Natural Capital
Leaders Platform

Resilience in commercial forestry

Doing business with nature

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Natural Capital Leaders Platform

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This document is part of a series of 'Doing business with nature' publications; these identify challenges and opportunities for companies whose future growth depends on a healthy and sustained supply of nature's goods and its services, known as 'natural capital'. The rationale for investing in sustainable natural capital management is set out in Doing business with nature: Opportunities from natural capital and has been further developed through commodity-specific Action Research Collaboratories (ARCs) for dairy in the UK and Ireland, for cotton and for Commercial Forestry.

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Executive summary

Now, more than ever, companies are urged to recognise the fundamental role that nature's goods and services play in business operations.

Commercial forestry, which includes timber as well as pulp and paper, is fundamentally dependent on natural resources such as water, biodiversity, soil and carbon. To maintain competitiveness, differentiate themselves in the market and secure long-term resilience, companies along the supply chain should aim to manage the risks and opportunities associated with natural resources.

A number of efforts and initiatives, including those spearheaded by the World Wide Fund for Nature (WWF), the Food and Agriculture Organization of the United Nations (FAO) and certification bodies, support companies in building sustainability and resilience. Within this context, companies are working to improve understanding of how practices on the ground and sourcing or purchasing decisions downstream can impact on natural resources.

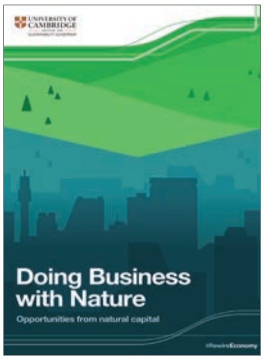
As these resources are crucial for the long-term supply of raw materials, it is important to empower the forestry sector to better manage them. The sector has come a long way in improving the sustainable management of commercial forests; there is now an opportunity to build on existing efforts by better measuring and communicating corporate impacts on natural resources. Such metrics would help inform internal decision-making, support supplier performance reviews and demonstrate progress to stakeholders, including customers and investors. These metrics, combined with developments in science and technology, will enable industry leaders to address natural resource risks and build resilience in commercial forestry.

This report highlights how businesses in the forestry sector impact and depend on water, biodiversity, soil and carbon and looks at existing efforts to address the related challenges. It suggests that it is possible for the sustainable management of production landscapes to simultaneously benefit natural resources and build resilience in the commercial forestry sector. Better understanding of how commercial forestry impacts and depends on natural resources will facilitate the necessary research, collaboration and action going forward.

It is possible that the sustainable management of production landscapes simultaneously benefits natural resources and builds resilience in the commercial forestry sector.

Contents

This report is part of a series of related CISL outputs that explore the sustainable management of natural resources:



The report aims to engage industry in a review of the global challenges around water, biodiversity and soil, and showcases the extent, to which companies are working to develop new interventions in the face of natural resource degradation.

The report represents different perspectives of the dairy value chain and concludes that more sustainable use of natural resources would create a more resilient dairy industry by providing opportunities for increased productivity, reduced input costs and mitigated risks.

The report focuses on cotton's growing stage of the value chain in which natural resource challenges are most prevalent. It is complemented by an online tool, created for businesses to engage with.

Part 1

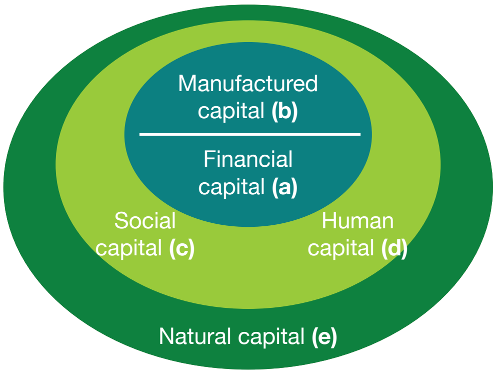
Introduction

1.1 Natural capital and commercial forestry

Forests provide essential goods and services to society and all life on Earth: they asborb carbon, clean air, regulate water, and promote wild species.

Timber, pulp and paper industries all depend upon forests, water, biodiversity, soil and carbon. This natural resource base, often referred to as 'natural capital', sustains production of raw materials and supports other forms of the capital valuable to business (Figure 1).

Commercial forests depend on natural resources to maintain business productivity and profitability; managment practices that degrade these resources can threaten supply chain resilience. Sustainable management of natural resources can yield significant business opportunities while supplying wood and fibre as well as goods and services in perpetuity.



(a) money, stocks, bonds
(b) infrastructure, tools, roads
(c) families, communities, governance systems
(d) knowledge, skills, health
(e) water, biodiversity and soil, ecosystems, sea

Figure 1: Natural capital needs to be acknowledged as the foundation for other forms of capital[2]

Stocks of water, biodiversity and soil are deteriorating globally.[3,4,5] Such trends have implications across corporate departments including procurement, supply chain management and corporate social responsibility. If not managed sustainably, natural resource degradation will translate into risks for companies that rely on them for the production of raw materials (Box 1a).

Sustainably managing the stocks and flows of natural resources can provide tangible business opportunities (Box 1b). This suggests that the sustainable management of production landscapes may simultaneously benefit natural resources and build resilience in the commercial forestry sector. Commercial forestry can play a key part in maintaining the world's natural capital base.

Risks

- Lack of access to raw materials and complicated responsible sourcing
- Stressed supply chain and decreased efficiency
- Increasingly stringent regulatory demands and market forces
- Growing pressure for appropriate supplier contracts and procurement conditions
- Lack of compliance with global certification schemes and loss of high conservation value areas
- Interrupted access to capital and loss of investor confidence
- Challenged reputation and brand identity
- Expensive inputs to counter the degradation of water, biodiversity and soil
- Reduced business continuity

Box1a: Risks related to natural resource degradation for companies reliant on commercial forestry

Opportunities

- Resilient supply chains
- Increased productivity and avoidance of liabilities caused by environmental damage
- Anticipated regulatory changes and credibility to shape regulation
- Reinforced consumer trust, investor interest and finance
- Innovation to satisfy consumer demand
- Competitive advantage and market differentiation
- Maintained commercial value
- Recognised conservation and mitigation efforts
- Wellbeing and health of forest landscapes and communities

Box1b: Opportunities associated with the sustainable management of natural resources

Part 2

Global forestry

2.1 A complex challenge: habitats, types and management scales

It is challenging for businesses to consider natural resources in their decision-making processes. This is particularly true for commercial forestry which operates across different habitats and types and at different management scales across the world.

2.1.1 Habitats

Commercial forestry operations occur in boreal, temperate, subtropical and tropical habitats that span different geographical and political boundaries (Figure 2).

