MOVING FROM RISK TO RESILIENCE

CLIMATE CHANGE AND THE FORESTRY SECTOR

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ABOUT ZSL

ZSL (Zoological Society of London) is an international conservation charity working to create a world where wildlife thrives. From investigating the health threats facing animals to helping people and wildlife live alongside each other, ZSL is committed to bringing wildlife back from the brink of extinction. Our work is realised through our ground-breaking science, our field conservation around the world and engaging millions of people through our two zoos, ZSL London Zoo and ZSL Whipsnade Zoo.

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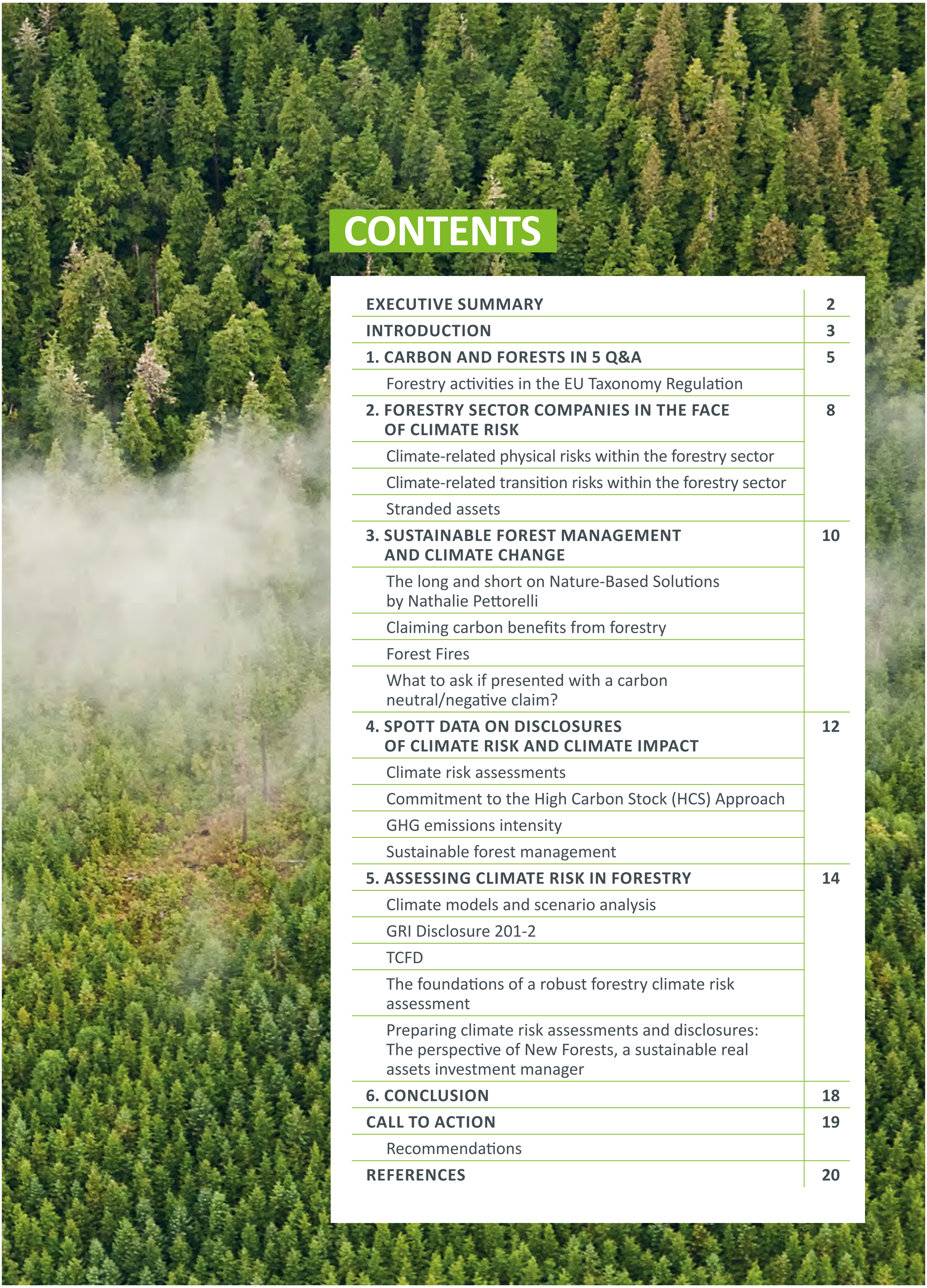


CONTENTS

EXECUTIVE SUMMARY

The forestry sector is dependent on ecosystem services and stable climatic conditions, both of which are already being impacted by climate change.

The entire forestry sector has high exposure to climate risks, however research by ZSL shows that most forestry companies do not conduct or disclose climate risk assessments and insufficiently report on sustainable forest management practices, which are necessary to achieve resilience and mitigation.

Forests play a key role in the global carbon cycle. Forested areas are vast carbon reservoirs through storage in vegetation and soil biomass, and biological processes such as photosynthesis, respiration and decomposition continually move carbon between the land and atmosphere. They also influence global precipitation pattens and harbour an estimated 80% of all terrestrial biodiversity. More than a quarter of the global population depends on forests for their livelihoods, but all life on earth is at risk if deforestation progresses past its tipping point.

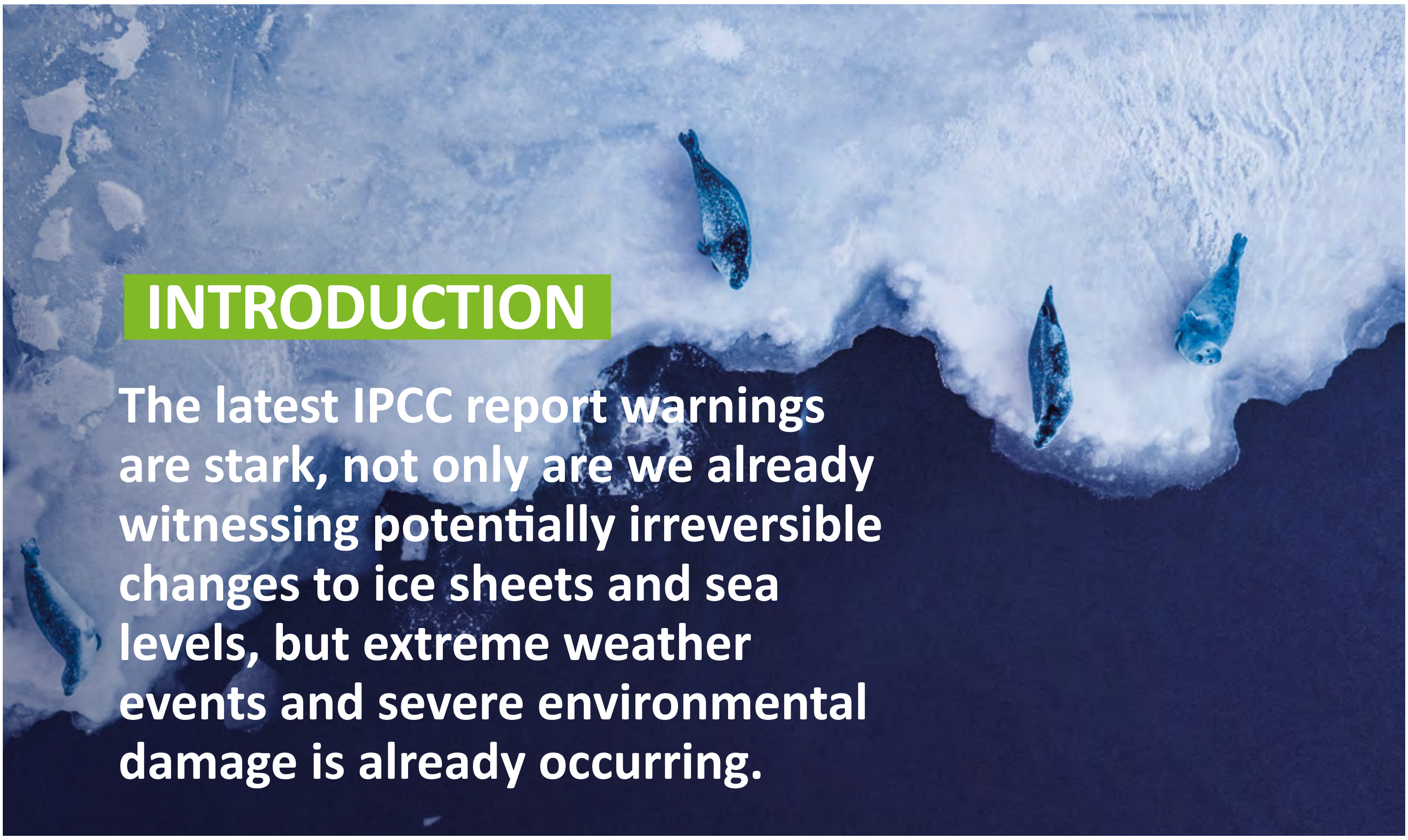
As natural forests and plantations are dynamic systems, a forested area may be a net source or sink of greenhouse gases, depending on the net movement of CO_2. Climate change will impact the relative rate of capture and release, but CO_2 is also released from forests as a result of human activities like forest clearance, fires and peat soil drainage.

