

In collaboration with
the SPACES Coalition



Location Matters:

Using spatial intelligence for business action on nature and climate

WHITE PAPER

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Foreword



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The science couldn't be clearer – we are in the midst of a planetary emergency. The rise in global temperature of 1.1°C since pre-industrial times is already generating record extreme heat, droughts, forest fires, flooding and sea-level rise that threaten food security, water security and livelihoods.¹ Meanwhile, natural ecosystems have declined by 47% on average relative to their earliest estimated states, with 25% of studied species at risk of extinction.² These impacts will only increase exponentially as the world pursues its dangerous trajectory of exceeding the 1.5°C target set out in the Paris Agreement and overexploiting natural resources.

The business case for action to protect nature is abundantly clear. A previous report published by the Global Future Council on Nature Based Solutions, [Scaling Investments in Nature](#), outlines the risks and opportunities of failing to protect nature. More than half of the world's GDP – \$44 trillion – is “moderately or highly dependent on nature”, while 52% of agricultural land is already “moderately or severely” degraded. One estimate puts the cost of land degradation at \$450 billion annually, not including many hidden costs.^{3,4} By degrading nature, we turn our natural assets into economic liabilities.

Nature and nature-based solutions account for one-third of the emissions reductions needed to deliver on the Paris Agreement. Businesses therefore need integrated strategies that tackle nature loss and climate change. World Economic Forum analysis has found that a “nature-positive” pathway (including halting biodiversity loss and investing in nature-positive outcomes) could generate \$10 trillion in annual business

opportunities and create 395 million jobs by 2030.⁵ Thankfully, there is growing momentum behind integrated nature and climate action by governments, businesses and investors.

The question now is how to deliver at scale. We can learn from the energy sector, but we must recognize that nature-related outcomes are much more complex to measure, track and prioritize than climate. While climate action is focused on one, location-agnostic indicator (reducing greenhouse gas emissions), nature requires action on multiple, location-specific metrics, including forest cover, soil health, water quality and biodiversity.

Spatial intelligence – the use of spatial data to drive action – will play a central role in supporting businesses to set science-based targets for nature, understand their impacts and dependencies on nature, and identify opportunities across their value chains to contribute to a nature-positive and net-zero economy. Spatial intelligence can also underpin government efforts to develop integrated land-use plans that optimize action for both nature and climate goals, and provide much needed clarity for business.

This report is written for business leaders. It sets out the opportunities for how companies can incorporate spatial intelligence into their strategies and operations. As data and technology are improving exponentially and government commitments on nature and climate are ratcheting up, every industry and economic sector will be affected. We hope the recommendations in this report will help business decision-makers chart a course towards a nature-positive and net-zero economy.

Executive summary

The collapse of nature is a global challenge, but its impacts and the remedies will vary from place to place and business to business. Developing solutions, understanding risks and transparently reporting results will require the use of spatial intelligence for nature and climate.

Aiming for net-zero emissions is essential but not enough. Businesses are increasingly realizing the need for integrated action on nature and climate. Diverse ecosystems – which provide valuable services such as climate regulation, healthy soil, clean water and pollination that many businesses and communities depend upon – are in decline. While often viewed apart, the nature and climate crises are fundamentally connected and require integrated approaches to be effectively addressed. Nature is critical for climate resilience and adaptation, as emphasized at the 2021 United Nations (UN) Climate Change Conference (COP26) in Glasgow, and, with negotiations over the post-2020 global biodiversity framework ramping up ahead of the UN's Biodiversity Conference (COP15) in December 2022, nature will garner greater attention.

Delivering on nature positive is complex, requiring location-specific solutions. Unlike climate, where reducing greenhouse gas emissions is the sole, location-agnostic indicator, tracking nature impact requires collecting location-specific data across several variables, such as freshwater availability, soil health and biodiversity intactness, to name a few. Therefore, defining and monitoring location-specific metrics is key for driving global, regional and local action on nature and climate.

Rapidly developing technologies are generating new tools and data to enable and drive business action. Spatial intelligence (see Box 1), for example in the form of satellite imagery of land-use and forest-cover change or maps of biodiversity hotspots, can help businesses to understand their impacts on nature and climate, where governments and other stakeholders are taking action, and where business interventions can have the greatest positive effect. Rapid advances in data-collection technologies, for example sensors or drones to monitor habitat conditions and environmental DNA (eDNA)⁶ sampling to detect which species are present in a body of water, are helping to develop more accessible and real-time data to pinpoint financial risks and support action.

Spatial intelligence can help businesses to track and credibly report on the implementation of nature-positive and net-zero strategies. The transparency and trust this technology generates are good for business and investors, helping protect their licence to operate and enabling them to reap the benefits of environmental and social leadership.

Greater uptake of spatial intelligence requires an understanding of its potential, clarity on available tools and data, and the right incentive structures. Some businesses, as highlighted in this report, are already applying spatial intelligence to understand their nature and climate risks, and to set science-based targets. Others will need more encouragement and support. Governments will play a key role in driving the uptake of spatial intelligence through financial incentives, standards and regulatory requirements. For spatial intelligence to be credible and trusted, businesses need to consult and align with all stakeholders, including Indigenous peoples and local communities.

Businesses need data disclosure standards for nature positive. The Taskforce on Nature-related Financial Disclosures (TNFD) is developing a beta framework that highlights the importance of businesses not just collecting and analysing their data, but disclosing it too. The quality of biodiversity and nature-related data is improving rapidly, and many companies have begun to invest in mapping their value chains in more detail. However, this is not yet happening at the necessary scale, nor being disseminated widely enough. We believe that rapid technological advances and the rapidly declining cost of data acquisition will change this picture rapidly.

Investors demand transparent data on nature. A recent poll finds that “70% of investors believe a lack of available data is a key barrier to making investments that support biodiversity”.⁷ A radical approach to transparency will not only prevent the need for multiple businesses to collect the same information time and again, but could



↑ African forest elephant and a herd of African forest buffaloes in Lango Bai in the rainforest of the Congo Basin.

also encourage the broad cooperation that is critical to tackling climate change and nature loss, while driving long-term investment towards nature- and climate-positive business strategies. Governments and other key stakeholders can play an essential role here to enable a credible and trusted data architecture.

This white paper lays out practical opportunities for action by businesses and governments:

Businesses should start by defining nature-positive business strategies and integrating them with (existing) net-zero targets – using spatial intelligence to identify, understand and track progress. This will require regular and transparent disclosure. Most will need to invest in spatial intelligence expertise and data,

and critically review and integrate the spatial intelligence already available within their different departments. With the help of spatial intelligence, businesses can strengthen their collaboration with governments and engagement with local communities to take on-the-ground action (e.g. water stewardship programmes, land restoration projects). They can also participate in pilot projects through frameworks such as [TNFD](#) and the [Science Based Targets Network \(SBTN\)](#).

Governments should set transparent targets and strategies for nature and climate that provide long-term predictability for businesses. They will also need to set standards and incentives to promote spatial intelligence and ensure transparency. Whole-of-government approaches will be critical to ensure policy coherence and consistency.

BOX 1 What is spatial intelligence?

Spatial intelligence is the use of location-specific data, tools, analysis and visualization to strengthen decision-making. It can help governments, businesses and civil society to understand, manage and monitor their impacts and dependencies on nature, climate and people. Within the next few years, it will be feasible to expect businesses to track their entire supply chains to source, estimating the nature impacts of their activities and quantifying supply-chain risks.

Governments use spatial intelligence in an analogous way to set national strategies and meet their objectives. Regulators and civil society can use the same information to call for greater ambition and assess business performance. From a business perspective, public sector involvement in setting data standards as well as in data collection and verification can help strengthen transparency, level the playing field for all businesses, lower the cost of capital for companies moving towards nature positive and – critically – build trust with local communities.

FIGURE 1 | Spatial intelligence: using data for nature, climate and people⁸

Spatial intelligence is the use of spatial data, tools, analysis and visualization to strengthen decision-making. It can help businesses understand, manage and monitor their impacts and dependencies on nature, climate and people, and can help countries with their spatial planning practices.