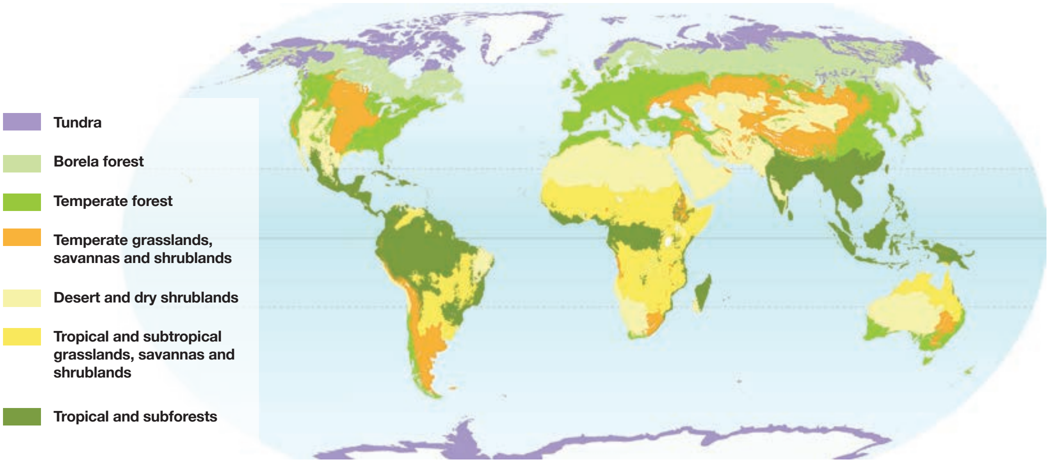


Figure 2: World forests according to habitat and vegetation.[6] Other noteworthy habitats include Mediterranean and montane

While habitats differ in their prevalence, composition and global significance, they are all linked to water, biodiversity, soil and carbon, and clean air (Table 1). There are different risks associated with these forest habitats including governance and land use issues, scrutiny from non-governmental organisations (NGOs), climate change impacts and pest and disease occurrences. In the face of these risks, sustainable supply is becoming constrained while demand for timber is set to triple by 2050.[5]

Boreal	Temperate	Tropical & Subtropical
Represents thirty-three per cent of total forest cover: generally evergreen and coniferous • Source of surface freshwater, including networks of wetlands • One of the last places where herds of herbivores and predators can roam free and millions of birds breed in or migrate through the boreal forest each year • Boreal tree species have adapted to the acidic, thin and nutrient-poor soils • Store enormous quantities of carbon, mostly in peatland and soil, but also in biomass These areas have recently been under pressure from illegal logging, mining, hydroelectric development and oil and gas exploration.[7]	**Represents eleven percent of total forest cover:** broad-leaf deciduous, evergreen coniferous and mixed with shrubs and bushes • Regulate water cycling and precipitation levels • Host emblematic species and provide functional and structural diversity • Protect soil erosion and provide leaf litter that enriches the soil with inorganic and organic nutrients • Have a high capacity to sequester carbon in biomass and soil Important risks include hotter and longer droughts as well as increasingly frequent and intense wildfires; these have significant effects on evaporation rates and cause substantial water stress.	**Represents forty-seven and nine per cent of total forest cover:** include very wet and coniferous forests • Provide one-fifth of the world's freshwater and help maintain drinking water supplies • Support 50-90 per cent of all of Earth's species • Forest biomass provides nutrients and organisms to the soil • Constitute almost half of the world's living terrestrial land carbon pool Risks are particularly prominent because of vulnerability to high rates of deforestation and to climatic events. NGOs and nature conservation efforts have challenged companies to improve management and ensure biodiversity is safeguarded.[8]

Table 1: Boreal, temperate and tropical/subtropical forests differ in their prevalence, composition and global significance. They are all intricately linked to water, biodiversity, soil and carbon

2.1.2 Types

Commercial forestry operates across different forest types.

Commercial forests that are planted or selected through natural regeneration occupy approximately 258 million hectares, representing seven per cent of the total world forest area.[9] While they represent a relatively small proportion of the world's forest area, planted forests provide one third of global roundwood production, which comprises wood removed from the forest to be processed into timber, veneer, pulp or other products (Figure 3).[10]

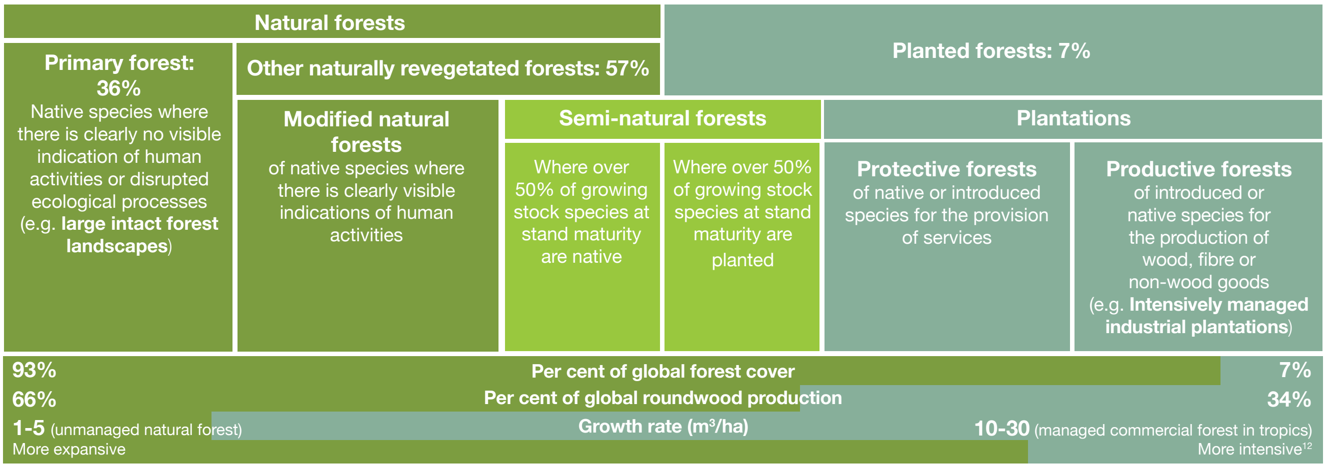
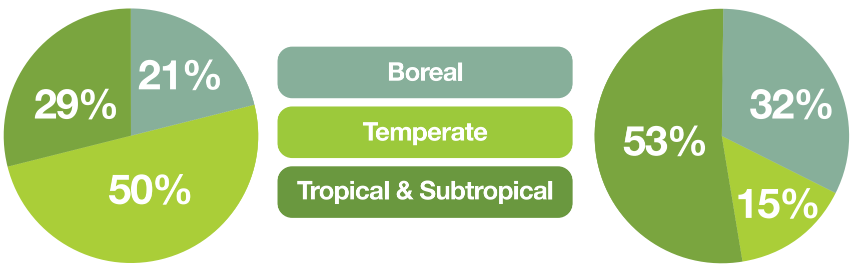


Figure 3: Forest types can range from natural to planted[13]; planted forests cover only seven per cent of total forest cover yet supply one-third of roundwood production

Mosaic forest landscapes are made up of different land patches. These areas serve different purposes that meet economic and social needs while maintaining natural resources. Mosaics normally include commercial areas, protected areas, high conservation value areas and ecological networks.