Forestry has significant potential to mitigate the impacts of climate change and is increasingly being looked towards as part of 'nature-based solutions'. However, as the impacts of climate change worsen over the coming years, the viability of many forestry operations may decrease. As well as mitigation, long term adaptation strategies should be factored into forest management practices to increase the resilience of the forest or plantation ecosystem.

To effectively mitigate and adapt to climate change, forestry companies need to allocate time and resources to carefully assess climate risk to their operations. Although the broad climate risks are well studied, there are a multitude of on-the-ground factors that determine the specific vulnerabilities of a natural forest or plantation. Further, companies should publicly disclose information on sustainable management practices as part of their reporting on how they manage and mitigate risks.

There is a lack of forestry-specific climate risk assessment frameworks available in the public domain, which is compounded by key knowledge gaps on the complex relationship between climate change, the carbon cycle, and forestry. However, given the urgency of the climate crisis and the significance of risks to the sector, forestry companies should act immediately to address this.

This report aims to provide stakeholders exposed to climate risk through the forestry sector, including forestry companies, buyers and financial institutions, with (1) an accessible overview of risk factors and vulnerabilities within the industry (2) approaches to conducting risk assessments and (3) an introduction to mitigation opportunities and best practice.



INTRODUCTION

The latest IPCC report warnings are stark, not only are we already witnessing potentially irreversible changes to ice sheets and sea levels, but extreme weather events and severe environmental damage is already occurring.

The Earth is warmer than it has been in 125,000 years and even under the most optimistic scenario considered, we are likely to reach 1.5°C of warming compared to pre-industrial levels within the next 20 years.[1]

The ongoing climate crisis is progressing in step with a biodiversity crisis. The Living Planet Index – a measure of global biodiversity trends developed by WWF and ZSL[2] – showed an average rate of decline in animal population size of 68% between 1970 and 2016 globally. In 2019, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment found that 1,000,000 species are threatened with extinction, with negative biodiversity trends continuing in all but the most “transformative” scenarios.

The important role of forests to biodiversity and climate stabilisation are well documented, as is global loss of forest cover over recent decades. Reforestation, restoration and afforestation to mitigate climate change as part of ‘net-zero strategies’ or ‘nature-based solutions’ appear relatively attractive, which presents the forestry sector with significant opportunities.

Strategies to address the climate crisis at all levels of governance, from international treaties and national strategies to corporate commitments, all rely on different degrees of reducing, greening and compensating damaging activities and the greenhouse gas (GHG) emissions they entail.

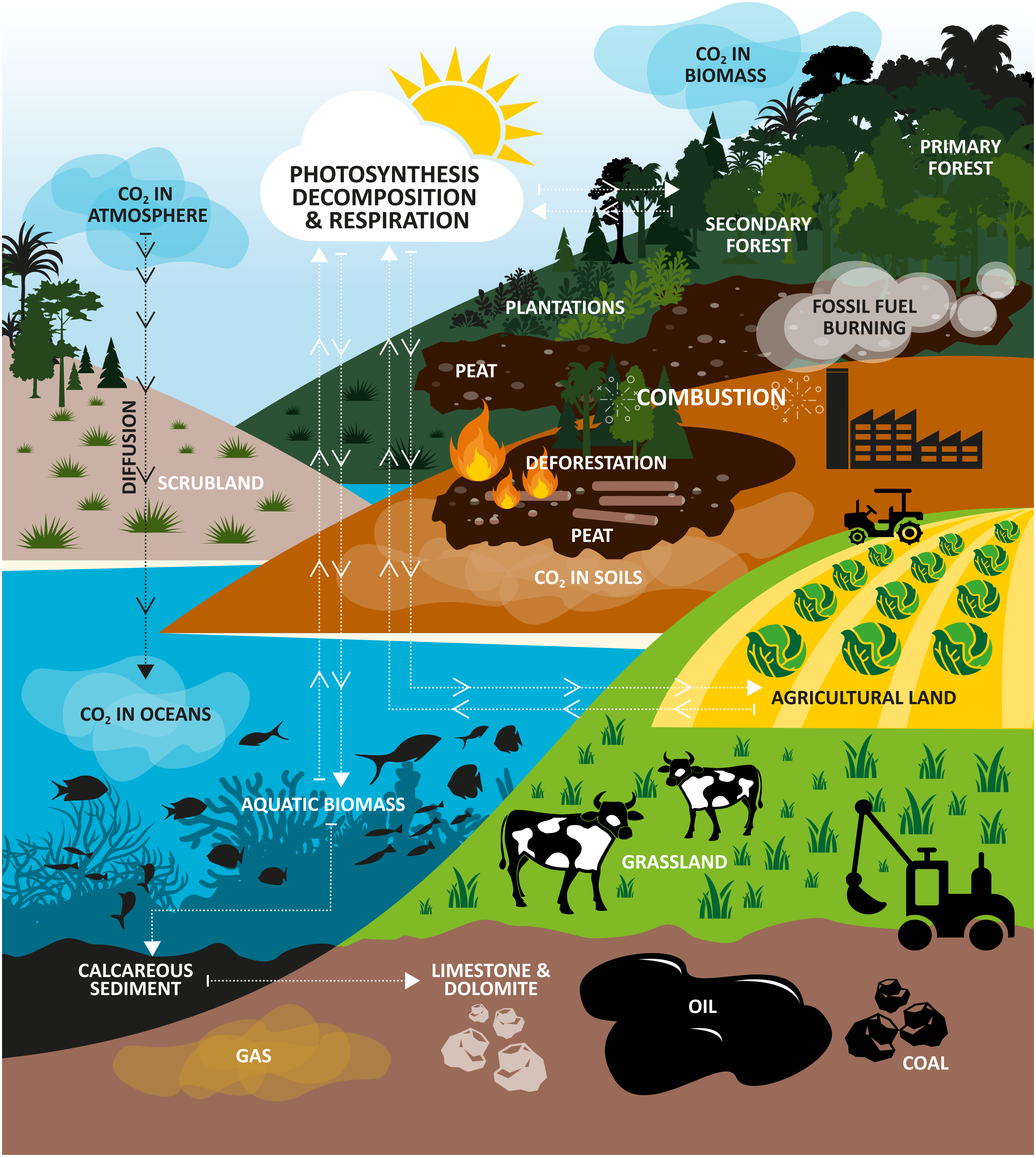
Most scientific climate change scenarios include assumptions on future adoption of technological fixes like Carbon Capture and Storage (CCS), renewable energy generation and shifting food production systems. While significant efforts are expended on the development of greener technologies, it is equally urgent to safeguard existing forests, as a key asset in the fight against the climate and biodiversity crises.

The precise numbers are still highly debated within the scientific community, but it is thought that nature-based solutions can provide up to a third of the CO_2 reductions mitigation potential needed by 2030 under 2°C scenarios, with forest pathways making up 75% of this potential.[3] Forests also harbour 80% of the world’s terrestrial biodiversity, directly support the livelihoods of 1.6 billion people and provide key ecosystem services which are crucial to climate change mitigation, such as nutrient cycling, water and air purification, and maintenance of wildlife habitats. However, efforts to address deforestation, forest fragmentation and forest degradation so far have yielded uneven and insufficient outcomes, with loss of primary rainforest increasing by 12% between 2019 and 2020.[4] Worse still, according to the IPCC, up to 11% of global emissions stem from land use and land-use change activities (mainly tropical deforestation).[5] Yet, it was estimated that only 3 percent of available climate mitigation-related development funding went towards agriculture, forestry, land-use, and natural resource management in 2015-16.[6]

As stewards of vast tracts of natural or plantation forests, forestry sector companies are a key stakeholder in forest governance in the context of climate change, as they are simultaneously exposed to climate change and able to contribute to its mitigation.

But how can forestry companies both assess climate risk to their forestry assets, and accurately reflect the ways in which these assets contribute to reducing that risk? This report offers an introduction to key issues relevant to climate risk in the forestry sector.

FIG 1: THE ROLE OF FORESTS WITHIN THE CARBON CYCLE



1 CARBON AND FORESTS IN 5 Q&A

The carbon cycle describes the series of dynamic processes that move carbon atoms around the environment, between the Earth and the atmosphere, and between different chemical and biological compounds. Carbon is stored in reservoirs or sinks such as rock, soil, sediment, oceans, forests, and all living organisms, and consequently is always in flux. The time carbon spends in a reservoir varies significantly, from less than a minute to more than a millennium. Carbon stored in biomass can be released as a result of many different processes including respiration, decomposition and combustion.