Spatial intelligence can better support businesses and countries if data collection, analysis and visualization are designed to target decision-making needs. Social, economic, environmental and governance objectives need to be identified, and challenges and opportunities to align these need to be explored. **Engagement with stakeholders throughout the process highly increases**

Data collection

Remotely sensed data

Satellites, aircrafts and drones can be used to measure and monitor key variables and trends from a distance.

Field data

Data collected “on-the-ground” using individual or networks of sensors (e.g. audio), camera and live traps, citizen science, field surveys and sampling (e.g. environmental DNA) etc.



Spatial data is processed

Data processing

Adjustments to spatial data are often needed to account for different formats and resolutions, before data can be aggregated, integrated, filtered, processed and stored.

Data analytics

Analysis changes data into information e.g. mapping different solutions or modelling scenarios. Advances like artificial intelligence help analyse data more efficiently, identify spatial patterns and provide richer insights.



Possible scenarios are visualized, a decision is made and actions are implemented

Visualization

Visualizing analysed spatial data can be a powerful engagement and decision-making tool, identifying effective actions.

Data accessibility

Spatial intelligence has to be transparent, accepted, affordable and accessible by its users (mindful of privacy and confidentiality).

Action for nature, climate and people

Spatial intelligence can help to select locations to implement actions for nature, climate and people, monitor progress and channel finance.



Source: SPACES Coalition

1

Spatial intelligence: a key enabler for action on nature and climate

As companies commit to nature-positive alongside net-zero business strategies, investing in spatial intelligence is key to understanding location-specific impacts, managing risks, prioritizing action and engaging stakeholders.

1.1 The need for integrated action on nature and climate

The dynamic interactions between the nature and climate crises are generating escalating risks for businesses. Early movers will be best positioned to minimize their risks, while also creating opportunities associated with nature- and climate-positive business strategies.

Unprecedented financial, supply-chain and reputational risks

Human impacts on nature and climate have driven us to the brink of a planetary emergency.^{9,10} While often viewed in silos, the nature and climate crises are fundamentally interconnected. To address them effectively requires integrated, urgent and concerted action.^{11,12,13}

It is beyond doubt that both nature and climate materially affect current and future business activities.¹⁴ World Economic Forum research published in 2020 revealed that more than half the world's GDP – \$44 trillion – is “moderately or highly dependent on nature and the goods and services it provides” and therefore could be at risk of disruption due to nature loss.¹⁵ Failure to act will have serious economic consequences for businesses and their supply chains.¹⁶ Costs to meet biodiversity goals are expected to double if action is delayed another decade.¹⁷

Meanwhile, regulatory and public pressure on businesses is mounting. New legislation is emerging on supply-chain due diligence, and litigation enforcing existing or new environmental laws is becoming more common. Specific examples include the EU Taxonomy establishing a list of environmentally sustainable economic activities, and Brazil's Supreme Court ruling that landowners in the Brazilian Amazon are liable for using illegally deforested land.^{18,19}

Nature-based solutions (NbS) have huge potential to help address both the nature and climate crises, while also generating benefits for local communities. NbS, such as restoring and protecting forests, waste minimization and water purification, have the potential to account for more than 30% of the emission reductions and carbon capture needed to reduce global greenhouse gas (GHG) emissions to net zero by 2050.^{20,21}

Businesses are increasingly considering nature and climate in their strategies, as the scale of their dependences and vulnerabilities becomes clear. In particular, businesses need to better understand the nature and climate impacts of their supply chains and implications for their risk management and balance sheets. Similarly, they need to halt the degradation of nature to protect local communities and maintain their social licence to operate.

“ Nature-based solutions have the potential to account for more than 30% of the emissions reductions and carbon capture needed by 2050

A ten trillion dollar global opportunity for business leadership

Early-movers are benefitting from the growing momentum towards embracing nature-positive economic models alongside net-zero ambitions.

Business action can be a catalyst for positive outcomes, providing opportunities for new ways to “do business better”. Analysis by the Forum has estimated that halting biodiversity loss and investing in actions with positive outcomes for nature and climate can create new business opportunities worth \$10 trillion annually and create 395 million jobs by 2030.²³

1.2 The need for location-specific information

Nature’s diversity is geographically specific – and so therefore are the impacts on nature. This specificity requires new ways of capturing, tracking and presenting data for decision-making. Spatial intelligence can provide businesses with the location-specific information they need to help answer pressing questions.

Business impacts on nature are location-specific

Consumers, employees, financial institutions and shareholders are increasingly expecting companies to credibly demonstrate their impact on and efforts to protect nature and safeguard local communities. Location matters a great deal here. While reducing carbon dioxide emissions by a metric tonne at a factory in one part of the world is essentially the same as reducing carbon dioxide emissions by a metric tonne at a factory somewhere else, the same is not true for efforts to protect nature. For example, it matters greatly whether a company operates close to a highly biodiverse nature reserve, a fragile freshwater ecosystem, or in a water-stressed environment.

Since businesses – and the communities they operate in – are inherently dependent on ecosystem health, site-specific indicators of impacts on nature need to be defined and monitored for every location. Examples include freshwater availability, soil health and richness of biodiversity.

Spatial intelligence helps companies pursue nature goals while optimizing performance

Spatial intelligence enables action towards nature and climate goals, and can help optimize business performance. Businesses can use spatial intelligence to understand and better integrate nature and climate into their business strategies. Spatial intelligence links information (e.g. the increased

chance of droughts) to its specific place (e.g. a potato farm supplying a potato chips manufacturer) to determine impact and dependencies (e.g. potential financial losses for the potato chips manufacturer due to increased drought). It can enhance already-existing measurement processes, data systems and disclosure requirements within companies. And when integrated within these systems and used to drive action, it can help optimize business performance.

Answering location-specific questions

Spatial intelligence can help businesses answer detailed, location-specific questions such as:

- Which of the potential new factory locations would avoid damaging biodiverse habitats?
- Where are my greatest supply chain risks from a nature and climate perspective and how can I reduce them?
- How would my balance sheet differ if I fully accounted for changes in natural capital in my operations?
- How can I better engage local communities to reduce my risks and improve performance?
- How does my business strategy align with government policies?
- Where does the water for my operations come from and are there any risks to this water source? Who else might be wanting to use the same water resources?
- Which of my distribution networks is most likely to be flooded by storm surges?
- Where could implementing nature-based solutions on land holdings result in the greatest benefits for nature, climate and people?

“ By linking information on business activities to a specific place, spatial intelligence can help determine impacts from and risks to business operations

2

Exploring the potential of spatial intelligence for business

Innovative spatial intelligence tools offer huge benefits for nature, business and government. But a lack of awareness, investment and alignment hampers uptake.

A technological revolution is underway that is expanding the frontiers of spatial intelligence to support business action on nature and climate. Many businesses have yet to fully embrace the potential of spatial intelligence. Leading

businesses are, however, beginning to take action and demonstrate what is possible. Similarly, governments and civil society are turning to spatial intelligence to drive transparency and accountability for nature and climate objectives.

2.1 What are the business applications for spatial intelligence?



Understand risks and opportunities related to both nature and climate, as well as their overlaps with other business risks and opportunities



Track and disclose progress towards nature-positive outcomes and net-zero carbon emissions



Raise green finance and lower the cost of capital through carbon markets, biodiversity credits and access to capital linked to environmental, social and governance (ESG) criteria



Better engage with local communities and align business strategies with national policies, for example through stakeholder consultations and alignment with national spatial planning efforts



Get ahead of external scrutiny of their supply chains and operations by ensuring they have the spatial intelligence to pinpoint and remedy negative impacts from their business operations



↑ Boreal forest, Charlevoix, Quebec, Canada

Understand risks and opportunities

Spatial intelligence can help businesses understand how their operations and value chains affect and rely on nature and climate. For example, a company might track how its supply chains affect high-value biodiversity hotspots or natural carbon stores, such as mangroves and peatlands. This approach can also help identify nature- and climate-related financial risks resulting from the loss or degradation of natural capital assets, for example the potentially significant reduction in a company's profits that could result from water scarcity.²⁴ Such insights can help businesses understand and prioritize integrated, location-specific actions that could deliver benefits for nature, climate and people.²⁵

Such integrated approaches are critical, because there is a high overlap between priority actions for preserving biodiversity (in line with the Convention on Biodiversity's draft post-2020 global biodiversity framework)²⁶ and a range of other benefits, including storing carbon (in line with the Paris Agreement) and benefits for local communities. For example, restoring forests in a specific location could help:

- Improve relationships with local communities, which might in turn reduce risks to business operations and supply chains
- Secure water supplies for production of ingredients (reducing business risk and contributing to more reliable water supplies for local communities)

- Sequester carbon (supporting net-zero targets)
- Reduce water run-off and flood risk (reducing disruption risk and protecting adjacent communities)
- Increase habitat quality for local wildlife (potentially contributing to national nature-positive ambitions)

Track and disclose progress towards nature-positive outcomes and net-zero carbon emissions

Tracking, demonstrating and disclosing performance towards nature-positive and net-zero ambitions is vital for businesses, so they can be held to account for their actions and avoid perceptions of greenwashing. Similarly, management and boards need greater visibility on real-time business risks resulting from the nature and climate crises. Companies can use spatial intelligence for risk inventories and to set and operationalize science-based targets with clear baselines.