Planted forests are primarily in temperate habitats (Figure 4a) yet productivity is highest in intensively managed tropical forest plantations (Figure 5). If established through conversion of natural forests, these plantations can significantly reduce biodiversity and therefore decrease the overall landscape resilience. As planted forests are increasingly targeted to satisfy the growing demand for industrial roundwood, it is fundamental to ensure that they are sustainably managed through a mosaic approach that maintains both biodiversity and productivity.

As part of mosaic landscapes, planted forests are becoming increasingly important in the restoration of degraded ecosystems especially wetland and riparian areas, natural resource conservation and climate change policies. They are seen as important to reducing harvest pressures on remaining natural forests which primarily include high risk tropical habitats and boreal intact forest landscapes (Figure 4b).[11] Certification bodies have fully integrated plantations into their standards. Investors have also started expressing an interest in planted forests, suggesting that they recognise that more sustainable practices in planted investments translate into more secure and sustained profits. Since there are still a number of concerns associated with planted forests and their expansion, sustainable commercial forestry must seek to manage production and protection of natural resources simultaneously.[12]



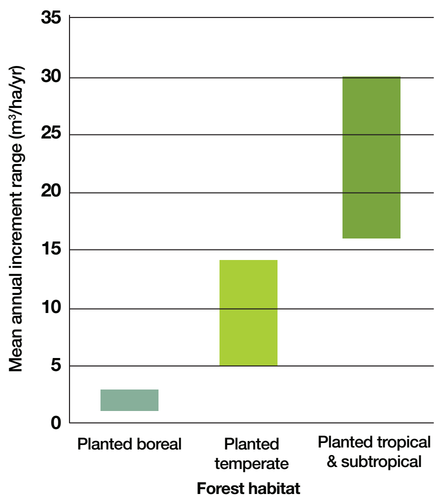


Figure 4a: Composition of planted forests. As defined by the 2015 Global Forest Resources Assessment[14]

Figure 4b: Composition of natural forests[14]

Figure 5: Productivity of planted forests[12, 15]

2.1.3 Management scales

Commercial forests are managed across different scales. They can be privately owned or managed by small and medium enterprises (SMEs), including communities.

Each forest habitat and type needs to be approached differently by the forestry sector with recognition of the variety of management scales. SMEs and communities are assuming growing importance as stewards of the world's forests yet the sector, customers and society at large have not successfully managed to include them in current management strategies and certification programmes.

This can lead to small and medium growers failing to get certified and can result in their release from supply chains.[16] Addressing this risk will need to consider technological and innovative solutions and the sector, customers, NGOs and certification schemes need to collaborate on their successful implementation.

2.2 Responding to the challenge

Businesses are exploring responses to better manage impacts and dependencies on natural resources across different forest habitat, types and management scales (Figure 6).

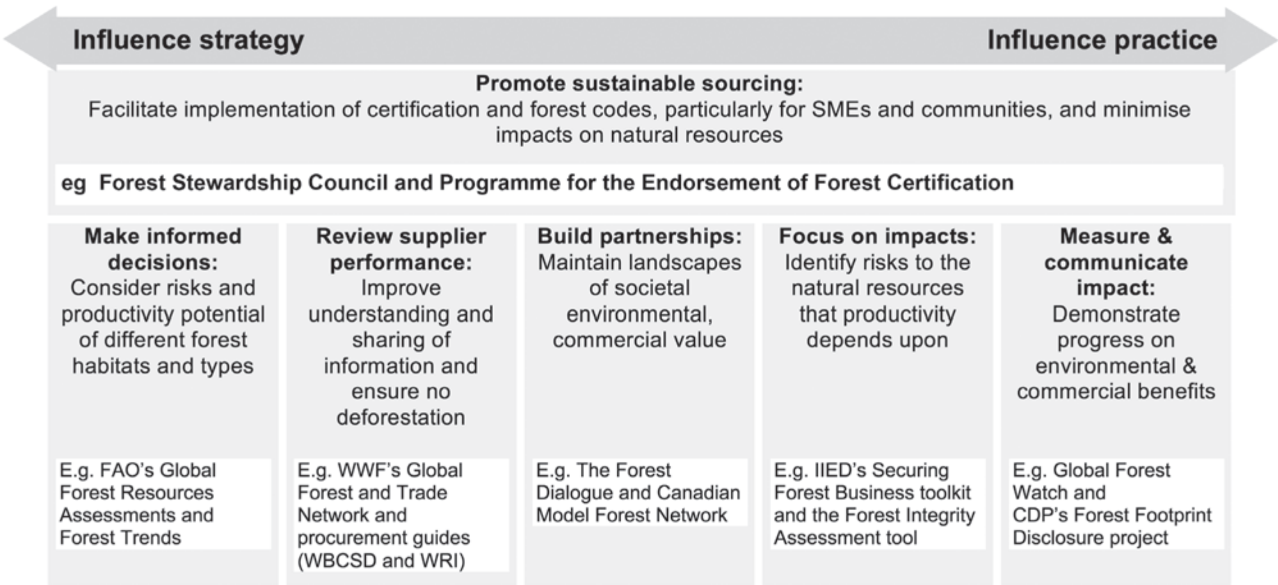


Figure 6: A continuum of activities required to build resilience

2.2.1 Certification and reporting

Prompted by regulation, companies have commonly responded to the challenge of sourcing sustainable timber by adopting forest management certification systems.[17] The challenge is now to make them more inclusive and take them to scale.

Businesses use certification as a market mechanism to ensure sustainable and legal sourcing.[18] Notable examples of certification include the American Tree Farm Program (ATFP)[19], Canadian Standard Association (CSA)[20], Forest Stewardship Council (FSC)[21], Programme for the Endorsement of Forest Certification (PEFC)[22], Sustainable Forest Initiative (SFI)[23] and Green Tag (GT).[24] Both PEFC and FSC issue Chain of Custody certification to ensure appropriate labeling and the traceability of timber from forest to user.[25]

While there has been significant progress with regards to sustainable management, only ten per cent of total forest cover is certified and the vast majority of these certified forests are planted forests and large tracts of boreal forests. As demand for timber is set to triple by 2050[5], buyers and customers who wish to source and use timber from certified areas alone will be challenged[26] (Figure 7).

Certification provides the greatest assurance of sustainable sourcing. With only ten per cent of total forest cover certified, companies will have to work towards ensuring that they are sourcing timber products responsibly (Figure 8).