#1 WHAT IS A CARBON SINK?

The IPCC defines sinks as "Any process, activity, or mechanism that removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas or aerosol from the atmosphere". This definition is important because it encompasses both natural and artificial sinks. While artificial sinks refer to technologies such as carbon capture and storage, the main natural carbon sinks are:

- Rock, sediment and soils (peat in particular), e.g. organic matter
- Oceans, e.g. dissolved CO_2 and biomass in aquatic organisms
- Forests and forest products, e.g. biomass in living and dead plants[i]

It is important to note that the notion of sink is dynamic and includes a time dimension: A carbon reservoir is considered a sink if, during a given time period, it stores more carbon than it releases.

#2 ARE ALL FORESTED AREAS EQUAL IN TERMS OF CARBON STORAGE CAPACITY?

No. The amount of carbon which can be stored by forested areas (whether plantations or natural forests)[ii] varies over a period of time and depends on many factors, including but not limited to:

- **The size of the area and its biomass density:** Carbon forms the chemical basis of all life forms on Earth, making up close to half of all dry biomass. The higher the density and larger the area, the greater the carbon storage capacity.
- **Location and climate:** The altitude and local/regional climate conditions can have a bearing on its carbon storage capacity, with high-altitude forests and plantations typically storing less carbon than their lower-altitude equivalents.
- **Soil composition:** All soil types store carbon as organic matter, but forests that grow on peatlands[iii] will store huge quantities of soil carbon depending on their extent and depth, provided they do not dry out due to land drainage or droughts.
- **Degradation and fragmentation** of the forested area undermines ecosystem functions, including carbon storage. Continuous, intact forest landscapes tend to store significantly more carbon than their degraded counterparts.
- **The tree species planted/present:** Carbon storage capacity between different species is primarily determined by growth rates.
- **Biodiversity and ecosystem health:** Healthy, biodiverse ecosystems tend to correlate to higher carbon stocks. Besides trees, many other forest organisms from fungi to large mammals play an important role in the carbon cycle.
- **Management and conservation practices:** For all types of forested areas, whether plantations, managed forests or protected areas, human interventions have the potential to either positively or negatively impact the overall health of the ecosystem (including soils), and therefore its function. Forest disturbances tend to negatively impact carbon storage.

Older, natural forests tend to be denser and more biodiverse, and naturally occur and thrive in places where climate conditions are stable. It is crucial from a climate mitigation perspective to prioritise protection, regeneration, restoration and sustainable management of natural forests. This also means that the world's forests are vulnerable to, and already impacted by abrupt, frequent, or sustained changes to the climate they are adapted to. Such changes are made more likely as the climate crisis deepens.

#3 CAN FORESTS BECOME NET CARBON SOURCES?

Yes. As forests are dynamic, what was once a sink can become a source if conditions change, and vice versa. Forests are considered sinks when carbon sequestered is greater than carbon released, meaning the net balance is negative. At any given time, there are simultaneous processes occurring that capture or release carbon. When natural occurrences or human activities increase the carbon being removed from a forest at a greater rate than it is being sequestered, then it has become a source. Examples of events that remove carbon include logging (both large-scale and selective logging), peat draining and fires.

The extent of carbon sequestration in natural sinks is partly dependent on local climatic conditions and thus is affected by climate change. The extent of carbon release is partly through natural biological processes, and partly due to human activity related to land use and forest management. Climate change related risks and impacts are complex and multidimensional, but the scale and rate of change in many locations is enough to cause noticeable, often negative impacts to forest ecosystems and their functions.

i. Including wood products (construction timber, floors, furniture etc) provided they remain intact and are not allowed to decompose.
ii. While mangrove forests are crucial carbon sinks, they are not included in the scope of this report which focuses more particularly on commercial forestry.
iii. An Aidenvironment report published in February 2021 found that 2.6 million hectares of land that is given out for industrial tree plantations concessions (HTI) in Indonesia is peatland – this represents 23% of the total amount of land under HTI permits.

#4 WHAT IS THE RELATIONSHIP BETWEEN THE FORESTRY SECTOR AND GLOBAL GHG EMISSIONS?

The forestry sector is considered to provide potential for climate change mitigation through carbon storage in plantations and forest ecosystems and in products made from the harvested wood (depending on product life cycle). Additional gains can also potentially be achieved where wood products and wood-biomass-derived energy can replace more carbon-intensive alternatives.[i/7]

However, sustainability claims associated with biofuels are controversial for multiple reasons, such as their potential to act as a driver of land-use change including natural forest clearance, the short-lived nature of carbon stored before it is re-emitted to the atmosphere, and a carbon-intensive supply chain. Even if clean and affordable Carbon Capture and Storage mechanisms became mainstream and reduced emissions, major land use and biodiversity-related concerns around biofuel sourcing would remain. The 'sustainability' of biofuels therefore should be assessed with considerable caution.

The additionality of forestry-sector contributions depends on both local baselines and interventions:

- **In the case of plantation forestry** – and particularly in densely forested countries – it is not uncommon that operations have replaced natural forests. While plantation forestry has the capacity to efficiently respond to growing needs for wood and pulp products, and therefore possibly reduce pressure on natural forests, forest conversion for plantations typically means an overall decrease in carbon storage. In addition, effective carbon sequestration outcomes partly depend on sustainable management practices being implemented.
- **In the case of natural forest operations, logging and other forms of disturbances can jeopardise storage:** sustainable forest management practices are key to maximise outcomes. (see Sustainable forest management and climate change section p.10).

While the forestry sector has a key role to play in the fight against climate change, additionality should not be assumed and should be determined at company or operator level, on a case-by-case basis, considering landscape features, land-use history, the implementation of sustainable forest management practices and product life-cycle analysis.

#5 SHOULD WE JUST PLANT AS MANY TREES AS POSSIBLE?

While afforestation has potential to support the fight against climate change by increasing biomass, thus sequestering additional carbon, it does not mean that indiscriminate tree planting is a complete solution. Following the "right tree in the right place" notion, the added value of any afforestation project must consider:

- **What the proposed planting would replace:** Depending on context, non-forest ecosystems can have as much, if not more, conservation value than the proposed project. All the various trade-offs must be assessed and considered from climate, environmental and social perspectives.
- **What will be planted and under what management:** Monoculture planting will have different characteristics from agroforestry or planting seeking to recreate a functional forest ecosystem. Species should be selected to be able to withstand current and future climate conditions and local pressures.
- **How well and how long will the afforested area be monitored and managed:** Management is costly and it takes several years for planted saplings to start making a significant contribution as carbon stores. In the absence of management in both the short and long term, sapling survival rates may be lower and the area may change ownership and/or be converted to another land use before the expected gains have even been achieved, cancelling out any benefits.
- **If harvested, what will happen to the wood coming from trees grown through afforestation:** While wood can store carbon after harvest, if it is allowed to decompose or is burnt for energy generation, the carbon stored will be released into the atmosphere.

i. This is the object of significant scientific debate, and a cause for concerns among environmental NGOs. In October 2021, uncertainties about achievability of carbon-neutrality caused the FTSE100 wood-biomass energy company to be deselected from a green energy index, the same company is subject of a formal complaint before the OECD.

FORESTRY ACTIVITIES IN THE EU TAXONOMY REGULATION

The EU taxonomy for sustainable activities (“the EU taxonomy”), which is part of the EU action plan on financing sustainable growth, is a classification system providing a list of environmentally sustainable economic activities. While it can be perceived as more sustainable than other sectors, when considering forestry, the EU Taxonomy Regulation[ii/8] specifically excludes plantation forests (short rotation plantation for wood, fibre and energy). It specifies that “For the purposes of the Taxonomy, significant mitigation achievement for Forestry is judged through improvement in activities’ own performance, with a focus on the maintenance of forest carbon stocks and sinks and increase of sequestration potential within the sector”.[9] Forestry activities (including existing forest management) which are included in the taxonomy must demonstrate “sustainable and substantial mitigation” in relation to climate change by meeting “Do no significant harm” criteria,[10] including:

- Compliance with Sustainable Forest Management requirements
- The establishment of a verified GHG balance baseline
- Reporting on the above through a forest management plan at ten-year intervals

ii. While the EU Taxonomy’s focus is on achieving climate-related goals, it not only sets out definitions for which economic activities can be considered environmentally sustainable, but also environmental and social criteria to assess minimum good practice that must be met for each of these activities.

