.6 Gt CO_2 annually (average 2005-2017) from tropical deforestation due to expansion of agriculture and forest plantations. We have divided that by 52 Gt CO_2e annual total global anthropogenic emissions as estimated by IPCC (2019). Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002. IPCC. (2019). Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems www.ipcc.ch/srccl
5. Hubau, Wannes, Simon L. Lewis, Oliver L. Philips, Kofi Affum-Baffoe, Hans Beeckman, Aida Cuní-Sanchez et al. (2020). Asynchronous carbon sink saturation in African and Amazonian tropical forests." Nature 579:80–87 (2020). https://doi.org/10.1038/s41586-020-2035-0
6. Wolosin, Michael and Nancy Harris. (2018). Tropical Forests and Climate Change: The Latest Science. World Resources Institute. https://wriorg.s3.amazonaws.com/s3fs-public/ending-tropical-deforestation-tropical-forests-climate-change.pdf
7. Lawrence, Deborah and Karen Vandecar. (2014). Effects of Tropical Deforestation on Climate and Agriculture. Nature Climate Change 5:27-36. https://doi.org/10.1038/nclimate2430
8. We used three satellite-based estimates of CO_2 emissions from loss of tropical forests during 2000-2010, as cited in the Chapter 2 of IPCC (2019): (1) 1.6 Gt CO_2 per year from Baccini et al. (2017); (2) 3.2 Gt CO_2 per year from Achard et al. (2014); (3) 4.8 Gt CO_2 per year from Tyukavina et al. (2015). The median of these estimates (3.2 Gt CO_2 per year) is 7 percent of the estimated 49 Gt CO_2e average annual global GHG emissions over this time period, per Figure SPM.1 of the Working Group III contribution to the IPCC (2014) Fifth Assessment Report. Baccini, Alessandro, Wayne Walker, Luis Carvalho, Mary Farina, Damien Sulla-Menashe, Richard A. Houghton. (2017). Tropical forests are a net carbon source based on aboveground measurements of gain and loss. Science 358(6360):230-234. https://doi.org/10.1126/science.aam5962. Achard, Frédéric, René Beuchle, Philippe Mayaux, Hans-Jürgen Stibig, Catherine Bodart, Andreas Brink, et al. (2014). Determination of tropical deforestation rates and related carbon losses from 1990 to 2010. Global Change Biology 20(8):2540-2554. https://doi.org/10.1111/gcb.12605. Tyukavina, Alexandra, Alessandro Baccini, Matthew C. Hansen, Peter V. Potapov, Stephen V. Stehman, Richard A. Houghton. (2015). Aboveground carbon loss in natural and managed tropical forests from 2000 to 2012. Environmental Research Letters 10(7):074002.
9. Hubau, Wannes, Simon L. Lewis, Oliver L. Philips, Kofi Affum-Baffoe, Hans Beeckman, Aida Cuní-Sanchez et al. (2020). Asynchronous carbon sink saturation in African and Amazonian tropical forests." Nature 579:80–87 (2020). https://doi.org/10.1038/s41586-020-2035-0
10. Pendrill et al. (2019) estimate 2.6 Gt CO_2 annually (average 2005-2017) from tropical deforestation due to expansion of agriculture and forest plantations. We have divided that by 52 Gt CO2e annual total global anthropogenic emissions as estimated by IPCC (2019). Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002. IPCC. (2019). Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and green-

house gas fluxes in terrestrial ecosystems www.ipcc.ch/srccl
11. We used three estimates of the mitigation potential of forests and other natural ecosystems: (1) Roe et al. (2019) estimated that reduced land use change and restored forests, peatlands and coastal wetlands could, by 2050, provide 16 percent of the mitigation needed to limit warming to 1.5 degrees C in 2100. (2) Combining multiple solutions from Wilkinson et al. (2020), protection and restoration of forests and other natural ecosystems could provide 18 percent of the mitigation needed between now and 2050 to limit warming to 1.5 degrees Celsius in 2100. (3) Griscom et al. (2017) estimated that natural climate solutions based on forests, grasslands, and wetlands could, by 2030, provide 30 percent of the mitigation needed to limit warming to 2 degrees C in 2100. Roe, Stephanie, Charlotte Streck, Michael Obersteiner, Stefan Frank, Bronson Griscom, Laurent Drouet et al. (2019). Contribution of the land sector to a 1.5 °C world. Nature Climate Change 9:817-828. https://doi.org/10.1038/s41558-019-0591-9. Wilkinson, Katherine. (2020). The Drawdown Review 2020. San Francisco, CA: Project Drawdown. https://drawdown.org/drawdown-framework/drawdown-review-2020. Griscom, Bronson W, Justin Adams, Peter Ellis, Richard Houghton, Guy Lomax, Daniela A. Miteva, et al. (2017). Natural Climate Solutions. Proceedings of the National Academy of Sciences 114(44):11645-11650. www.pnas.org/cgi/doi/10.1073/pnas.1710465114.