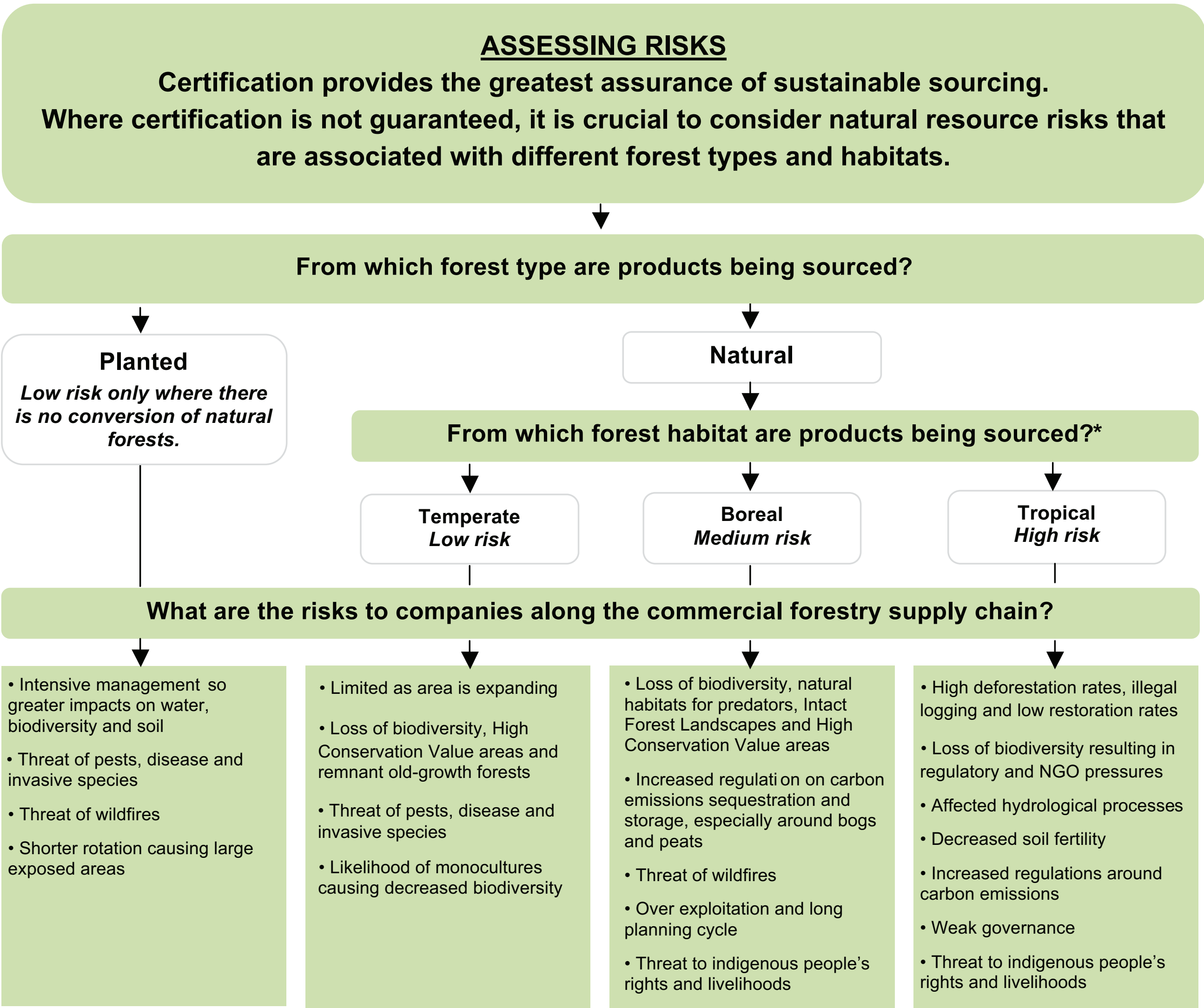
To address this demand-supply gap, there are steps that companies can take to ensure sustainable and responsible products (Figure 6). This will enable them to enhance competitiveness, differentiate themselves in the market and secure long-term resilience.[27]

2.2.2 Managing for resilience

Leading companies are working towards managing corporate impacts on natural resources to ensure both environmental and commercial resilience.

When managing for resilience, businesses can take into account the natural resource risks to different commercial forestry habitats and types and consider the trade-offs involved in addressing these.[25,28,29] For example, climate change mitigation policies to improve the carbon storage and sequestration capabilities of commercial forests may come into conflict with efforts to address other natural resource challenges, including biodiversity loss. Consideration of these trade-offs can support businesses to maintain a sustainable supply of raw materials while safeguarding the resilience of the overall landscape.[30–36]

With this in mind, it is possible that a commercial forest better sustains natural resources than an area that is managed for a specific purpose, such as a protected area.[37] This has not yet been proven. Evidence in the form of impact metrics is needed to demonstrate that commercial forests can be managed for both environmental and commercial purposes.



***Subtropical forests** cover a large area and lie mainly between temperate and planted forests in terms of risks and management considerations.

Figure 7: Where certification is not guaranteed, it is crucial that decision-making considers the natural resource risks that are associated with different forest types and habitats

DEFINING RESPONSIBLE PRODUCTS

Certification provides the greatest assurance of sustainable sourcing. Where certification is not guaranteed, it is crucial to consider different forest types and habitats to source responsible products.

What helps define responsible products if not certified?

For all levels of risk: Traceability

For high and medium levels of risk: Controlled wood†, implemented national forest code and due diligence

From which forest type are products being sourced?

Planted
Low risk only where there is no conversion of natural forests.

Natural

From which forest habitat are products being sourced?*

Temperate
Low risk

Boreal
Medium risk

Tropical
High risk

What could decision-making consider in relation to specific forest types and habitats to help define responsible products?

Planted

- Mosaic planted forests through landscape scale planning
- Afforestation and no deforestation
- Opportunities for SMEs and communities to meet standards
- Protect High Conservation Value areas and carry out integrity assessments
- Protection of freshwater ecosystems

Temperate

- Operations carried out within a mosaic landscape
- Opportunities for SMEs and communities to meet standards
- Protect High Conservation Value areas and carry out integrity assessments
- Protection of freshwater ecosystems

Boreal

- Mosaic felling
- Conserving Intact Forest Landscapes and High
- Long-term planning
- Free, prior & informed consent (FPIC) for indigenous people
- Protection of freshwater ecosystems!

Tropical

- Strong biodiversity and ecosystem management plan to maintain the natural cycle and valuable forest services
- Selective harvesting only of any forest products
- Opportunities with communities to meet standards
- Ecological infrastructure and peat management
- Free, prior & informed consent (FPIC) for indigenous people rights and livelihoods

Management impacts on natural resources need to be managed as commercial forestry depends on these resources for ecological resilience and sustained annual yields

- Water quality and quantity
- Species abundance and diversity
- Soil fertility, structure and water holding capacity
- Carbon stocks above and below ground

†Controlled wood is material that can be mixed with certified material during manufacturing FSC Products. It has to meet certain criteria: no illegally harvested wood • not harvested in violation of traditional and human rights • not harvest where management threatens high conservation value areas • not from forests being converted to plantations or for non-forest use • not from forests where genetically modified trees are planted

Figure 8: Where certification is not guaranteed, it is crucial that decision-making considers the different forest types and habitats to source responsible products

Part 3

Key implications for commercial forestry

Commercial forestry impacts and depends on water, biodiversity, soil and carbon with implications for companies across the supply chain.