2 FORESTRY SECTOR COMPANIES IN THE FACE OF CLIMATE RISK

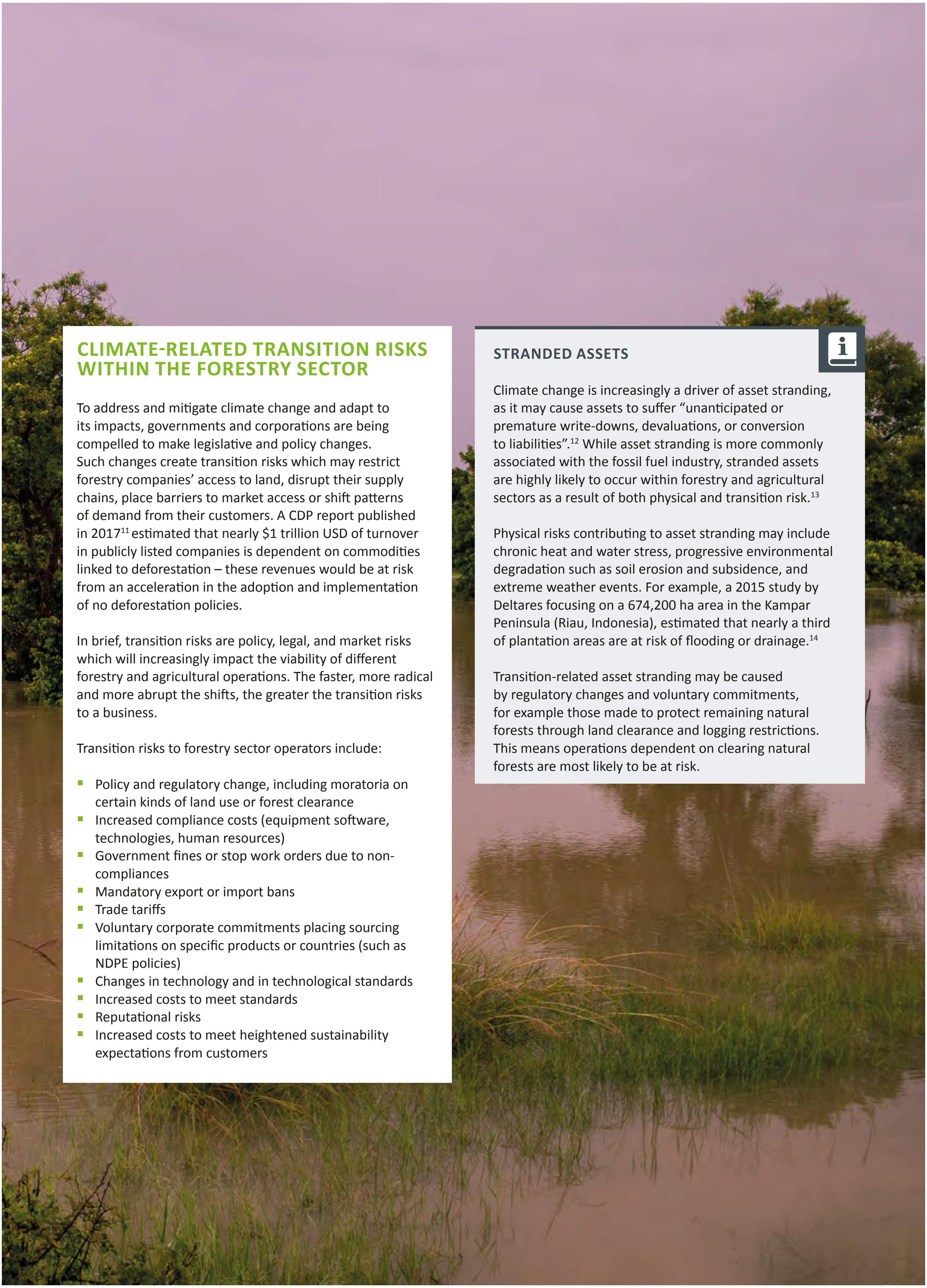
Climate risks can be considered to fall into two broad categories: physical risks and transition risks. It is well established that climate change is likely to significantly impact all industries dependent on natural resources. Forestry has both exposure to, and impact on climate change-related risks, yet there is little in the way of forestry-related climate risk assessment available in the public domain.

CLIMATE-RELATED PHYSICAL RISKS WITHIN THE FORESTRY SECTOR

Although the specific risks and their respective intensity will vary significantly in different locations, they include increased likelihood of extreme weather events, changing temperature and precipitation patterns, changes in fire regimes (including frequency, location and intensity), changes to humidity, soil moisture, and water tables and desertification. Climate change will also lead to ecosystem disturbance which may introduce risks such as changes in the distribution of diseases and behaviour of disease vectors, pests, pollinators and invasive species. In certain locations, there will also be heat and water stress on infrastructure, production assets (like machinery) and on workers and local communities. Specific impacts on forestry operations will also vary, as risks in tropical areas are likely to be different to temperate or boreal regions, and risks in natural forests will be different to those in plantations. Impacts may affect different ecosystem services (including animal, fungi and vegetal species contributing to some of them) differently. With regards to trees, impacts may vary across not only different species but also between individual trees, depending on their own characteristics.

FIG 2: A NON-EXHAUSTIVE SUMMARY OF CLIMATE-RELATED PHYSICAL RISKS TO THE FORESTRY SECTOR

ACUTE RISKS (primarily from extreme weather events)	**CHRONIC RISKS** (primarily from temperature rises and local changes in climate)
▪ Yield decrease/ tree loss due to windthrow, wind snap, flooding or fires ▪ Damage to/ destruction of machinery and facilities ▪ Asset stranding through peat subsidence, flooding or desertification ▪ Increased insurance costs and discount rates ▪ Operational disruption from systems failure such as power cuts ▪ Logistics and supply chain failures	▪ Yield decrease/ tree loss due to heat and water stress or diseases ▪ Increased pest control costs ▪ Increased pollination costs ▪ Disruptions to working conditions, including heat stress on machinery and workers ▪ Increased incidence of insect-borne diseases affecting workers ▪ Loss of local livelihoods for forest-dependent communities



CLIMATE-RELATED TRANSITION RISKS WITHIN THE FORESTRY SECTOR

To address and mitigate climate change and adapt to its impacts, governments and corporations are being compelled to make legislative and policy changes. Such changes create transition risks which may restrict forestry companies' access to land, disrupt their supply chains, place barriers to market access or shift patterns of demand from their customers. A CDP report published in 2017[11] estimated that nearly $1 trillion USD of turnover in publicly listed companies is dependent on commodities linked to deforestation – these revenues would be at risk from an acceleration in the adoption and implementation of no deforestation policies.

In brief, transition risks are policy, legal, and market risks which will increasingly impact the viability of different forestry and agricultural operations. The faster, more radical and more abrupt the shifts, the greater the transition risks to a business.

Transition risks to forestry sector operators include:

- Policy and regulatory change, including moratoria on certain kinds of land use or forest clearance
- Increased compliance costs (equipment software, technologies, human resources)
- Government fines or stop work orders due to non-compliances
- Mandatory export or import bans
- Trade tariffs
- Voluntary corporate commitments placing sourcing limitations on specific products or countries (such as NDPE policies)
- Changes in technology and in technological standards
- Increased costs to meet standards
- Reputational risks
- Increased costs to meet heightened sustainability expectations from customers

STRANDED ASSETS

Climate change is increasingly a driver of asset stranding, as it may cause assets to suffer "unanticipated or premature write-downs, devaluations, or conversion to liabilities".[12] While asset stranding is more commonly associated with the fossil fuel industry, stranded assets are highly likely to occur within forestry and agricultural sectors as a result of both physical and transition risk.[13]

Physical risks contributing to asset stranding may include chronic heat and water stress, progressive environmental degradation such as soil erosion and subsidence, and extreme weather events. For example, a 2015 study by Deltares focusing on a 674,200 ha area in the Kampar Peninsula (Riau, Indonesia), estimated that nearly a third of plantation areas are at risk of flooding or drainage.[14]

Transition-related asset stranding may be caused by regulatory changes and voluntary commitments, for example those made to protect remaining natural forests through land clearance and logging restrictions. This means operations dependent on clearing natural forests are most likely to be at risk.

3 SUSTAINABLE FOREST MANAGEMENT AND CLIMATE CHANGE

The forestry sector can mitigate climate change either through reducing emissions from deforestation and degradation, or through increasing forest carbon sinks. To adapt to climate change, management practices should be orientated around increasing the resilience of forests and forest-dependent people to the impacts of climate change.

Given that forests have both high exposure to climate change and high mitigation potential, sustainable forest management (SFM) practices will increasingly need to incorporate climate risk assessments and use them to develop intervention, mitigation, and adaptation strategies.

Sustainable forest management is defined by the FAO as a "dynamic and evolving concept, which aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations." SFM should, at a minimum, result in no net loss of carbon from biomass or soil, nor reduce any other ecosystem function. Forests have the capacity to mitigate and buffer the impacts of climate change if they are managed well and are increasingly sought after as part of 'nature-based solutions'.