Target-setting and tracking demonstrate public commitment to nature and climate, and allow businesses to take integrated action across their value chains. For the finance sector, spatial intelligence can increase transparency around the impacts of their portfolios, which in turn can inform investment commitments by locating and monitoring financial risks.

For more information on the latest developments in nature-related disclosures, see section 2.2 below.

“ For the finance sector, spatial intelligence can increase transparency around the impacts of portfolios

Raise green finance and lower the cost of capital

Spatial intelligence is a critical tool to build the incentive mechanisms needed to fill the investment gap²⁷ for nature-positive action. Global accounting and non-financial reporting standards increasingly require the systematic collection and use of nature- and climate-based spatial intelligence. Financial institutions are starting to screen potential investments for their contribution to global nature objectives, as they already do with GHG emissions.

Tracking and reporting positive carbon and biodiversity impacts offers new opportunities to access finance through carbon markets, biodiversity credits or preferential ESG-linked capital, to name a few. For example, a business might attract green finance if it could use spatial intelligence to plan its forest restoration activities, then demonstrate and (financially) quantify how this creates positive, credible nature and climate impacts.

Better engage with local communities and align business strategies with national policies

The need for spatial intelligence has been increasingly recognized in global goals and targets. For example, spatial planning is codified in Target 1 of the Convention on Biodiversity's draft post-2020 global biodiversity framework.²⁸ Businesses can also support national spatial planning and mapping programmes, for example by contributing data on ecosystems, species and assets. Businesses benefit from clarity in national

plans, as those plans define where businesses are permitted to operate. This can be seen, for example, in the public-private collaboration on spatial intelligence for river corridor management along China's Yellow River (see Case Study 3).

Engaging in spatial planning practices also enables businesses to support multi-stakeholder and cross-institutional processes. Maps provide a practical means to "get everyone around the table". Through such engagement, spatial intelligence can be used as a tool to help parties mediate competing uses of, and rights to, land for agriculture, industry, infrastructure, nature conservation and so on, in the service of climate, nature and people (see for example Rio Tinto's experience in Case Study 1). This can be beneficial, as integrated strategies – developed with governments, businesses, local communities and other stakeholders – are likely to yield better results at lower costs.²⁹

Get ahead of external scrutiny

The public availability of location-specific information on nature and climate impacts is rising rapidly. Increasing transparency enables local communities, non-governmental organizations, regulators, the media and others to shine a spotlight on a company's impacts on nature and climate. Forward-looking companies will aim to get ahead of external scrutiny of their supply chains and operations by ensuring they have the spatial intelligence to pinpoint and remedy negative impacts from their business operations. Proactive engagement of local communities and other stakeholders will help to reduce the risks from disruptions and maintain businesses' social licence to operate.

2.2 The innovations and developments improving the potential of spatial intelligence applications

The potential applications of spatial intelligence for the private sector are developing rapidly as technology innovations and developments in reporting and disclosure gather pace.

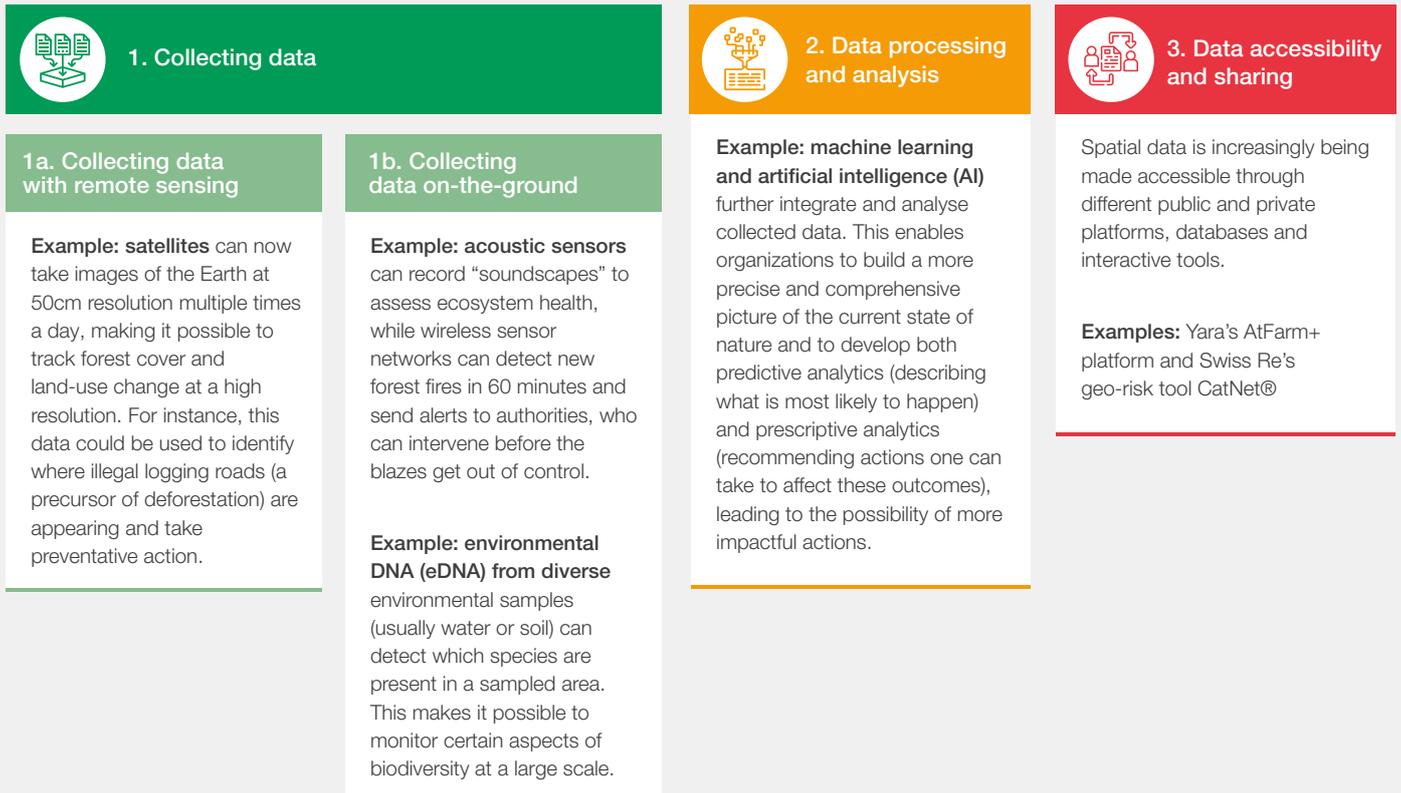
Innovations in data-collection technologies

The spatial data "revolution" has led to the increased availability of integrated, high-quality, usable spatial intelligence for nature and climate. The precision and uses of spatial intelligence are likely to increase further in the next few years, driving greater transparency into value chains.³⁰ Emerging data-collection

technologies, such as remote sensing, eDNA and the use of artificial intelligence, allow for new, better insights (see Figure 2).^{31,32}

These innovations are only valuable if the nature-specific data they generate is integrated with climate data, asset locations and operational data to support effective decision-making and action. This will require new data combinations and resources.³³ At present, supply chain managers mostly rely on modelled economic data to estimate where products may be coming from, rather than knowing specific details about product origins and their impacts. Collection and analysis of asset location data can increase the accuracy and reliability of spatial analysis.