In production landscapes, protected and zoned areas can often sustain the natural resources that commercial forestry depends upon. Nevertheless there are opportunities to improve the sustainable management of the commercial areas themselves and build resilience.

It is important to understand how commercial forestry practices impact and depend on natural resources. These components interact and provide a variety of services that benefit society (Figure 9).

While this report focuses on optimising natural resources across different forest types, it is important to acknowledge the implications of commercial forestry on society.

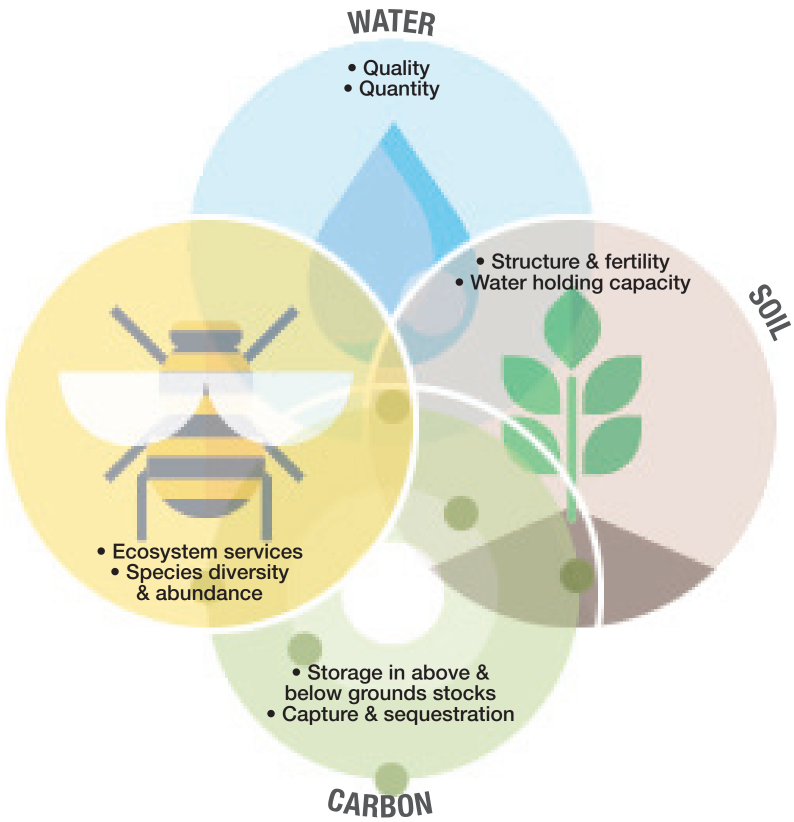


Figure 9: The services provided by and the interactions between water, biodiversity, soil and carbon

Part 3: Key implications for commercial forestry *continued*

3.1 Water and commercial forestry

Commercial forestry depends and impacts on water quality and quantity.

DEPENDENCIES

Commercial forestry depends on rainwater for tree growth and to maintain the evapotranspiration rates necessary to respond to climatic changes.

IMPACTS

Commercial forestry practices can cause surface water acidification, changes in interception rates and in streamflow[38], sediment and nutrient inputs to drainage systems[39], transpiration reductions, water quality decreases and leaching.[40]

BUSINESS IMPLICATIONS

- *Regulatory risks* can occur as a result of altering hydrological cycles and exacerbating climate change
- *Reputational risks* can result from disrupting community water supplies
- *Remediation costs* can occur because of the need to treat affected streams
- *Intensified vulnerability of supply* can result from natural events, including storms and fires

Businesses are under increasing regulatory and reputational pressure to ensure that forest management practices do not exacerbate, but rather mitigate, climate change impacts[38], many of which relate to **better water regulation**. This includes maintaining evapotranspiration rates as well as rainwater capture and storage. Forest watersheds are fundamental to global hydrological cycles as they receive water from rainfall, fog and mist, store it in forest soils and release it into streams, rivers and the atmosphere. As forest catchments supply 75 per cent of freshwater, practices that threaten the provision of clean water to local communities may pose substantial reputational risks for companies.[41]

Forest management can impact the biological and physical characteristics of watersheds.[40] For example, harvesting and the subsequent removal or loss of biomass decreases water retainment and increases land vulnerability to erosion and run-off. Similarly, poorly designed and constructed roads and skid trails can cause the leaching of chemicals, surface runoff[42] and other negative impacts on surface and subsurface water quality.[43] It is therefore essential that management should focus on maintaining the regulating services of forested watershed and on promoting freshwater stewardship.

Forest management practices, such as drainage, road construction and harvesting operations, are considered non-point sources of pollution.[44] The implementation of riparian buffer zones may help mitigate negative impacts on stream water through nutrient sequestration, maintenance of local micro-climates, filtering of sediment and other materials and regulation of nutrient export.[45,46] The importance of riparian zones and of their structural or functional values depends on the intensity of management activities and on the area's vulnerable resources.[47] To ensure that **riparian buffer zones are efficiently and sustainably established to maintain water quality**, companies are working with local organisations, such as Silver Taiga in the Russian boreal region, to better map and understand vegetation distribution using dynamic global vegetation models and satellite-derived land cover maps.[48]

3.2 Biodiversity and commercial forestry

Commercial forests depend and impact on species diversity and abundance.

DEPENDENCIES

Biodiversity underpins many ecosystem services. The functional traits of individual species play an important role in determining ecological processes necessary for forest growth and ecosystem resilience.

IMPACTS

Forest management impacts biodiversity through clearcutting, drainage, thinning, forest fragmentation, edge effects[49] and the use of alien species.[50] Management practices may result in loss of ecosystem, species and genetic diversity and may therefore reduce stand resilience to epidemics.

BUSINESS IMPLICATIONS

- *Reputational risks* and result from forest fragmentation and decreased biodiversity
- *Brand impacts* can occur because of NGO activity and affect customer and investor trust in the company's ethical stance and brand
- *Raw material supply risks* can result from decreased resilience because of impacted ecosystem services
- *Regulatory demands* can put pressure on businesses to meet appropriate biodiversity levels and targets

Global and European efforts have led to the development of policies, regulations and targets for the conservation and enhancement of forest biodiversity. While these are particularly relevant to the tropical regions[51] which harbour high levels of species diversity, they also apply to boreal and temperate regions which host emblematic species. Such policy measures are urging companies to shift their management practices to retain structural diversity, preserve key habitats and safeguard protected areas.[50] In these cases, commercial forests may be able to support higher native species diversity than non-forest land uses, including pasture and annual crops, presenting a signficiant reputational opportunity for companies.[52]

Several studies have highlighted links between biodiversity and ecosystem services, including pollination, seed dispersal, photosynthesis, predation, decomposition and biomass production in forests.[49]

Ecosystem services are fundamental for ensuring structural diversity and landscape resilience. These are both necessary to sustain business operations and the supply of raw materials.[53] Commercial forests must therefore operate **within mosaic landscapes.** These mosaic landscapes can include protected areas, high conservation value areas and ecological networks. Management practices that maintain species interactions and occurrence of migration routes through the forest, can help protect biodiversity and the numerous services it provides in commercial forested areas.