The use of nature-based solutions as a mitigation strategy is expected to accelerate over the coming years, to the extent that they are even included in the assumptions of future input scenarios for climate modelling. It is worth noting that given the exposure of the forestry sector to climate change, the nature-based solution approach should take into account the capacity of a forest to continue to deliver the mitigation benefits as the impacts of climate change become more extreme. For example, carbon sequestration from afforestation projects may drop significantly as areas become hotter and drier, as has been predicted in some forest carbon offset projects in California.[15]

THE LONG AND SHORT ON NATURE-BASED SOLUTIONS BY NATHALIE PETTORELLI, SENIOR RESEARCH FELLOW, INSTITUTE OF ZOOLOGY, ZSL

"Loss of biodiversity is deepening the climate change crisis because we are destroying the Earth's capacity to sequester and store the carbon we emit, while removing opportunities for our societies to adapt to the new climatic normal.

Together with radical measures to decarbonise energy systems, nature-based solutions could be a game changer to jointly address the climate change and biodiversity crisis. They are defined as actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges while simultaneously providing human well-being and biodiversity benefits. **Well-implemented and sustainably scaled, these nature-based solutions are a low risk, low cost, low maintenance answer to the existential threats we face. Deployed in the wrong place and in the wrong way, they become a menace to biodiversity, local communities and human rights.**

In recent years, a number of principles, standards and guidelines have emerged to support the effective implementation of nature-based solutions and ensure biodiversity benefits from their deployment. Research has also highlighted ways to evaluate the likely effectiveness of various nature-based solutions under future climate conditions, enabling practitioners to ensure that the likely effects of climate change on the solutions they are considering is factored in their decision-making process. As our ability to (1) track changes in ecosystem distribution and identify ecosystems occupying environmental niches about to shift beyond the ecosystem's ecological limits and (2) predict local climate trajectories improve, risks assessments for nature-based solutions deployment will become more robust and precise."

NATHALIE PETTORELLI
SENIOR RESEARCH FELLOW, INSTITUTE OF ZOOLOGY, ZSL

Conversely to the benefits of SFM, unsustainable forest management can directly contribute to climate change though increased GHG emissions, as well as exacerbate existing climate change impacts though loss of biodiversity, loss of livelihoods, increased air pollution, and weakened ecosystem functioning such as clean water provision.

One major forest management issue made more likely and severe by climate change is fire. Forest fires releases vast quantities of CO_2, pose a threat to human life and wildlife (at times wiping out entire animal populations), can have severe financial impacts on local economies through destruction of corporate assets as well as public and private property, and often lead to population displacements. When fires occur in forests and plantations which are located on drained peatlands, the particularly high carbon content of the peat makes it a strong fuel, exacerbating both the fires and their associated GHG emissions.

CLAIMING CARBON BENEFITS FROM FORESTRY

By maintaining or increasing forest cover, SFM has the potential to increase terrestrial carbon storage and therefore mitigate some of the impacts of climate change. Conversely, carbon markets can send a price signal that forests are part of climate mitigation pathways and support the economic viability of forest management over other activities which may otherwise cause land use change.

However, it is a common misconception that all forestry operations, including afforestation projects, are carbon negative or carbon neutral. Net carbon ecosystem productivity is notoriously difficult to calculate accurately and is the focus of much academic research. Forested areas are dynamic and responsive and there are complex sets of biological interactions within the carbon cycle which then determine the rate of sequestration versus the rate of release, as discussed in the **Carbon and Forests** section of this report (see pages 4-6).

Key challenges:

- The representation of carbon claims can be altered depending on the timescales and baselines that are used as part of the net productivity calculations, alongside carbon measurement methodologies.
- The rate of sequestration changes with the age, species and climatic conditions of the forest or plantation, which means where the start and end date are set on the calculation will have a significant impact on the results.
- Similarly, to accurately portray the baseline, the net productivity under the previous land use should also be considered. This is particularly true in land where natural forests have been replaced with plantations.

Any company making carbon claims in relation to forestry assets should be following an industry standard methodology and disclose it. Given the complex and developing nature of scientific understanding of the carbon cycle, it is advisable to use conservative estimates by assuming higher emissions and lower sequestration potential.

FOREST FIRES

The frequency and severity of wildfires has been increasing rapidly over recent years, with devastating fires in Australia, California, Greece, Portugal, Siberia and other locations. Climate change is increasing the risk of wildfires due to hotter, drier conditions but there are other factors which also contribute to the risk. For example, unprecedented fires in Portugal in 2017 have been principally blamed on large tracts of *Eucalyptus globulus* plantations, a non-native, fast growing subtropical which sheds flammable bark. The scale of wildfire impacts has been blamed on extreme weather events occurring in an area where unregulated and ineffective large planting regimes of a high fire-risk species have been implemented without sufficient firebreaks, zoning or consideration of fire or climate risks.

Indonesia has seen several years of extreme forest fires, in particular during the ‘haze crisis’ of 2015, where daily emissions from fire exceeded the average daily emissions of the entire US economy, and the associated pollution caused an estimated 100,000 fatalities.

In Brazil, fire is still routinely used to clear forest for agriculture. In 2021, research on the carbon budget in the Amazon Basic yielded unnerving results. The net emissions in the south-east of Amazonia are now greater than the amount of carbon entering the sink, meaning an area long considered to be one of the world’s most important carbon sinks is now a net source.[16]

WHAT TO ASK IF PRESENTED WITH A CARBON NEUTRAL/NEGATIVE CLAIM?

- **For forestry operations:**
  - What method/standard has been followed?
  - Have calculations been verified, for example through 3rd party certification?
  - What is the timescale used for calculations?
  - Has there been a change of land use and if so, is this reflected in baselines? Is land use change considered as part of the baseline?
  - Have scope 1, 2, and 3 emissions been disclosed, as defined by the Greenhouse Gas Protocol?

- **In addition, if the claim is given for forest products:**
  - Has a lifecycle assessment been conducted that includes carbon calculations? The carbon in the forest-derived product can only contribute to a claim as long as it is ‘locked up’. The carbon in single-use products or fuel will likely be re-emitted to the atmosphere in a very short space of time, and any ‘carbon negative’ claim associated with the original tree growth will become positive as it is released.
  - Have any offsets been used to contribute to the claim? Offsets typically come in the form of purchased/acquired carbon credits, either where GHG emissions have been reduced or carbon storage has increased.

4 SPOTT DATA ON DISCLOSURES OF CLIMATE RISK AND CLIMATE IMPACT

SPOTT is ZSL's free online platform that assesses forest-risk commodity companies on their public disclosure of over 100 sector-specific indicators on environmental, social and governance (ESG) issues. This facilitates constructive industry engagement with investors, ESG analysts, buyers and other supply chain stakeholders – those with the power to influence companies to increase disclosures and improve their practices on the ground.

This brief analysis draws on data from the SPOTT assessments of 100 timber and pulp producers and traders published in June 2021, focusing on indicators most directly linked to climate change, both in terms of climate-related risks to the company and climate impact of the company.

CLIMATE RISK ASSESSMENTS [i/17]

In 2021, only 12 out of 100 companies had carried out and published some form of climate risk assessment, making either the full document or a summary of findings available, and some of these companies make explicit reference to TCFD recommendations. While there has been progress on this indicator compared to 2020, when just 7 out of 100 companies scored at least partial points, these results may indicate a concerning lack of awareness and accountability with regards to climate risk that tropical forestry companies are facing.

COMMITMENT TO THE HIGH CARBON STOCK (HCS) APPROACH [ii]

In 2021, 6 out of 64 relevant companies had made a commitment to the High Carbon Stock approach.[xi] Although the low uptake is partially explained by HCS Approach being originally developed for a South-East Asian context, it is crucial that more companies operating in Asia and beyond apply the HCS Approach to prioritise development and conservation activities.

GHG EMISSIONS INTENSITY [iii] AND EMISSIONS FROM LAND USE CHANGE [iv]

Only 26 out of 100 companies assessed in 2021 disclosed at least some information on GHG emissions, 9 of which, mostly publicly listed companies, published clear GHG intensity figures for all their operations. Out of the 57 companies who operate plantations or natural forest concessions, only one single company reports on emissions from land use change.

SUSTAINABLE FOREST MANAGEMENT

Most forestry companies do not disclose key information related to SFM. Only 5% of companies disclose evidence of deforestation monitoring[v] despite over 50% having a commitment to zero deforestation or similar.[vi] 14% commit to best management practice of soil and peat,[vii] while only 7% disclose evidence relating to this.[viii] 19% disclose evidence on reduced impact logging[ix] and 27% disclose evidence of fire monitoring and management.[x] These figures show that disclosing evidence on key sustainable forest management indicators is still not mainstream.

Disclosures on climate and GHG emissions in the tropical forestry sector are still scarce and unsophisticated, which is at odds with the sector's exposure to climate risk, and its potential contributions to climate change. What's more, companies disclose insufficient information about the implementation of key sustainable forest management practices, making it difficult to assess the degree to which vulnerabilities, adaptation and mitigation opportunities are integrated into the management of their forestry assets.