FIGURE 2 | Recent innovations in data technology



Source: SPACES Coalition

Developments towards a common reporting framework

A common reporting framework, as is being developed by entities such as the Taskforce on Nature-related Financial Disclosures (TNFD) and the Science Based Targets Network (SBTN), could help cut through the complexity and uncertainty of data collection and measurement, and also help create economies of scale as businesses seek common data. These nature-positive disclosure standards and frameworks will need to be dynamic – evolving in step with advances in scientific understanding, experience and the ongoing spatial data “revolution”.

TNFD is playing a critical role in defining a common corporate standard, which supports consistent measurement, target-setting and

assessment against specific targets and metrics at global, regional and local levels. The TNFD’s “beta framework” is currently going through a public consultation process, aiming to release the final framework by late 2023. Meanwhile, SBTN is defining guidance for businesses in setting science-based targets for nature. Both initiatives incentivize the collection and use of spatial data for target setting, reporting and disclosures.^{34,35}

Measuring nature’s complexity requires multiple, location-specific indicators. TNFD, for example, recently published its “Illustrative assessment metrics and criteria for user selection Indicators” ranging from “volume of water discharged” to “species richness”.³⁶ Indicators pertinent to business performance are not yet widely agreed. Innovative technology can help meet these potentially complex and geographically specific data requirements.

2.3 A showcase of spatial intelligence applications

Some businesses have started to act on spatial intelligence. The following case studies, provided by the World Economic Forum's Global Future Council members, illustrate some of the ways companies are already applying spatial intelligence to their operations.



CASE STUDY 1

Rio Tinto reports on water use under international disclosure frameworks

Challenge/opportunity

According to mining company Rio Tinto,³⁷ “water is a key part of our operational environmental footprint” but the company also recognizes that water is a shared resource, critical to sustaining biodiversity, local communities and their economic prosperity.³⁸ Rio Tinto reports their water impact to adhere to several audit procedures, while also disclosing data under frameworks of the Task Force for Climate-related Financial Disclosures (TCFD) and the International Council of Mining & Metals (ICMM).

Approach

Rather than focusing on water scarcity as a single metric highly dependent on context, Rio Tinto assesses water risk across four key themes: water resources (scarcity); dewatering (removing water from solid material or soil); water discharge quantity and quality; and long-term impacts and obligations.

Based on these water risk profiles, their ICMM commitments and local community and environmental interdependencies, Rio Tinto was able to set six specific site-based targets in 2019.

Impact

To better understand their water resource risk, Rio Tinto used the publicly available Water Risk Atlas³⁹ of the World Resources Institute (WRI) to identify the baseline water-stress level for each of their 56 asset sites. With this tool they concluded that in 2021, 14% of their sites were located in water-stressed areas. Combining this data with site-specific usage and allocation data, the company is making progress towards

meeting its target to publicly disclose data on permitted surface water allocation volumes, annual allocation water usage and associated surface water allocation catchment rainfall runoff volume estimates – for all managed operations by 2023.

Rio Tinto also set six site-based water targets in specific high-risk areas. One of these targets relates to the Oyu Tolgoi mine in Mongolia's South Gobi Desert, an arid and remote area where water is both in high demand and a scarce resource. This site-based water target led to investment in water recycling and conservation practices, resulting in the company's copper and gold mining and concentrating operation becoming one of the most water-efficient of its kind in the world.

Currently, more than 80% of the water used in production at Oyu Tolgoi is recycled. Additionally, a participatory water monitoring programme was launched in collaboration with herders, local people and the government to verify that water controls are working. Both Rio Tinto and the community keep location-specific water records, to make sure that water remains an accessible resource for the mine and for local herders, who rely on shallow sources of groundwater for their animals.^{40,41,42,43}

Spatial technologies, data and tools used

Rio Tinto used WRI's Water Risk Atlas and digital elevation models to determine catchment extent, and site data collected using a variety of networked sensors and satellites. The company used a central GIS platform to track and disclose its water data.



↑ Rio Tinto's operations in the Oyu Tolgoi mine in Mongolia's South Gobi Desert



CASE STUDY 2

Yara maps operations and identifies opportunities to optimize location-specific action on nature, climate and people

Challenge/opportunity

As global demand for food rises, the need for innovations that can sustainably improve farming yields becomes ever more urgent. Yara has developed several precision-agriculture solutions to meet this need, drawing on over a century of agronomic knowledge and crop nutrition experience gained by working closely with local farmers. Yara combines this practical expertise with its hardware tools, digital solutions, API products and sustainability focus – providing a fully integrated, climate-smart approach to nutrient management.

Approach

Yara has developed several solutions and tools aimed at enabling farmers to optimize their activities on the ground, while helping the entire food value chain to move towards climate-smart practices.

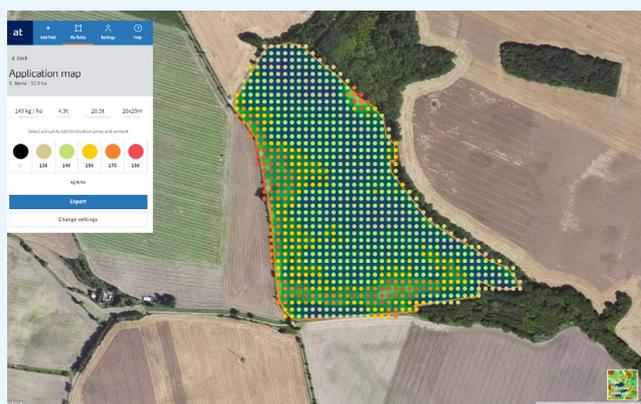
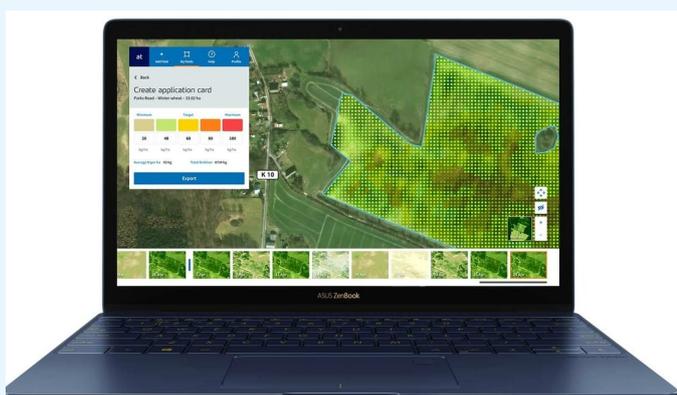
Impact

Digital expertise in agronomic algorithms and data analytics has enabled Yara to support decision-making for 11 million cropped hectares. By monitoring these processes through its digital solutions, Yara has helped improve fertilizer use and increased crop yields for farmers. Its ambition is to actively monitor 150 million hectares by 2025 – approximately 10% of all arable land worldwide.

In particular, the use of AtFarm+, Yara's flagship digital platform for crop nutrition, has been shown to reduce fertilizer use by 12% and increase yields by 6%. Given that the use of nitrogen in fertilizers is one of the biggest drivers of agriculture's environmental impact (accounting for 2.4% of global GHG emissions and 20% of agricultural emissions),⁴⁴ this demonstrates the tool's potential in reducing the industry's negative footprint. Bringing this data together into a "digital food supply chain" facilitates end-to-end transparency, making it possible for all stakeholders to guarantee provenance and gain a clearer view of any efficiency or sustainability issues across the entire supply chain.

Spatial technologies, data and tools used

The AtFarm+ platform implements a unique set of optimized indices based on satellite data that provides on-field imaging and customized crop recommendations to maximize nutrient-use efficiency. These recommendations help users to manage nutrients accurately and efficiently, to make the most sustainable and profitable decisions throughout the cropping season.