Two per cent of South Africa is forested with commercial plantations of predominantly pine and eucalyptus trees. Their establishment, including site preparation, can have severe impacts on biodiversity by threatening the indigenous and native composition and function of biodiversity in the region. When considered at the larger landscape-scale, biodiversity can be sustained by safeguarding protected areas and high conservation value areas and by setting up Ecological Networks (ENs). By doing so, the industry has retained over half a million hectares of remnant habitat in and among exotic tree plantations as ENs allowing **plantations to be part of an ecologically productive mosaic landscape.** These help mitigate biodiversity loss, maintain ecosystem processes and services and improve the quality of life of local communities, while at the same time ensuring the financial viability of forest operations.[54]

Part 3: Key implications for commercial forestry *continued*

3.3 Soil and commercial forestry

Commercial forestry depends and impacts on soil structure and fertility.

DEPENDENCIES

Soil provides nutrients and water to support the growth and health of vegetation and it acts as an anchor for tree roots[55]. Soil structure and fertility help regulate valuable ecosystem processes including nutrient uptake, decomposition, water availability and wood production[55]

IMPACTS

Forest management can result in soil acidification, compaction and soil erosion[55].

BUSINESS IMPLICATIONS

- *Increased costs* can result from the need for expensive inputs, such as fertilisers, and for machinery to counter the degradation of soil
- *Risks to revenue generation* can result from poor quality soil being unable to sustain yields from existing lands
- *Increased risks* around security of supply can result from soils within the landscape being degraded and prone to erosion

Not only does soil anchor tree roots[56], it also provides the structure that underpins productive forests. As a result, management practices that impact on soil may interfere with recovery capacities of commercial forest areas.[55] The impact of practices, including poorly managed burning regimes and harvesting, can be evidenced by erosion, degradation, acidification and levels of organic matter.[55] When soil material erodes it impacts on both the productvity of the site and the way water moves through the forest system. This has a knock on effect on ecosystem services, including the provision of water and is therefore of significant concern to forestry companies.

To sustain soil fertility and ensure high production rates management must aim to **balance stocks and flows of nutrients**; businesses could invest in advanced nutrient cycle management techniques[55] and other practices including fertilisation and restoration. Forest restoration in dryland areas and watershed management in upland areas are appropriate measures to protect and rehabilitate areas prone to soil degradation and erosion, and can help maintain soil fertility and structure. Management practices that aim to maintain forest cover on soils and on run-off pathways, as well as to balance nutrient budgets, can help safeguard soil structure and control the risk of erosion.

Forest management practices, including restoration, have a significant role to play in improving soil fertility. Nigeria's tropical rainforest has been heavily exploited, seriously degraded and fragmented. The natural recovery of such areas is generally very slow because of soil degradation. Management efforts should therefore aim at restoring these areas to improve their productive and ecological values. Enrichment planting, which involves the deliberate introduction of tree seeds or seedlings into a degraded forest, has been introduced as a means of improving forest resources management. Because it has the **potential to improve soil fertility, yields and restoration of degraded forests**, it has gained the attention of companies wishing to secure future availability of timber.[57]

3.4 Carbon and commercial forestry

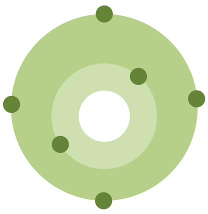
Commercial forests depend and impact on carbon capture and storage.

DEPENDENCIES

Biological growth of trees requires carbon from the atmosphere for assimilation, photosynthesis and transpiration.[58] Through photosynthesis, carbon dioxide (CO_2) is converted into important food for trees and is fundamental for growth.[59]

IMPACTS

Forest management may impact carbon sequestration rates and decrease the soil carbon stock in the organic layers of the forest floor by as much as 50 per cent through more frequent logging, drainage and site preparation operations.[60] This can then be released into the atmosphere as CO_2. Impacts are intensified after thinning interventions and at the end of rotation periods.[61]



BUSINESS IMPLICATIONS

- *Reputational pressures* from NGOs and other groups can occur because of business practices that impact climate change
- *Increased risks* around license to operate and activities can result from climate change impacts
- *Regulatory demands* around carbon emissions can occur because of increased regulations from governments and civil society groups
- *Influence on consumer and investor interest* can result from negative brand image and identity

Given growing concerns around climate change impacts, carbon is an area of increasing focus for society, governments and businesses alike. Forestry companies are especially targeted as forests capture and store one third of the atmospheric carbon dioxide (CO_2) picked up by terrestrial ecosystems. Carbon is stored above ground and below ground in biomass, dead organic matter and soil carbon pools for long periods of time.[53] As a result, there is increased scrutiny of how companies manage carbon stocks and stores; such is the case in boreal forests and northern peatlands which play an important role in the global carbon cycle accounting for 25-35 per cent of the world's soil carbon, and in tropical areas where intense deforestation promotes CO_2 emissions.

Decreased soil carbon stocks and stores may have implications on corporate licenses to operate as well as on reputations, especially as climate change impacts intensify. Sustainable forest management, with regards to carbon capture and storage, should aim for **high rates of above ground and below ground litter fall, or dead organic matter**, so that large amounts of carbon are continuously circulated within the system.[61] Different management practices, such as harvesting or prescribed burning, will have different impacts on the sequestration capacities and carbon stocks of trees depending on when and how they are carried out. Management practices should aim at optimising carbon stocks above and below ground so that production areas can play a positive role in carbon management.

Logging results in decaying residues and soil disturbance, thereby contributing to greenhouse gas emissions and climate change, and causing significant damage to carbon stocks and to ecological integrity.[62] In the Congo Basin, this has drawn attention to logging practices and has prompted different responses. The REDD+ process* incentivises organisations to improve carbon storage through sustainable forest management; it provides **increased economic returns per hectare where there are quantifiable carbon emission reductions** and has improved forest productivity and health.[63]

Part 4

A focus on impact

Understanding how management practices impact on the natural resources that commercial forestry depends upon can accelerate the progress towards building environmental and commercial resilience.

Certification standards, including FSC, are already grounded on impact assessments and indicators. Where forests or timber are not certified, hotspotting areas of risk using academic evidence can help identify where efforts need to be prioritised to safeguard natural resources. This process can help deduce indicative values for how management practices impact on water, biodiversity, soil and carbon (Tables 2 and 3). Please refer to the **Technical report** for detail on each of the impact values allocated.

1. Selecting tree species: *in relation to site characteristics and local climate selecting appropriate tree species can be done to satisfy different economic, social and environmental objectives which will involve different trade-offs.*

Impact on natural resources depends on species originally present and depends on what species are being planted.