SPOTT Timber & Pulp Indicators

i. Indicator #11
ii. Indicator #76
iii. Indicator #99
vi. Indicator #100
v. Indicator #54
vi. Indicator #51
vii. Indicator #87
viii. Indicator #89
ix. Indicator #92
x. Indicator #95
xi. The High Carbon Stock (HCS) Approach is a methodology that distinguishes forest areas for protection from degraded lands with low carbon and biodiversity values that may be developed. See more at: https://highcarbonstock.org/the-high-carbon-stock-approach/

FIG 3: **AN OVERVIEW OF THE STATE OF DISCLOSURE ON KEY CLIMATE-RELATED INDICATORS AMONG TROPICAL FORESTRY COMPANIES, AS ASSESSED ON SPOTT.ORG.**

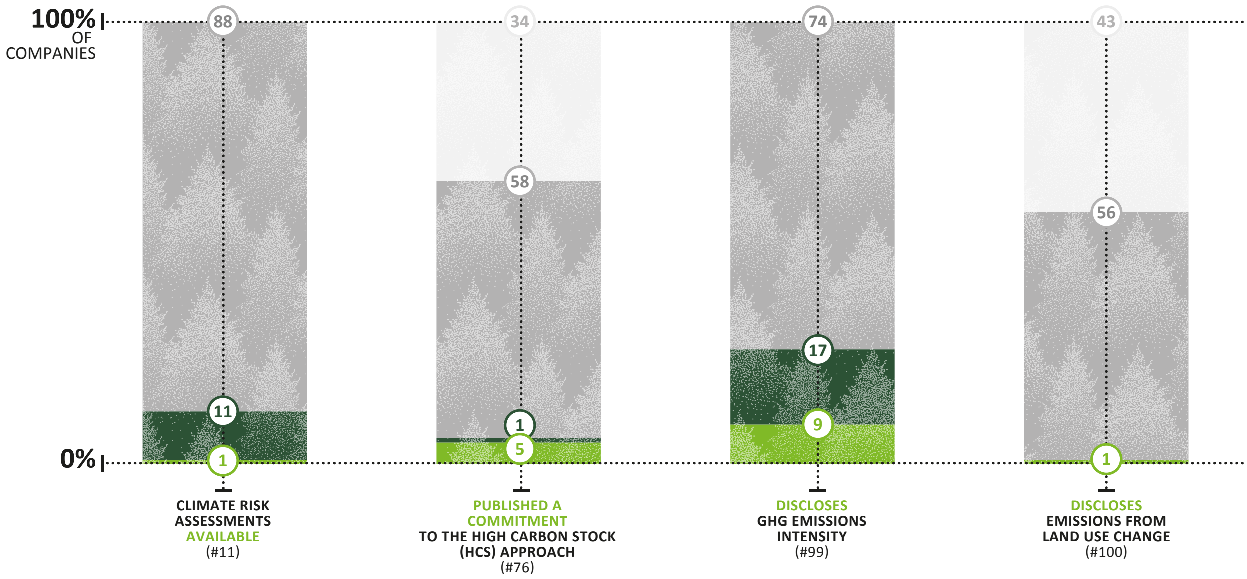
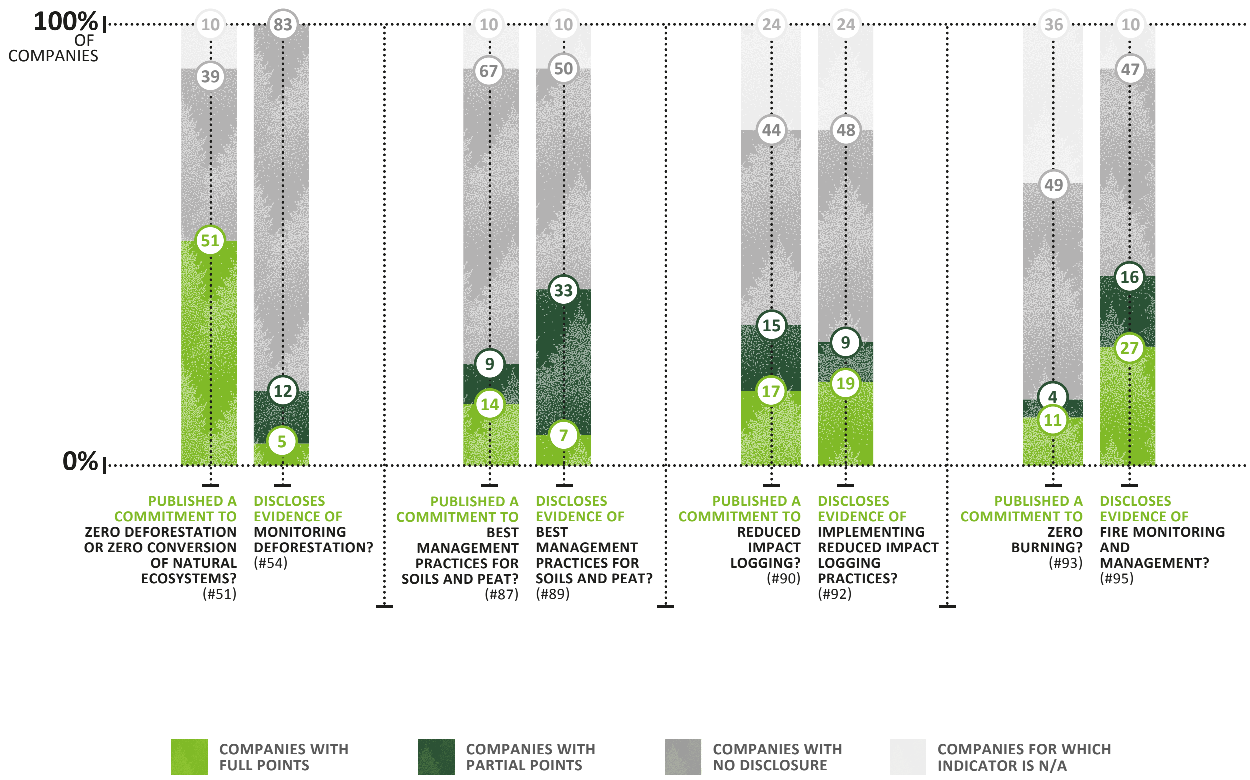


FIG 4: **AN OVERVIEW OF THE STATE OF DISCLOSURE ON KEY SUSTAINABLE FOREST MANAGEMENT -RELATED INDICATORS AMONG TROPICAL FORESTRY COMPANIES, AS ASSESSED ON SPOTT.ORG.**



5 ASSESSING CLIMATE RISK IN FORESTRY

The forestry sector is dependent on many natural assets and ecosystem services, including but not limited to rainwater and ground water, pollinators, soil structure, micro-biosphere and nutrient composition, and atmospheric regulation for sunlight and temperature, all of which are rated as 'high' or 'very high' materiality on ENCORE risk management tool.[i]

These dependencies mean the forestry sector has high exposure to climate change. An understanding of specific risks is therefore necessary to plan interventions or management strategies that will mitigate impacts and ensure forests are able to adapt to the changing environment. This is particularly true of plantations, which are typically more vulnerable than natural forests due to lower biodiversity and ecosystem functions. Developing and implementing informed strategies is fundamental to ensuring the long-term viability of forestry operations as well as their continued positive contribution to biodiversity, ecosystem services, climate regulation, and livelihoods.

It is important that a risk assessment accurately categorises the biophysical characteristics of a given forested area, as such factors directly relate to its vulnerability and adaptive capacity. This makes an 'off the shelf' forestry risk assessment difficult to produce. However, there are a set of high-level risks that are applicable to all forestry operations and can form the basis of a rudimentary risk assessment while a more comprehensive review is underway. **See pages 8-9 for an overview of risks.**

With the proliferation of climate service providers offering risk assessments to the corporate sector, it is important to understand that there is inherent uncertainty when linking physical climate risk projections with business outcomes. Nevertheless, the financial risk to forestry assets should be a strong motivator for all actors within the value chain, from landowners to commodities traders, downstream buyers or financial institutions.

i. ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) is a tool to help users better understand and visualise the impact of environmental change on the economy. See more at: https://encore.naturalcapital.finance/en/about

CLIMATE MODELS AND SCENARIO ANALYSIS

Regardless of sector, climate risk assessments are dependent on climate modelling to provide predictive information. The models themselves are inherently complex due to a multitude of factors, including mathematical assumptions and limitations, and uncertainties associated with current scientific knowledge, particularly environmental thresholds and tipping points.

Models utilise a range of projected emissions scenarios and possible socio-economic and technological developments (inputs) to distil a range of likely climate forecasts (outputs). Put simply, they provide a spectrum of best-case to worst-case climate change scenarios.

There are various human and environmental factors that define different input scenarios, for example projections of fossil fuel consumption and other direct emissions, land use change, and CCS mitigation strategies over the coming decades. These are all intrinsically uncertain and therefore introduce uncertainty into the models. The environmental response to changes within the biophysical environment is also complex and uncertain, including how and when certain thresholds are met or exceeded. Once ‘tipping points’ are reached, positive feedback loops lead to cascading impacts, collectively termed ‘runaway climate change’.