↑ Yara's AtFarm+ digital platform⁴⁵



CASE STUDY 3

Public-private collaboration on spatial intelligence for river corridor management along China's Yellow River



↑ Yellow River nearby Lanzhou, China⁴⁹, Unsplash

Challenge/opportunity

The Yellow River is the second largest river system in the People's Republic of China, accounting for 26.5% of the country's gross domestic product (GDP). Feeding a population of 420 million, it is vital for socio-economic development.⁴⁶ In 2021, the State Council of China issued the *Guidelines of Yellow River's Ecological Protection and High-quality Development*, addressing the current water scarcity, industrial pollution and ecosystem degradation in the region, and outlining plans and requirements for its protection and development in the future. The guidelines stress cooperation among public and private sectors, with the guidelines serving both policy-making and engineering project-planning in the basin.⁴⁷

Approach

Spatial intelligence is used by government agencies and enterprises to promote spatial mapping and to strengthen protection of the Yellow River. Integration of different types of data is key. The Intelligent Yellow River Innovation Platform, for instance, measures nature and climate using both on-the-ground sensors and satellites, and combines comprehensive analysis models to carry out intelligent early (flood) warning, generate visual analysis and support other (auxiliary) decision-making.⁴⁸

A specific example includes the integration of different types of satellites, which together with various algorithms and analysis models can carry out comprehensive monitoring of natural disasters (e.g. flooding) and provide support to nature protection (e.g. monitor illegal dumping, mining or construction in the Yellow River Basin).

Impact

The public and private sectors are working together to collaboratively protect, restore and manage the basin. Provincial governments, together with enterprises and universities, are now establishing the Yellow River Basin Science and Technology Innovation Alliance, while technology alliances in different industries and sectors are also being established. The involvement of government agencies in such alliances helps ensure smooth implementation of guidelines issued for the Yellow River's protection, and keeps governments updated with the latest technologies when framing relevant guidance and supporting policies.

Spatial technologies, data and tools used

The programme used a variety of satellite sensors, on-the-ground sensors and field data, combined with high-quality data analytics.



CASE STUDY 4

Swiss Re, understanding risk and potential insurance considerations

Challenge/opportunity

Over half of global GDP is moderately or highly dependent on high-functioning biodiversity and ecosystem services.⁵⁰ However, a staggering one-fifth of all countries globally are at risk of their ecosystems collapsing due to a decline in biodiversity and related beneficial services.⁵¹

To build understanding around this global issue, Swiss Re Institute developed the Biodiversity and Ecosystem Services (BES) Index, enabling businesses and governments worldwide to compare and benchmark the state of selected ecosystem services that underpin their economies. The data can be used to directionally identify exposures due to BES decline, while stakeholders can use this data to prioritize areas where communities are or may become at risk from poor-functioning BES.

Approach

The Swiss Re BES Index aggregates data from 10 different ecosystem services (water security, timber provision, food provision, habitat intactness, pollination, soil fertility, water quality, regulation of air quality and local climate, erosion control and coastal protection). The data is provided at a resolution of 1km² across the globe and can be aggregated across the 10 services and to country level.

The data is integrated into CatNet®, Swiss Re's proprietary geo-risk tool, and into PUMA, Swiss Re's project engineering underwriting assessment tool. CatNet® assesses natural catastrophe risk by combining hazard, loss, exposure and insurance information with maps and satellite imagery. PUMA provides information support for project engineering risk assessments. The data is also linked to the Encore database of the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), to allow industry-specific dependency and impact analysis, in conjunction with the capacity of the 10 ecosystem services.

Impact

The tool was recently launched, so impacts are yet to be measured. However, its integration with other hazard and risk assessment tools aims to provide a powerful combination of spatial insights to support planning and prioritization, helping re/insurers, corporates, public entities, portfolio managers and asset owners understand their potential exposures and insurance needs.

Spatial technologies, data and tools used

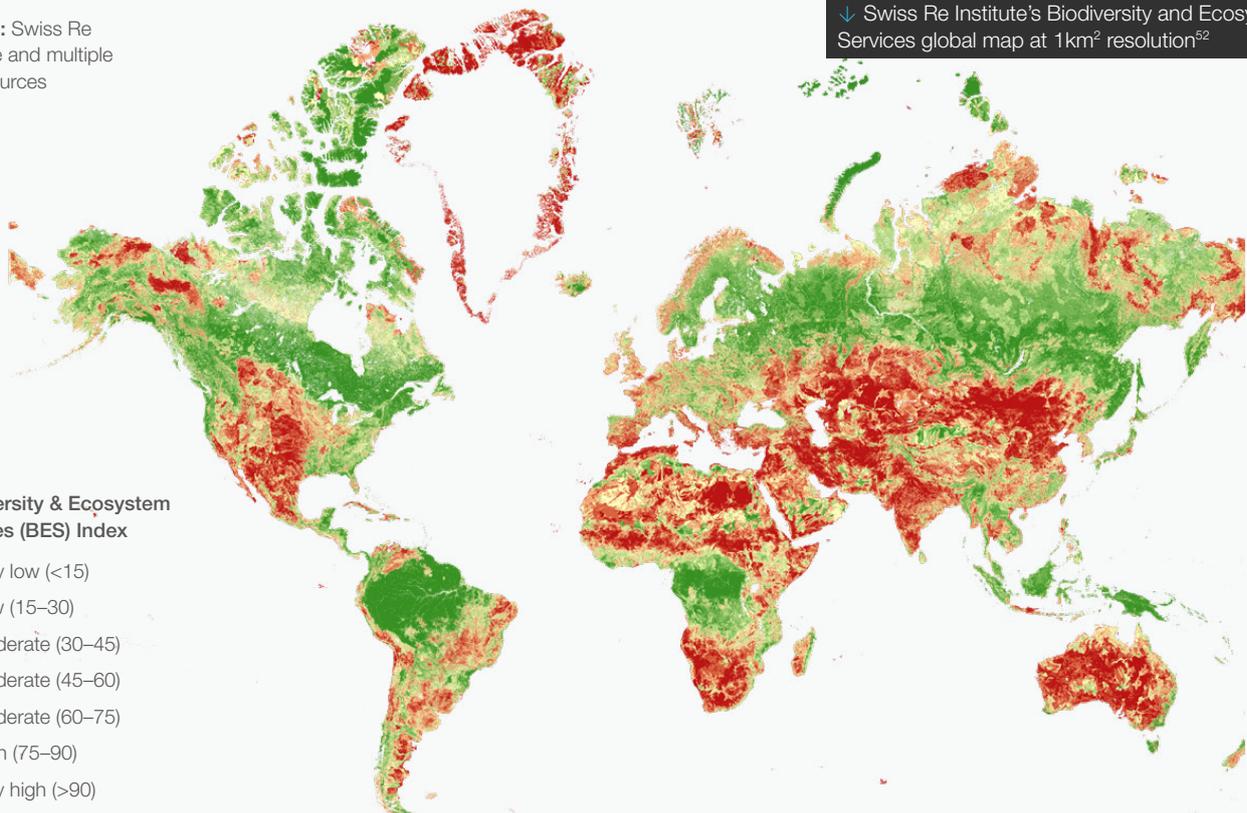
The data sources are from field and satellite data, combined with high-quality data analytics.

Source: Swiss Re Institute and multiple data sources

↓ Swiss Re Institute's Biodiversity and Ecosystem Services global map at 1km² resolution⁵²

Biodiversity & Ecosystem Services (BES) Index

- Very low (<15)
- Low (15–30)
- Moderate (30–45)
- Moderate (45–60)
- Moderate (60–75)
- High (75–90)
- Very high (>90)



2.4 Barriers to greater uptake of spatial intelligence by businesses

Although there are some early adopters, many businesses currently do not fully utilize the spatial data and technical methods available, and are not sufficiently prepared for the vast amount of information that could become available in the next few years.⁵³ Even when spatial intelligence and the underlying data are available, it still needs to be accessible and clear to businesses how they can use it to answer key questions.

There are many barriers to the greater uptake of spatial intelligence by businesses, including a lack of awareness, capacity and knowledge, clarity, enabling environment, governance and funding. These barriers are explored in more detail below.

Awareness

Many business leaders know of spatial data but may not be aware of its full potential, or simply don't see the relevance of spatial intelligence to their operations and supply chain management. A chief executive's commitment to nature and climate action can catalyse a transformation of business intelligence systems and the benefits of using spatial data on nature.