Positive[1.1] | Positive[1.2] | Limited evidence[1.3] | Limited evidence[1.4]

2. Thinning and pruning: *selectively removing parts of the tree, including branches, buds or roots. Thinning can be beneficial in terms of removing deadwood, maintaining health, preparing species for transplantation and providing increasing light and rainfall to the forest floor.*

Impact on natural resources depends on thinning methods used and depends on thinning timing and intensity.

Positive[2.1] | Limited evidence[2.2] | Limited evidence[2.3] | Limited evidence[2.4]

3. Constructing roads, skid trails and landings: *constructing roads to connect land, skid trails to move trees from landings to decks and landings to stack, store and load logs onto transport trucks. This infrastructure is integral to forest access systems for general management, maintenance and timber extraction. Roads and skid trails need to be strategically located to minimise soil erosion, reduce compaction and improve efficiency.*

Impact on natural resources depends on number, design, location and use and depends on the design and layout of culverts.

Negative[3.1] | Negative[3.2] | Negative[3.3] | Limited evidence[3.4]

4. Harvesting: *involves clear-cutting or removing products from a forest to make room for a new generation of trees. While harvesting modifies wildlife and alters natural systems, it is fundamental to the continuity of commercial systems.*

Impact on natural resources depends on scale, configuration, timing and location of cutting and depends on area's natural disturbances and timing compared to harvesting regimes.

Negative[4.1] | Limited evidence[4.2] | Negative[4.3] | Limited evidence[4.4]

Table 2: Core commercial forestry practices and their impacts upon water, biodiversity, soil and carbon. The caveats should be taken into account when generalising these impacts

5. Fertilising soils: *increasing soil fertility to improve forest productivity and inputs through applications to the soil, including liming. Inputs can maintain soil fertility by improving chemical and biological soil properties, can shorten rotation lengths with trees reaching merchantable size at a younger age and can improve yields substantially.*

Impact on natural resources depends on type of fertiliser used and depends on timing and existing soil conditions.

Negative[5.1]	Negative[5.2]	Positive[5.3]	Limited evidence[5.4]

6. Controlling pests: *controlling pests through pesticide application, prevention of pest introduction, integrated pest management or changes in stand composition. Controlling pests promotes resilient forests and protection against native, alien or invasive insects to safeguard productivity.*

Impact on natural resources depends on method used to prevent pests and depends on practices used to control pests.

Limited evidence[6.1]	Limited evidence[6.2]	Limited evidence[6.3]	Limited evidence[6.4]

7. Tilling soil: *fracturing the soil profile after soil has been compacted and soil structure has been lost to promote appropriate soil structure. Tilling the soil can increase soil porosity, improve aeration and allow root systems of perennial plants to occupy the soil.*

Impact on natural resources depends on depth of tillage practice and depends on existing soil profile and texture.

Limited evidence[7.1]	Limited evidence[7.2]	Limited evidence[7.3]	Limited evidence[7.4]

8. Establishing drainage systems: *adjusting the water content of the soil to a certain level to control run-off from sites as part of ground preparation work prior to commercial tree planting. Drainage systems create a favourable planting site for new transplants by loosening compacted soil, removing surface water and creating a raised planting position to lessen the effect of competing vegetation.*

Impact on natural resources depends on timing of drainage and depends on location and alignment of ditches.

Negative[8.1]	Limited evidence[8.2]	Negative[8.3]	Negative[8.4]

9. Zoning natural habitats: *actively managing zones as natural habitats to prioritise biodiversity conservation. Natural habitats, in the form of protected reserves, high conservation value areas or ecological networks, which include corridors and buffer zones are crucial to the functioning of ecosystems and to the conservation of species and habitats.*

Impact on natural resources depends on size and location of zoned areas and depends on native species diversity and ecosystems.

Positive[9.1]	Positive[9.2]	Limited evidence[9.3]	Limited evidence[9.4]

10. Carrying out prescribed burning: *burning a predetermined area to decrease the risk of intense fires by reducing the fuel build up in the forest floor. Prescribed burning stimulates the germination of some desirable forest trees, may improve wildlife habitat as well as control alien species, competing vegetation and tackle disease.*

Impact on natural resources depends on frequency and geologic, topographic and intensity of burns and depends on the amount and intensity of precipitation, soil and cover characteristics.

Negative[10.1]	Limited evidence[10.2]	Limited evidence[10.3]	Limited evidence[10.4]

11. Restoring lands: *re-instating ecological processes to accelerate the recovery of forest structure, ecological functioning and biodiversity levels. Restoration enables the land to regain ecological integrity and ensure resilient systems. Economic benefits result from increased productivity from previously degraded lands and can offer new livelihood opportunities for forest-dependent communities.*

Impact on natural resources depends on original land uses and depends on methods used to restore land.

Limited evidence[11.1]	Positive[11.2]	Positive[11.3]	Positive[11.4]

Table 3: Optional and additional commercial forestry practices and their impacts upon water, biodiversity, soil and carbon. The caveats should be taken into account when generalising these impacts

Part 5

Empowering change

Better measuring and communicating how commercial forestry practices impact on natural resources will help inform internal decisions, support supplier performance reviews and demonstrate progress.

5.1 Informing internal decisions

Impact metrics can inform internal decisions to ensure the sourcing of sustainable products.

The impacts of commercial forestry upon natural resources are not insignificant. They could be considered in decision-making in the same way that quality and cost are assessed in procurement, or be included in standards for improved practices.[64] Reporting on the impact of management practices is already part of certification schemes; however certified forests represent the minority of commercial forests. To accelerate and scale up change, impact metrics that demonstrate improvements, or indeed degradation of natural resources, need to be promoted in forests where certification is not applied, including those managed by small and medium sized enterprises and communities.

Empowering this change will require engagement from supply chains, corporates, local governments and communities, amongst others. It will call for technological and innovative developments, including Earth observation tools and social media, to enable the entire supply chain to better measure the impacts of commercial forestry on natural resources.

New technology and Earth observation tools, complemented by traditional field approaches, are helping identify how companies can best support biodiversity and ecosystems while maintaining productivity. Assessing how commercial forestry practices may impact on carbon storage and biodiversity, through the use of remote-sensing and GIS approaches, will help determine how best to ensure working forests that have both environmental and commercial values.

5.2 Reviewing supplier performance

Impact metrics can be taken into account when reviewing supplier performance.

Instead of box tick audits, supply chain relationships could be based upon commitment to continuous improvement. Awareness and measurements of how commercial forestry impacts and depends on natural resources will help companies formalise these commitments and improve performance. This will increase natural resource stewardship and accountability.

Companies can use impact metrics to review and measure supplier performance. This process could include:

- Reviewing supplier codes of conduct and the topics included in these
- Requesting suppliers to submit impact assessments as part of a tender
- Embedding impact criteria in contracts and reviewing these regularly
- Assessing the approach and programmes to engage with suppliers
- Including natural resource impact metrics as part of a due diligence process when investigating new or potential suppliers

5.3 Translating metrics to demonstrate progress

Translating impact metrics into simple indicators can enable companies to demonstrate their progress on natural resource management.