12. Wilkinson, Katherine (ed). (2020). The Drawdown Review 2020. San Francisco, CA: Project Drawdown. https://drawdown.org/drawdown-framework/drawdown-review-2020
13. Wilkinson, Katherine (ed). (2020). The Drawdown Review 2020. San Francisco, CA: Project Drawdown. https://drawdown.org/drawdown-framework/drawdown-review-2020
14. Geraghty, Michael. (nd). No Place to Hide? Climate Change and Systemic Financial Risk. New York, NY: Cornerstone Capital Group. http://cornerstonecapinc.com/wp-content/uploads/No-Place-to-Hide_Climate-Change-and-Systemic-Financial-Risk.pdf
15. Piotrowski, Matthew and Anthony Mansell. (2019, August 29). Why deforestation policies mean stranded land assets. Innovation Forum. https://www.innovationforum.co.uk/articles/why-deforestation-policies-mean-stranded-land-assets
16. Barbier, Edward and Sebastian Troëng. (2020, February 13). Carbon taxes are key to stop deforestation. Climate Home News. https://www.climatechangenews.com/2020/02/13/carbon-taxes-key-stop-deforestation/
17. Setzer, Joana and Rebecca Byrnes. (2019). Global trends in climate change litigation: 2019 snapshot. London: Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, London School of Economics and Political Science. http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2019/07/GRI_Global-trends-in-climate-change-litigation-2019-snapshot-2.pdf
18. Carbon Trust News. (2019, April 3). Research reveals consumer demand for climate change labelling. https://www.carbontrust.com/news-and-events/news/research-reveals-consumer-demand-for-climate-change-labelling
19. Paterson, R.Russell M and Nelson Lima. (2018). Climate change affecting oil palm agronomy, and oil palm cultivation increasing climate change, require amelioration. Ecology and Evolution 8(1): 452-461. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5756879/
20. World Wildlife Fund. (nd). Inside the Amazon. wwf.panda.org/knowledge_hub/where_we_work/amazon/about_the_amazon/
21. Dinerstein, E, C Vynne, E Sala, A R Joshi, S Fernando, TE Lovejoy, et al. (2019). A Global Deal for Nature: Guiding principles, milestones, and targets" Science Advances 5:4 https://doi.org/10.1126/sciadv.aaw2869
22. Lawrence, Deborah and Karen Vandecar. (2014). Effects of Tropical Deforestation on Climate and Agriculture. Nature Climate Change 5:27-36. https://doi.org/10.1038/nclimate2430
23. Human Rights Watch. (2019, September 22). Indonesia: Indigenous Peoples Losing Their Forests. www.hrw.org/news/2019/09/22/indonesia-indigenous-peoples-losing-their-forests#
24. Walker, Wayne S., Seth R. Gorelik, Alessandro Baccini, Jose Luis Aragon-Osejo, Carmen Josse, Chris Meyer, et al. (2020). The role of forest conversion, degredation, and disturbance in the carbon dynamics of Amazon indigenous territories and protected areas. Proceedings of the National Academy of Science 117 (6):3015-3025. https://doi.org/10.1073/pnas.1913321117
25. Nellemann, Christian, INTERPOL Environmental Crime Programme (eds). (2012). Green Carbon, Black Trade: Illegal Logging, Tax Fraud and Laundering in the World's Tropical Forests. A Rapid Response Assessment. United Nations Environment Programme, GRID- Arendal. http://hdl.handle.net/20.500.11822/8030