Capacity and knowledge

Few organizations have the in-house capacity or knowledge to analyse, interpret and act on spatial data for nature and climate. Understanding this technology requires users to have a high level of technical knowledge and experience. It also means technology providers must increase the understandability and usability of their spatial tools and platforms.

Clarity

Businesses can be challenged by a lack of clarity and direction in this rapidly evolving space – both in terms of technology (e.g. which data-collection technology should businesses use?) and approach (e.g. how can businesses assess if a tool or dataset is high-quality?).

It can also be difficult to identify how spatial intelligence can answer specific business needs, and which spatial tool is most appropriate for the defined context (see Box 2). The current landscape of available data, technologies and tools is relatively fragmented and lacks interoperability and transparency in methodologies.⁵⁴

BOX 2 A panoply of data, technologies and tools

To assist companies in getting started, the SBTN has compiled and reviewed a list of 140+ tools relating to nature.⁵⁵ For example, an investor could map the impacts and dependencies of its portfolio through [ENCORE](#), before focusing on a particular geography and commodity through using [TRASE](#). It could then use [IBAT](#) to look at specific (site-based) biodiversity sensitivities, before using [SPOTT](#) to understand what an individual company

is doing to mitigate risks and help develop their engagement plan.

However, while the breadth of tools offers greater coverage in defining what's possible, it remains difficult for many analysts to identify the right sources of spatial intelligence to respond to a specific need. This diversity of available tools can pose a barrier to integrated approaches to nature and climate.

“ No Nationally Determined Contributions (NDCs) to reaching the Paris Agreement contain actionable maps of current and future land use

Enabling environment

Businesses operate within the environment created by governments and other stakeholders, but spatial intelligence isn't yet widely adopted in policies and regulations. For example, no Nationally Determined Contributions (NDCs) to reaching the Paris Agreement contain actionable maps of current and future land use.⁵⁶ Such maps

could be extremely useful for local communities, businesses, local government and other actors to identify the most appropriate locations for activities such as restoration. These spatial planning approaches can be used to identify areas where actions would have positive impacts on nature and climate, locations that are less likely to be subject to development pressures in the short to medium term and so on.

Governance

Governance of spatial intelligence is vital for its credibility and success as an inclusive and participatory process. This requires the establishment of agreed principles and safeguards to govern processes of convening stakeholders and using sensitive data. Robust data governance approaches can help avoid decisions and their outcomes being challenged, for example when action has been taken based on contentious or incomplete datasets.

Funding

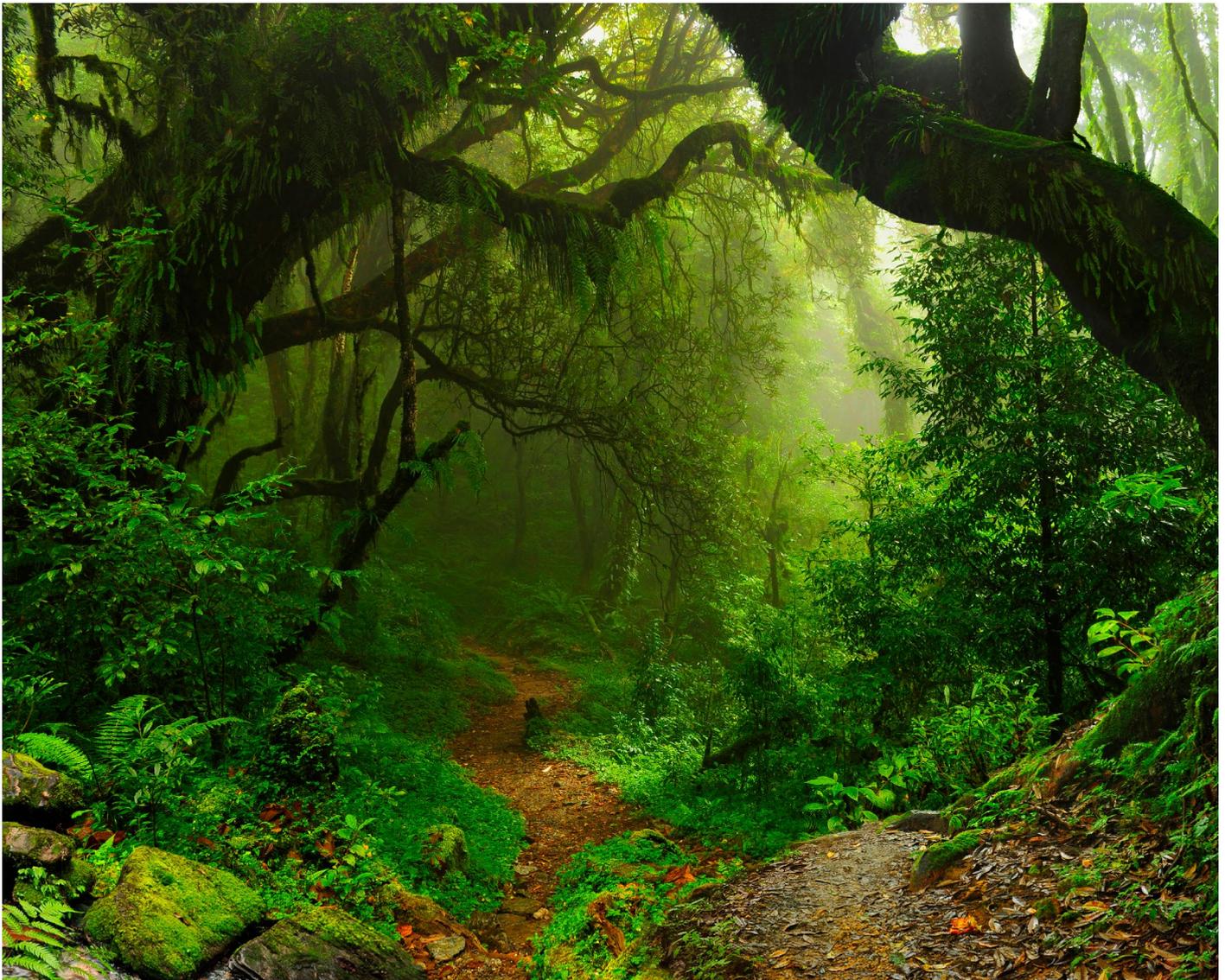
There are costs associated with collating, producing and analysing spatial data, which may hamper ambitions to enhance its accessibility and uptake for concerted action on the nature and climate agendas. Public and private entities that collect data or develop tools are seeking sustainable funding models for important aspects of their work that transcend traditional categories such as for-/not-for-profit

users or commercial/non-commercial terms. In many instances, spatial intelligence serves a public good or public purpose function (e.g. national planning, monitoring and reporting), in addition to internal business applications.

Two aspects of funding spatial intelligence can be barriers to greater use:

- Businesses can find it difficult to fully operationalize their nature and climate strategies, due to the investment in spatial intelligence systems that is required, such as acquiring high-quality spatial data and tools, investing in (in-house) expertise to use them, and/or funding for external advisory and outsourced services.
- More collaboration and partnerships are needed to develop the funding models required to make spatial intelligence available and accessible at scale. This will enable businesses and civil society to access comparable data across different countries, made available on a regular basis and with the necessary detail and resolution.

↓ Nepal jungle area at the foot of Annapurna



3

Unlocking the potential of spatial intelligence

Businesses, investors and governments have distinct roles to play in creating the enabling environment for a future where spatial intelligence informs effective and integrated nature and climate action.

3.1 Three conditions to realize the potential of spatial intelligence

What could a future where spatial intelligence underpins a nature-positive and net-zero emissions economy look like? This longer term vision focuses on the roles of government and business, while recognizing the important contributions from other stakeholders, including local communities. There are three conditions needed to realize this vision, as outlined below.

1. Spatial intelligence becomes a driver of public and private sector strategies and actions for nature and climate.

- All actors prioritize spatial intelligence to support integrated, location-specific actions.
- Businesses and governments invest in expertise (in-house or through expert partners) to fully integrate spatial intelligence into their strategic planning.
- Credible and comprehensive portals or guides are developed to provide assessments of existing spatial data and tools (building on existing reviews),^{57,58,59} to help businesses find the right tool for the job.