Positive feedback loops occur when a climate change-driven event contributes to further climate change. Well known examples include the drying of forests in temperate regions, which raises the likelihood of forest fires, or permafrost thaw in polar and sub-polar regions, resulting in the release of trapped methane gas and other GHGs.

GRI DISCLOSURE 201-2[18]

The GRI Impact Standards - GRI Disclosure 201-2 defines minimum reporting on Climate risk as follows:

“Risks and opportunities posed by climate change that have the potential to generate substantive changes in operations, revenue, or expenditure, including:

- ***i.*** *a description of the risk or opportunity and its classification as either physical, regulatory, or other;*
- ***ii.*** *a description of the impact associated with the risk or opportunity;*
- ***iii.*** *the financial implications of the risk or opportunity before action is taken;*
- ***iv.*** *the methods used to manage the risk or opportunity;*
- ***v.*** *the costs of actions taken to manage the risk or opportunity.”*

TCFD

The **Task Force on Climate-Related Financial Disclosures** (TCFD) was created by the Financial Stability Board (FSB) to encourage disclosure on “clear, comprehensive, high-quality information on the impacts of climate change” by companies, banks, and investors. The TCFD’s climate disclosure framework, also known as ‘TCFD recommendations’ is broken down into four thematic areas: governance, strategy, risk management, and metrics and targets. To support sector-specific disclosures, TCFD published Supplemental Guidance for non-financial groups, including Agriculture, Food, and Forest Products Groups, which forestry companies can use to as guidance for their reporting.

‘Disclosures, therefore, should focus on qualitative and quantitative information related to both the group’s policy and market risks in the areas of GHG emissions and water, and its opportunities around carbon sequestration, increasing food and fibre production, and reducing waste.’

TCFD[i]

THE FOUNDATIONS OF A ROBUST FORESTRY CLIMATE RISK ASSESSMENT

There is a multitude of frameworks available, but as climate risk assessments in forestry are still not mainstream, there is a lack of benchmarking and standardisation. The function of such risk assessments is ultimately to inform adaptation and mitigation strategies, where interventions can boost the resilience of a forest system. To produce a truly fit-for-purpose risk assessment, the assessor must consider the direct and indirect impacts under different projected scenarios, taking into consideration the specific vulnerabilities of the forest or plantation. This level of multidimensional analysis may be challenging for many smaller forestry companies to do considering the resources which may be needed, but there is still value to be gained from creating and disclosing a rudimentary risk assessment which can be built upon as research gaps continue to be addressed.

Based on ZSL's research, key components of a forestry climate risk assessment include:

Characteristics of natural forests and plantations to determine vulnerability and risk profile

- Tree species composition, age, and density
- State of the forest (overall health and ecosystem functioning)
- Soil type and structure, ideally including microbiome, organic carbon content, depth
- Ecosystem dependencies such as source of water, nutrients, pollinators, etc.
- Geography, including location and landscape characterises such as flat/sloped, coastal/inland, low/high altitude etc.
- Area of continuous tree cover and/or scale of forest fragmentation
- Surrounding land use.

Climate change scenario projections

The risk assessment needs to take into account climate change projections to the highest spatial resolution available, which is likely to be significantly larger than the assessment area. The projection should be analysed for likely impacts according to the risk profile of the forested area in question.

A range of predicted scenarios should be considered ranging from best- to worst-case, with an analysis of the potential impacts of each scenario under each physical and transition risk.

Overlapping pressures

The risk assessment should consider other changes or threats to a forest which may not be directly linked to climate change nor originate within the forest concession in question, but are likely to put strain on the ecosystem, therefore compounding climate risk and impacting the viability of the forestry operation. Such pressures will overlap and compound climate change impacts and, without due consideration, will result in the climate risk assessment becoming inadequate. For example, local deforestation and land-use change may cause significant changes to rainfall patterns. Trees, especially in tropical areas, emit significant quantities of water vapour though evapotranspiration which drives precipitation, both locally and in other regions connected though atmospheric currents.

Under this circumstance, a region that is suffering from climate change-driven drought events is likely to experience more severe water shortages than would be predicted by a climate change risk assessment alone.

Local stakeholder engagement, with a focus on forest-dependent people

As indigenous people and local communities are in many cases both stewards of, and dependent on, forested areas, inclusive climate change mitigation and adaptation strategies will have a higher chance of success than strategies where local stakeholders are excluded.

Indigenous people and local communities' knowledge provides insights that can inform the risk assessment, such as knowledge of past extreme weather events and how the ecosystem responded. Furthermore, indigenous and local people may have developed the most appropriate forest management techniques and understand local biological synergies that promote ecosystem resilience. Conversely, when livelihoods are lost, the risk of unsustainable practices increases.

i. TCFD (2021), Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures, https://assets.bbhub.io/company/sites/60/2021/07/2021-TCFD-Implementing_Guidance.pdf

PREPARING CLIMATE RISK ASSESSMENTS AND DISCLOSURES: THE PERSPECTIVE OF NEW FORESTS, A SUSTAINABLE REAL ASSETS INVESTMENT MANAGER[ii]

Q&A WITH EMILY SIMSO, SUSTAINABILITY MANAGER AT NEW FORESTS

How has New Forests' climate risk assessment shaped the climate disclosure report?

New Forests conducted a climate risk assessment to better understand the physical and transitional risks and opportunities associated with our business, which we outlined in our 2020 Climate Disclosure Report.[19] We subsequently mapped these risks and opportunities to their financial implications on our operations; while there is variation across timescales, likelihoods, and severity of impact, the analysis highlighted the need for strong management controls to address climate. Therefore, New Forests re-visited its climate-related governance structure to ensure climate considerations are embedded across business activities. Additionally, we integrated the Task Force for Climate-related Financial Disclosures (TCFD) guidance into our annual strategic planning process.

What were the key challenges of preparing the assessment and report?

One of the challenges to completing New Forests' climate risk and opportunities assessment was ensuring we addressed the varying conditions across the regions in which we operate. We wanted the analysis to be both globally applicable (so we could create standard management controls) and cognizant of regional variations. We believe that our TCFD framework addresses these items – the format, and many of the risks and opportunities, are standardised, but it also includes specific considerations based on guidance from our regional teams and third-party experts. New Forests engaged a range of internal stakeholders across our business in our climate risk and opportunities assessment as well as third party property managers and Boards of our portfolio companies, as applicable, to incorporate regional variations. It took approximately two years to develop a TCFD framework addressing material issues in our global portfolio and then apply it at the asset level. A key next step for us is integrating the TCFD framework more deeply into investment analysis and asset pricing as both the risks and opportunities associated with climate change, climate policy, and natural climate solutions are evolving rapidly for the forest, agriculture, and land sectors.

What have been the internal benefits of the carrying out the assessment and preparing the climate disclosure report?

A key outcome of New Forests' climate risk and opportunities assessment was creating a shared understanding of climate-related risks and opportunities across our business, including the third-party property managers who are responsible for day-to-day operations of our assets. Developing a robust framework helps ensure that all of New Forests' teams are aware of climate-related risks and opportunities and are integrating them into management decision-making.

ii. New Forests is a global investment manager offering high-impact strategies in sustainable forestry and related sectors, with AUD 7.7 billion (USD 5.7 billion) in assets under management (as of 30 June 2021). The AUM also includes transactions settled in July and September 2021 as well as approximately USD 550 million of committed uncalled capital from fund vehicles and managed accounts. To learn more, please visit: www.newforests.com.au

6 CONCLUSION

- Forests and plantations have the potential to mitigate some of the impacts of climate change through carbon sequestration and environmental stabilisation, but this is unevenly distributed and exists within a complex set of processes within the carbon cycle.
- The adaptive capacity of a forested area, and therefore the severity of climate change impacts, is dependent on numerous factors related to the characteristics of the forest or plantation.
- The forestry sector will increasingly be impacted by climate change and is vulnerable to a range of physical and transition risks.
- There is an industry-wide lack of climate risk assessments and disclosure for forestry.
- Climate risk can impact a company's bottom line, assessments are necessary to raise awareness and inform and allocate resources for adaptation measures.
- Forestry companies should also use climate risk assessments to maximise mitigation potential without losing sight of environmental and social impacts or trade-offs.
- Traders and retailers sourcing multiple commodities from different productive landscapes, as well as large financial institutions who are effectively 'universal owners'(even if not having exposure to forestry sector companies or to forests as real assets), may see indirect, systemic impacts resulting from damaging forestry activities or missed adaptation or mitigation opportunities. They could for example be faced with financial losses caused by crop failures or cascading supply chain disruptions.
- Additionally, downstream buyers and financial institutions are increasingly pressured - if not legally obliged- to undertake their own climate reporting and supply chain due diligence. This requires clear disclosures from the companies they are exposed to.
- **The current lack of disclosures is therefore a missed opportunity for pooling research, reporting costs and shared learning. Importantly, it creates unacceptable data gaps or 'blind spots' for financiers and buyers who need to consider their financing and sourcing's exposure to climate risk.**

CALL TO ACTION

In the face of the climate and biodiversity emergency, the world can neither afford to lose or degrade any more forests, nor can it afford to pass on the opportunity to restore them in order to achieve additional cost-effective mitigation. Forestry companies not only have a duty to sustainably manage the assets they depend on and protect them as much as possible from climate impacts, they are also uniquely positioned to do so.