26. IUCN. Nature-based solutions to disasters. www.iucn.org/resources/issues-briefs/nature-based-solutions-disasters
27. Allen, Toph, Kris A. Murray, Carlos Zambrana-Torrelio, Stephen S. Morse, Carlo Rondinini, Nathan Breit et al. (2017). Global hotspots and correlates of emerging zoonotic diseases. Nature Communications 8:1124. https://doi.org/10.1038/s41467-017-00923-8
28. Jenkins, Michael and Lyndon Haviland. (2020, March 26). Coronavirus: How Did We Get Here? Forest Trends. www.forest-trends.org/blog/coronavirus-how-did-we-get-here/
29. Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agri-

cultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002.
30. Escobar, Herton. (2019, November 22). Brazil's deforestation is exploding—and 2020 will be worse. Science https://doi.10.1126/science.aba3238
31. Machado, Adriano. (2020, May 7). Deforestation of the Amazon Has Soared Under Cover of the Coronavirus. NBC News. www.nbcnews.com/science/environment/deforestation-amazon-has-soared-under-cover-coronavirus-n1204451
32. Wijaya, Arief, Tjokorda Nirarta "Koni" Samadhi, and Reidinar Juliana. (2019, July 24). Indonesia is Reducing Deforestation, but Problem Areas Remain. World Resources Institute. www.wri.org/blog/2019/07/indonesia-reducing-deforestation-problem-areas-remain
33. Global Forest Watch. (2014) Washington, DC: World Resources Institute. www.globalforestwatch.org/. Accessed April 13, 2020.
34. Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002.
35. Curtis, Philip G., Christy M. Slay, Nancy L. Harris, Alexandra Tyukavina, and Matthew C. Hansen. (2018). Classifying drivers of global forest loss. Science 361(6407):1108-1111. https://doi.org/10.1126/science.aau3445
36. Kroeger, Alan, Haseebullah Bakhtary, Franziska Haupt, and Charlotte Streck. (2017). Eliminating Deforestation from the Cocoa Supply Chain. Washington, DC: World Bank. http://hdl.handle.net/10986/26549
37. Goldstein, Allie, Will R. Turner, Seth A. Spawn, Kristina J. Anderson-Teixeira, Susan Cook-Patton, Joseph Fargione, et al. (2020). Protecting irrecoverable carbon in Earth's ecosystems. Nature Climate Change 10:287-295. https://doi.org/10.1038/s41558-020-0738-8
38. Gauthier, Sylvie, Bernier, P., Kuuluvainen, T., Shvidenko, A. Z. & Schepaschenko, D. G. (2015). Boreal forest health and global change. Science 349:819–822.
39. Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002.
40. Because cattle are produced for both beef and leather, it is impossible to separate the individual contributions of these commodities to deforestation-related GHG emissions.
41. Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002.
42. Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002.
43. Prager, Alicia. (2019, March 19). https://news.mongabay.com/2019/03/brazils-key-deforestation-drivers-pasture-cropland-land-speculation/
44. Van Ypersele, Jean, Eric Lambin, Woldgang Cramer, Wolfgang Lucht, Peter Raven, Timothy D. Searchinger and Bjart Holtsmark. (2018, June 4). Re: Final Negotiations on Renewable Energy Directive. https://www.biofuelwatch.org.uk/wp-content/uploads/Scientists-letter-to-lead-European-Parliament-negotiators-regarding-biomass-rules-in-renewable-energy-directive.pdf
45. Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002.
46. Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002.
47. Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002.
48. Pendrill, Florence, U. Martin Persson, Javier Godar, Thomas Kastner, Daniel Moran, Sarah Schmidt, et al. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. Global Environmental Change 56:1-10. https://doi.org/10.1016/j.gloenvcha.2019.03.002.
49. Trase. (2018). Trase YearBook 2018. Trase Yearbook 2018, Sustainability in Forest-Risk Supply Chains: Spotlight on Brazilian Soy. Transparency for Sustainable Economies, Stockholm Environment Institute and Global Canopy. https://yearbook2018.trase.earth/chapter2/

50. Christopoulou, Alexandra, Tim Steinweg, and Gacriel Thoumi. (2018). The Financing of Leakage Refiners: Shareholders and Loan Issuers Include International Financial Institutions with Palm Oil Policies. Washington, DC: Chain Reaction Research. https://chainreactionresearch.com/report/report-the-financing-of-leakage-refiners-shareholders-and-loan-issuers-include-international-financial-institutions-with-palm-oil-policies/
51. Compere, Lauren. (2019). Banking on a Low Carbon Future: Finance in a Time of Climate Crisis. Boston, MA: Boston Common Asset Management. http://news.bostoncommonasset.com/bank-report-2019/
52. Greenhouse Gas Protocol. World Resources Institute and World Business Council on Sustainable Development. https://ghgprotocol.org/
53. Herbert, Matt. (2019, October 15). New Greenhouse Gas Protocol Standards/Guidance on Carbon Removals and Land Use. https://ghgprotocol.org/blog/new-greenhouse-gas-protocol-standardsguidance-carbon-removals-and-land-use
54. SBTi. (2020). Forest, Land and Agriculture. https://sciencebasedtargets.org/sector-development/forest-land-and-agriculture/; https://ghgprotocol.org/blog/new-greenhouse-gas-protocol-standardsguidance-carbon-removals-and-land-use
55. Ceres. (2020). Engage the Chain. https://engagethechain.org/climate-change
56. Based on analysis of JBS, Marfrig, Minerva, Musim Mas, Sinar Mas, and Wilmar. Scope 1 and scope 2 emissions estimates from CDP reports. Emissions associated with deforestation risk were calculated based on a combination of remote sensing and supply chain mapping data from Trase. Methodology described in: Escobar, Neus, E. Jorge Tizado, Erasmus K.H. zu Ermgassen, Pernilla Löfgren, and Jan Börner. (2020). Spatially-explicit footprints of agricultural commodities: Mapping carbon emissions embodied in Brazil's soy exports. Global Environmental Change 62:102067. https://doi.org/10.1016/j.gloenvcha.2020.102067
57. Mars. (2019). Mars – Climate Change 2019 report to CDP. Downloadable from the CDP website: https://www.cdp.net/en
58. Data from: Escobar, Neus, E. Jorge Tizado, Erasmus K.H. zu Ermgassen, Pernilla Löfgren, and Jan Börner. (2020). Spatially-explicit footprints of agricultural commodities: Mapping carbon emissions embodied in Brazil's soy exports. Global Environmental Change 62:102067. https://doi.org/10.1016/j.gloenvcha.2020.102067
59. Escobar, Neus, E. Jorge Tizado, Erasmus K.H. zu Ermgassen, Pernilla Löfgren, and Jan Börner. (2020). Spatially-explicit footprints of agricultural commodities: Mapping carbon emissions embodied in Brazil's soy exports. Global Environmental Change 62:102067.https://doi.org/10.1016/j.gloenvcha.2020.102067
60. Goldstein, Allie, Will R. Turner, Seth A. Spawn, Kristina J. Anderson-Teixeira, Susan Cook-Patton, Joseph Fargione, et al. (2020). Protecting irrecoverable carbon in Earth's ecosystems. Nature Climate Change 10:287-295. https://doi.org/10.1038/s41558-020-0738-8