2. Interoperable data and tools for effective spatial intelligence become accessible to all stakeholders.

- All actors develop sustainable financial models to make spatial data easily accessible for public and private use.
- Governments develop mandatory/voluntary standards for data collection, use and

sharing to support interoperability; this could include requiring businesses to use commonly agreed metrics and formats to report on their environmental impacts.

- Businesses and governments work together to fill data gaps and share collected data (e.g. from environmental impact assessments).

3. An enabling governance structure supports the collection, use and disclosure of spatial intelligence to inform nature-positive and net-zero strategies and actions.

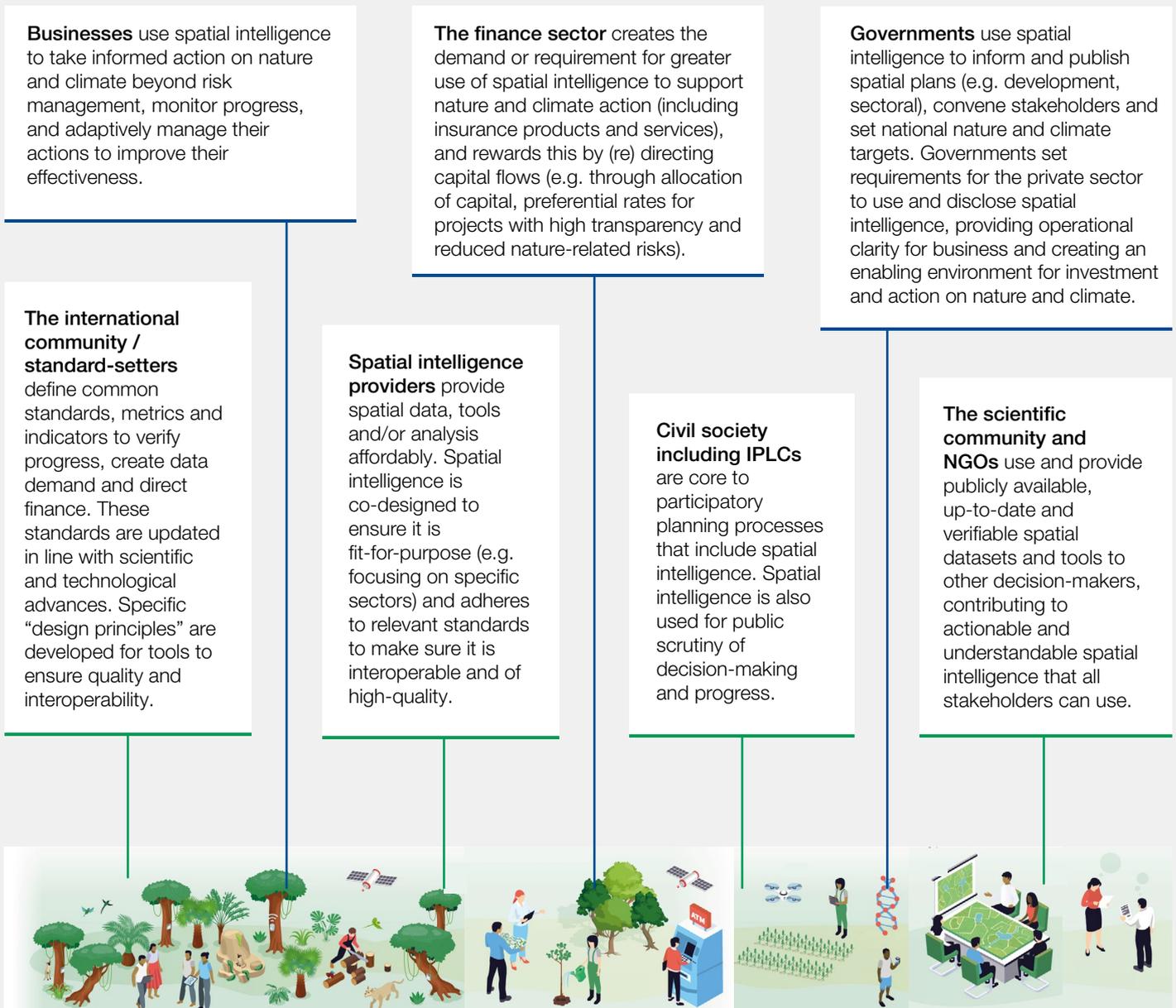
- All actors work together to develop the enabling governance structure to promote inclusive, participatory spatial intelligence.
- Governments facilitate cross-ministerial co-operation, meaningful and long-term engagement with local communities, and aggregated reporting at the national level.
- The private sector drives greater transparency by requiring companies to assess and disclose their nature and climate impacts and dependencies (e.g. as a condition of procurement or access to green finance) and relevant business information (e.g. asset data by the financial sector, supply chain information by businesses).

Businesses, financiers and government cannot achieve this imagined future alone. Figure 3 illustrates the roles that various actors could play to support a nature-positive and net-zero future that is underpinned by spatial intelligence.



↑ Rainforest trees in Sabah, Borneo, Getty

FIGURE 3 | Roles key actors could play to drive nature and climate action through spatial intelligence⁶⁰



3.2 Action areas for businesses: Commitment, Capability, Collaboration

The private sector can start by prioritizing three action areas: commitment, capability and collaboration – detailed below with specific examples of actions that businesses can take now (see Figure 3).⁶¹

Commitment: Define nature-positive commitments and integrate with net-zero targets

Use spatial intelligence to identify, understand and track location-specific progress.

Develop a nature and climate baseline to measure progress against targets and highlight risks and opportunities.

- Example: Map hotspots in operations and value chains, factoring in jurisdictional and national land-use/development strategies.

Set location-specific, science-based targets and track them over time using spatial intelligence.

- Example: Disclose impacts and dependencies across value chains through SBTN, and report progress through frameworks such as TNFD and TCFD.

Integrate spatial intelligence into financial decision-making processes to improve funding for integrated nature and climate action.

- Example: Integrate spatial intelligence into risk management and ESG policies and processes (for businesses and financial institutions).
- Example: Mandate the disclosure of nature and climate impacts within supply chains.

Capability: Invest in spatial intelligence expertise and data to continuously improve insights

Work with others to set up high-quality, credible and transparent systems that respect social and cultural norms.

Review existing spatial data and expertise to ensure it's widely used across business units internally.

- Example: Individual business units collate their own spatial data (e.g. site locations, environmental impact assessment data, GHG emissions monitoring data) and ensure it is available to other business units.

- Example: Invest in additional in-house capacity or partner with external experts.

Identify and close data gaps, collaborating with others to collect and host data in an interoperable, accessible, credible and equitable way.

- Example: Businesses or sector groups undertake a gap analysis to identify data gaps across key metrics and indicators, and set up agreements with data providers and institutions to support long-term, landscape-scale data collection and monitoring activities.
- Example: Financial institutions invest in innovative data collection activities.
- Example: Actors within a sector agree on a “set” of datasets and tools that they use and fund for certain analysis and assessments (e.g. guided by SBTN or TNFD frameworks).

Disclose collected data and methods

- Example: Businesses share asset-level or location-specific data, that they have collected, on a shared platform to access green finance, assure credibility and transparency, and improve public access to high-quality data.
- Example: The finance sector uses this data to provide preferential access to finance where positive action for nature and climate can be demonstrated using spatial intelligence.

Collaboration: Work with the public and private sectors and local communities to take action now

Meaningful, respectful collaboration is key, ensuring effective safeguards are in place.

- Example: Ensure that data collectors receive the benefits derived from data they collect and share, with particular focus on respecting the rights of Indigenous peoples and local communities (IPLCs).

Take initial no-regret actions by using spatial intelligence to locate and implement nature-based solutions in areas where they best contribute to nature and climate targets.

- Example: Kickstart collaborative water stewardship programmes in specific locations.
- Example: Don't source products from high-biodiversity areas.

- Example: Work with local communities to maintain healthy mangroves, so they can help protect coastal communities and businesses from storm surges.

Participate in pilot projects, such as those launched by TNFD and SBTN.

- Example: trial new methods and tools to inform their development and usability.

- Example: Collaborate with others through initiatives like SPACES⁶² and sectoral partnerships to test the applicability of metrics and indicators in a specific geographical context or across a value chain, to co-create a common architecture.