For impact metrics to be understood, considered and acted upon by stakeholders, they need to be simplified into accessible and relevant indicators (Table 4).

This information, combined with technology and innovation, will inspire and empower different stakeholders, including businesses, customers, investors, certification bodies and NGOs to take action and build greater resilience in the sector.

Water	Biodiversity	Soil	Carbon
• Wetland and riparian zones • Water quality bio-indicators • Water efficient species • Protection of key catchment areas	• Ecological infrastructure (corridors, networks, bridges) • Identified ecosystem services • Iconic and protected species • Monitored invasive species and pests • High Conservation Value areas	• Nutrient budgets • Water holding capacity • Evidence of compaction and erosion • Litter production and quality • Rehabilitation programmes • Soil sampling and surveys	• Above ground and below ground carbon stocks • Management of harvest residues • Rate of slash decomposition • Regional rates of carbon sequestration • Harvesting and replanting rates

Table 4: *Metrics that assess how commercial forestry impacts on water, biodiversity soil and carbon could be translated into simple indicators*

Part 6
Moving forward

Resilience for the forestry sector requires better understanding and measurement of the environmental and commercial impacts of sustainably managing natural resources. Promoting appropriate action, exploring applied research and collaborating with stakeholders can support the sector in addressing its natural resource challenges.

1. Act on natural resource challenges

Sustainably managing the stocks and flows of natural resources can provide tangible business opportunities (Figure 10). Companies can do so by:

- Considering the risks of different forest habitats and scales when making decisions
- Building partnerships to ensure landscapes of societal, environmental and commercial value
- Reviewing supplier performance and promoting sustainable sourcing
- Implementing better reporting and verification processes, including disclosure of sustainability performance and impacts[65]
- Appropriately addressing material environmental and social risks in financial statements, liabilities and costs[66]

2. Research on best management practices

Research can help inform sustainable management. This falls into four categories:

- Local expertise and research: Site-specificity is an important challenge and supply chain actors should liaise with local experts on the ground where possible.
- Integrated thinking: Management that protects a single natural resource is potentially problematic, as it might undermine long-term resilience and the important features of other natural resources.[67,68] The collective and integrated management of all natural resources should be core to commercial forestry.
- Accumulated knowledge: Increased stakeholder engagement by looking across temporal and geographic scales as well as across landscapes is integral to scaling up progress.
- Stakeholder mapping: Acknowledging which stakeholders safeguard and manage natural resources and who benefits from them would allow for more holistic impact assessments of different management practices.[69]

3. Collaborate for supply chain resilience

Given the growing landscape level pressures, collaboration around natural resource issues is increasingly important. Collaboration across supply chains and landscapes is needed to help identify the positive environmental impacts and the commercial value of sustainable forestry. These impacts can be communicated both internally and externally to supply chain partners and stakeholders.

Companies have the opportunity to take the lead to measure and communicate how their investments to better manage natural resources impacts on both environmental and commercial outcomes. This helps to build long-term resilience in the sector.

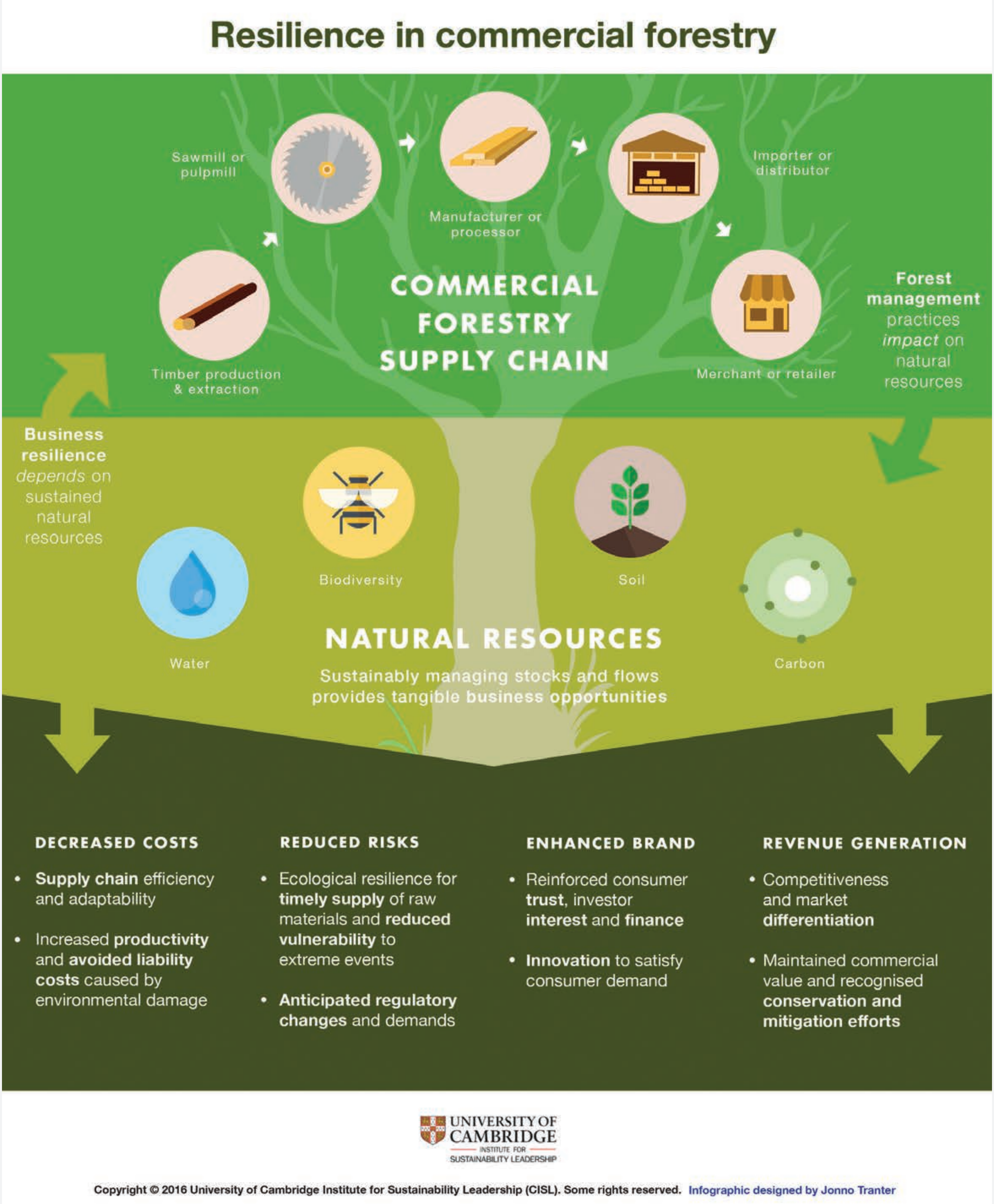


Figure 10: Sustainably managing the stocks and flows of natural resources can provide tangible business opportunities

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