There is a conspicuous lack of standardised frameworks for forestry climate risk assessments and low levels of climate risk disclosure. This increases the burden on individual companies who attempt to address it. Expectations should be commensurate to a companies' size and resources; the forestry sector does not always present high income margins and companies often point to how precarious their cashflow can be, which makes long-term planning or big capital expenditure difficult. It is therefore necessary to increase the availability and accessibility of climate risk information, best-practice approaches to risk assessment, incentives for disclosure and adoption of forest management techniques that mitigate climate change.

RECOMMENDATIONS

To maximise the contribution of forestry assets to nature-based solutions and therefore fully fulfil their role in the face of the climate crisis, forestry companies should:

- Conduct and publish climate risk assessments and use them to inform their commercial strategy
- Disclose GHG emissions and intensity as well as emissions from land use change
- Report against TCFD recommendations using sector specific metrics and disclose information on SFM practices and outcomes
- Publish clear information about land holdings (including land under development, undeveloped land and conservation set asides)
- Adopt and implement zero conversion/deforestation and zero burning commitments and commit to the HCV and HCS approach
- Working hand in hand with indigenous people and local communities, protect and manage HCVs and other conservation set asides in and around their concessions, and
- Commit to restoration of any area degraded as part of their operations.

Downstream buyers and financial institutions are also vulnerable to climate risk and therefore have clear interest in encouraging and supporting the forestry sector in effectively being a positive force towards the conservation of forests and the ecosystem services they provide. They should:

- Adopt and implement their own zero conversion/ deforestation and zero burning commitments
- Engage forestry companies to request they make the abovementioned disclosures
- Enquire about commitment and implementation progress, making sure to scrutinize and challenge insufficiently evidenced sustainability and additionality claims.
- Support the forestry sector in implementing best practice through preferential sourcing and transition/sustainable financing opportunities.

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ACRONYMS

CCS	Carbon Capture and Storage
ENCORE	Exploring Natural Capital Opportunities, Risks and Exposure (UN web-based tool)
ESG	Environmental, Social and Governance
FAO	Food and Agriculture Organisation (of the United Nations)
FSB	Financial Stability Board
GHG	Greenhouse Gas
GRI	Global Reporting Initiative
HCS	High Carbon Stock approach
HCV	High Conservation Value
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
NDPE	No-deforestation, No-peat and No-exploitation
SFM	Sustainable Forest Management
SPOTT	Sustainability Policy Transparency Toolkit
TCFD	Task Force on Climate-Related Financial Disclosures

DEFINITIONS

Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects. (Source: IPCC)

Additionality: The requirement by which, under the Kyoto Protocol and sound voluntary market standards, carbon credits will be awarded only to project activities where emissions reductions are "additional to those that otherwise would occur", i.e. additional reductions compared to the "baseline scenario" (Source: UN-REDD)

Afforestation: Afforestation is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources. (Source: UN-REDD)

Agroforestry: Agriculture incorporating the planting or conservation of trees. (Source: UN-REDD)

Baseline (scenario): In seeking to measure whether greenhouse gases have increased or decreased, it is necessary to have a known previously emitted amount (often connected to a baseline date or year), against which to make a comparison over time. This is often referred to as the "baseline scenario" or "baseline", i.e. expected emissions if the emission reduction activities were not implemented. (Source: UN-REDD)

Biodiversity: The total diversity of all organisms and ecosystems at various spatial scales (from genes to entire biomes). (Source: IPCC)

Biofuel: A fuel, generally in liquid form, produced from biomass. Biofuels currently include bioethanol from sugarcane or maize, biodiesel from canola or soybeans, and black liquor from the paper-manufacturing process. (Source: IPCC)

Carbon negative: A situation is carbon negative if, as a result of human activities, more carbon dioxide is removed from the atmosphere than is emitted into it.

Carbon neutral: Carbon neutrality is achieved when anthropogenic CO2 emissions are balanced globally by anthropogenic CO2 removals over a specified period. Carbon neutrality is also referred to as Net zero carbon dioxide emissions. (Source: IPCC)

Carbon sink: A reservoir (natural or human, in soil, ocean, and plants) where a greenhouse gas, an aerosol or a precursor of a greenhouse gas is stored. Note that UNFCCC Article 1.8 refers to a sink as any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere. (Source: IPCC)

Deforestation: Deforestation is defined as the clearance and permanent land use change of a forested area. (Source: ZSL)

Ecosystem: An ecosystem is a functional unit consisting of living organisms, their non-living environment and the interactions within and between them. The components included in a given ecosystem and its spatial boundaries depend on the purpose for which the ecosystem is defined: in some cases, they are relatively sharp, while in others they are diffuse. Ecosystem boundaries can change over time. Ecosystems are nested within other ecosystems and their scale can range from very small to the entire biosphere. In the current era, most ecosystems either contain people as key organisms, or are influenced by the effects of human activities in their environment. (Source: IPCC)

Evapo-transpiration: The sum of water lost from the soil to the atmosphere through evaporation and transpiration by plants on the land. Forest evapotranspiration comprises a large component of the total ecosystem water loss and therefore quantifying this resource is critical for forest and water resource-management. (Source: ZSL)

Forest: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or other land use. This definition of forest includes natural forests and tree plantations. However, for the purpose of implementing no-deforestation supply chain commitments, the focus is on preventing the conversion of natural forests only. (Source: Accountability Framework)

Forest Degradation: Degradation has been defined in many ways, but principally refers to a forest's reduced ability to provide ecosystem services such as carbon storage and water cycle regulation, and to provide habitats for forest dwelling species – without total forest clearance. Natural occurrences (such as fire and floods) can cause degradation, as can human activity – logging, mining and fuelwood extraction are typical causes. (Source: ZSL)

Fragmentation: The transformation of a contiguous patch of forest into several smaller, disjointed patches surrounded by other land uses.,

Mitigation: The term used to describe any action seeking to reduce the amount of greenhouse gases released into the atmosphere by human-related activities. Such actions might include reducing our use of fossil fuels and changing the way we use land - such as by reducing our rate of land clearing and deforestation, and increasing our rate of reforestation. (Source: UN-REDD)

Natural Forest: A forest composed of indigenous trees not established by planting or/and seeding in the process of afforestation or reforestation. (Source: UN-REDD)

Net Ecosystem Production (NEP): Net gain or loss of carbon from an ecosystem. NEP is equal to Net Primary Production minus the carbon lost through heterotrophic respiration. (Source: ZSL)

Offsets: Credits issued in return for a reduction of atmospheric carbon emissions through projects such as the provision of renewable energy to replace fossil fuel energy, or reforesting cleared land to create a carbon sink. By paying for such emission reducing activities, individuals and organizations can use the resulting credits to offset their own emissions, either voluntarily or under the rules of most emissions trading schemes. One offset credit is equivalent to an emission reduction of one metric ton of CO2e. (Source: UN-REDD)

Peat: Unconsolidated soil material consisting largely of partially decomposed organic matter accumulated under conditions of excess moisture or other conditions that decrease decomposition rates. (Source: IPCC)

Plantation: A forest predominantly composed of trees established through planting and/or deliberate seeding that lacks key elements of a natural forest native to the area, such as species composition and structural diversity. Plantations generally have one or a few tree species and tend to include one or more of the following characteristics: i) planted on cleared land, ii) harvested regularly, iii) trees are of even ages, iv) products from the plantation are managed and processed for commercial production. (Source: Accountability Framework)

Reforestation: Planting of forests on lands that have previously contained forests but that have been converted to some other use. (Source: IPCC)

Regeneration: The renewal of a stand of trees through either natural means (seeded onsite or adjacent stands or deposited by wind, birds, or animals) or artificial means (by planting seedlings or direct seeding). (Source: IPCC)

Restoration: The process of assisting the recovery of an ecosystem, and its associated conservation values, that has been degraded, damaged, or destroyed. The term "restoration" is also used in the context of remediation of human rights harms, for which restoration may come in many forms (e.g., restoration of benefits, employment, or access to lands). (Source: Accountability Framework)

Sequestration: The process of increasing the carbon content of a carbon pool other than the atmosphere. (Source: IPCC)

Subsidence: The sudden sinking or gradual downward settling of the Earth's surface with little or no horizontal motion. (Source: IPCC)

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