3.3 Action areas for governments: Transparency, Accessibility, Coherence

Governments also have a critical role to play in creating the enabling environment needed to scale up spatial intelligence for nature and climate. Governments can start by prioritizing three action areas: transparency, accessibility and coherence – detailed below with specific examples of actions that government agencies can take now.

Transparency

Develop land-use strategies and publish maps of current and intended land use, in support of national and global targets on nature and climate.

- Example: Revise NDCs under the UN Framework Convention on Climate Change and National Biodiversity Strategies and Action Plans (NBSAPs) to include maps that provide clarity to all stakeholders and to ensure that action on nature and climate is defined as a priority.
- Example: Create opportunities for engagement on spatial planning (e.g. highlighting how businesses and local communities can contribute to development plans, where stakeholders can access spatial intelligence, what the processes and pathways to action are so stakeholders can more easily navigate them).

Accessibility

Embed spatial intelligence into national policies and standards to incentivize and fund better collection, use and sharing of data.

- Example: Mandate the publishing and sharing of data collected in environmental and social impact assessments and government-collected data.
- Example: Donor governments can support greater data accessibility and availability (e.g. by investing in data-collection programmes to improve biodiversity data and making it available through relevant platforms).

Coherence

Act coherently, iteratively and inclusively

to deliver integrated action on nature and climate through coherent policies, integrating the latest technologies, and ensuring access to commercial opportunities that include businesses and local communities.

- Example: Ensure relevant ministries – such as finance, planning, agriculture, infrastructure and environment – share and use spatial intelligence (e.g. through a working group or other cross-ministerial mechanism), adopt a coherent planning approach and prioritize joint opportunities with local communities for progress.
- Example: Support additional opportunities for integrated action on nature and climate (e.g. better tracking and monitoring of forest protection and restoration programmes to create new financial opportunities through accessing carbon markets).

Conclusion

Collaboration across public and private sectors to mobilize spatial intelligence is critical for advancing integrated business action on nature and climate

Call for action

Members of the World Economic Forum's Global Future Council on Nature-Based Solutions call for urgent business action on nature and climate. We believe that spatial intelligence can play a critical role in advancing integrated action, and we call for collaboration across the public and private sectors to create the enabling conditions to accelerate uptake.

In this report, we provide examples of how businesses are starting to use spatial intelligence to answer important strategic questions and align with other stakeholders on integrated action for nature and climate. We also recognize that governments play a critical role in creating the enabling environment to scale up spatial intelligence-led action for nature and climate.

We therefore call on businesses to:

- **Invest in spatial intelligence expertise and data to continuously improve insights** – collaboratively setting up high-quality, credible, transparent systems to enable this; making data public when possible to increase credibility and transparency; starting by reviewing existing spatial data and capacity, and ensuring it is widely used across functions and sectors internally.
- **Define nature-positive business strategies and integrate them with (existing) net-zero targets** – using spatial intelligence to identify, understand and track progress towards these commitments.
- **Work together with governments, the private sector and local communities to take action now** – based on the best information and data currently available (but with mechanisms to integrate new data over time), and to take initial actions that support global nature and climate goals such as: setting science-based commitments and targets for nature and climate, implementing nature-based solutions (e.g. water stewardship programmes or land restoration), and participating in pilot projects through frameworks such as TNFD and SBTN.

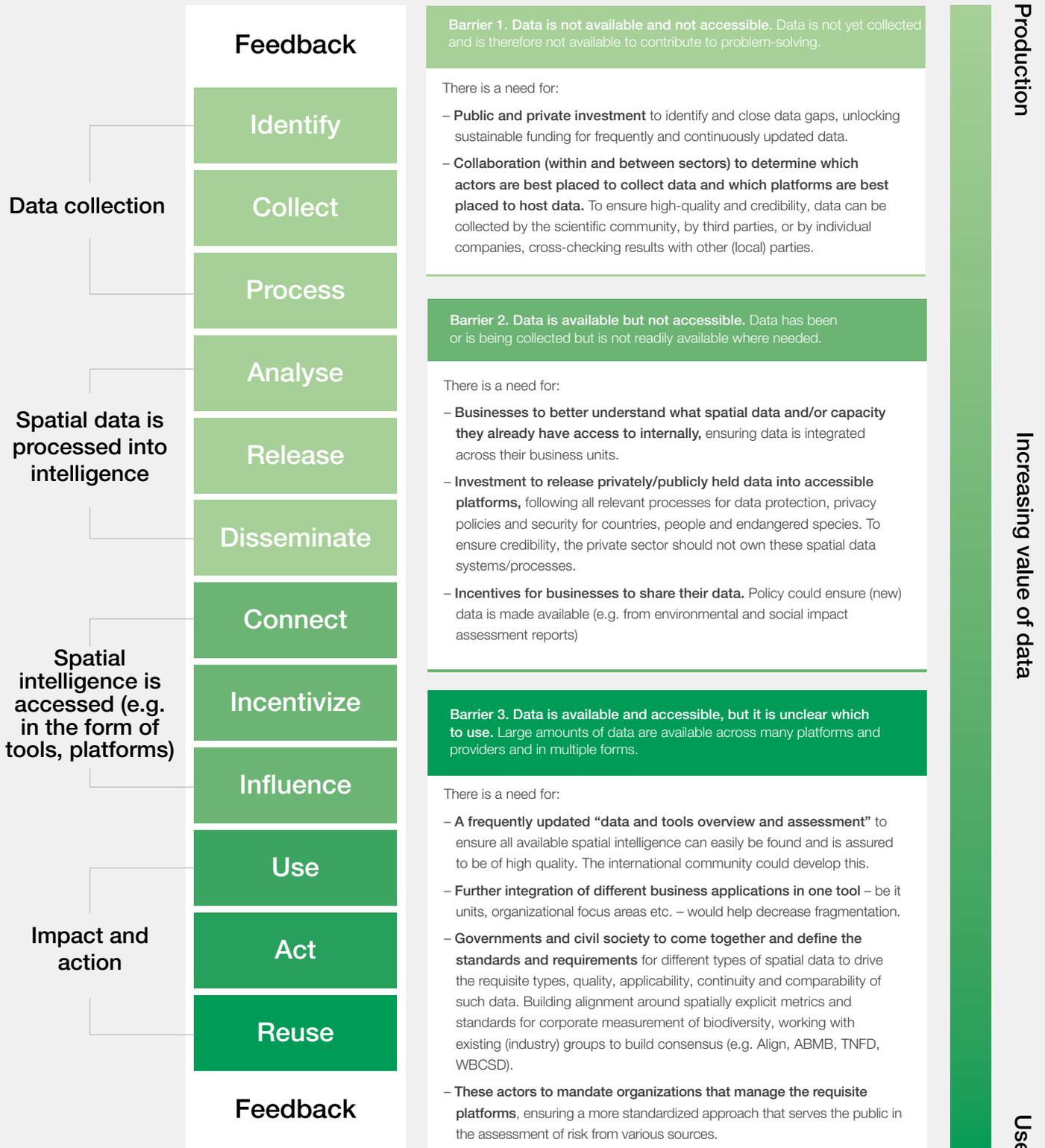
We therefore call on governments to:

- **Develop and publish spatially-explicit development plans, including maps of current and intended future land use**, in support of national and global targets on nature and climate. For example, countries should revise their NDCs and NBSAPs to include these maps, in order to provide clarity to all stakeholders and to ensure that action on nature and climate is defined as a priority.
- **Embed spatial intelligence in national policy and standards** to incentivize and fund better collection, use and sharing of data, for example by mandating the sharing of data collected in environmental and social impact assessments, publishing government-collected data, and investing in data-collection programmes to fill data gaps.
- **Act coherently, iteratively and inclusively** to deliver integrated action on nature and climate; for example, by ensuring policy coherence across ministries, integrating the latest technologies, including local communities in planning processes, and promoting commercial opportunities through carbon markets and other means that also benefit local communities.

Appendix

The figure below summarizes three barriers to the use of high-integrity data to inform decision-making and action, and steps to help overcome them.⁶³

Steps to overcome barriers to the use of high-integrity data



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