EXPLORING NATURAL CAPITAL OPPORTUNITIES, RISKS AND EXPOSURE:

A practical guide for financial institutions

COPYRIGHT AND INTELLECTUAL PROPERTY

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes without special permission from the copyright holder, provided acknowledgment of the source is made. The NCFA would appreciate receiving a copy of any publication that uses this publication as a source.

Suggested citation: *Exploring Natural Capital Opportunities, Risks and Exposure: A practical guide for financial institutions*, Natural Capital Finance Alliance (Geneva and Oxford), 2018

DISCLAIMER

EXECUTIVE SUMMARY

NATURAL CAPITAL AND THE FINANCE SECTOR

Natural capital is a way of thinking about nature as a stock that provides a flow of benefits to people and the economy. It consists of natural capital assets, such as water, forests and clean air that provide humans with the means for healthy lives and enable economic activity.

The goods and services that natural capital provides, such as food, water, or climate regulation are called ecosystem services, and these underpin all economic activity. Any adverse changes in natural capital therefore have a potential negative effect on the businesses that depend on it.

Human interactions with nature are depleting natural capital at an accelerating rate. This affects nature's capacity to continue providing the ecosystems services on which the economy depends. Environmental change can therefore trigger significant disruptions to economic production.

Financial institutions are exposed to natural capital risks that affect the businesses that they lend to or invest in. If a bank is lending to a farm that is unable to sustain production or facing increased costs due to water shortages, or whose crop is failing regularly due to changing climate conditions, then the farmer may not be able to service loan payments temporarily or may go out of business in the long term.

Financial institutions wishing to understand and assess their exposure to natural capital risks have faced a lack of comprehensive and systematic information on how businesses depend on the environment and the consequences when that relationship is disrupted by environmental change.

ENCORE – EXPLORING NATURAL CAPITAL OPPORTUNITIES, RISKS AND EXPOSURE

To help fill this gap and assist financial institutions in carrying out natural capital assessments, the Natural Capital Finance Alliance has partnered with UN Environment World Conservation Monitoring Centre to create ENCORE, a web-based tool that allows financial institutions to understand:

■ How do the businesses in my portfolio depend on nature for their production processes and how material are these dependencies to the business?

■ How does environmental change affect the ability of nature to continue providing the ecosystem services on which the businesses depend?

■ What drivers of environmental change (such as climate change or pollution) have the greatest impact on businesses in my portfolio?

The tool allows users to identify material natural capital risks to any business sector and assess these risks for any location, based on current environmental data.

KEY INSIGHTS INTO NATURAL CAPITAL RISK

The highest dependency on nature is to be found in primary sectors such as agriculture, aquaculture and fisheries and forest products. Other sectors with multiple material dependencies include energy—particularly hydropower production—water utilities, oil and gas, and mining. These sectors are highly dependent on nature to provide a wide range of goods and services to enable their production processes, and these dependencies are also highly material.

A disruption in nature's ability to provide them will have a significant impact on their business operations and on their profitability. The most important ecosystem services to the economy, in that they are material to a large number of sectors, are those related to water. Climate regulation, both at local and global level, is also a highly material ecosystem service for many business sectors. Finally, nature's role in reducing and managing a range of risks and hazards such as floods and landslides is also material to large parts of the economy.

Natural capital assets often underpin a variety of ecosystem services on which businesses depend, meaning, that environmental change at the level of a single natural capital asset can influence a large number of ecosystem services and businesses.

CONCLUSION

Environmental change is global and accelerating, affecting all financial institutions through their operations and financing decisions. ENCORE is the first knowledge base linking nature to the economy which is designed for financial institutions to assess their exposure to natural capital risk in a systematic and comprehensive manner.

We call on financial institutions to start exploring natural capital risk today. Only by understanding their exposure, assessing it, and ultimately integrating these considerations in their operations can financial institutions ensure that they are ready for a world of accelerating environmental change.

TABLE OF CONTENTS

INTRODUCTION

The Natural Capital Finance Alliance (NCFA) was set up in 2012 by a group of pioneering financial institutions who saw the need for better understanding of how finance both depends on and impacts nature, in order to manage risks and unlock opportunities. Initially formed around the four commitments of the Natural Capital Declaration, the NCFA's financial institutions and supporters work collaboratively to better understand the science linking nature to the economy, integrating this knowledge into their decision making, and sharing their experiences with the rest of the finance sector and stakeholders. The outputs of the NCFA contribute to developing a systematic and evidence-based approach to measuring, quantifying and valuing how environmental change affects companies and the financial institutions that fund or insure them.

Since its inception, the NCFA has developed tools and methodologies to incorporate natural capital risks and opportunities into financial analysis. These include a framework for addressing deforestation risk in commodity production and tools to incorporate water stress into traditional financial analysis for bonds and equities or that allows users to stress test their credit portfolio under a number of drought scenarios. The NCFA has also collaborated with the Natural Capital Coalition to develop the Finance Sector Supplement to the Natural Capital Protocol, which provides a framework for financial institutions to assess the natural capital impacts and dependencies of their portfolio.

This project – Advancing Environmental Risk Management – builds upon NCFA's previous work to provide a comprehensive view of the ways in which degradation or destruction of natural capital constitutes a risk to financial institutions. The first output towards including natural resource risks in cost of capital highlighted the fragmented nature of information that financial institutions face when it comes to such risks. For this next phase of the project, the NCFA has partnered with UN Environment World Conservation Monitoring Centre (UNEP-WCMC) to review existing knowledge and structure this information to enable financial institutions to better understand, assess, and integrate natural capital risk in their operations.

THE BUSINESS CASE FOR NATURAL CAPITAL ASSESSMENTS

Natural capital is a way of thinking about nature as a stock that provides a flow of benefits to people and the economy. It consists of **natural capital assets**—such as water, forests, and clean air—that together provide humans the means for healthy lives and enable economic activity. The goods and services that natural capital provides, in the form of foods and fibres, water, risk protection and absorption of pollution are called **ecosystem services**. Through inputs to production, risk reduction, impact mitigation, and by supporting life more generally, ecosystem services underpin all economic activity. Any adverse changes in natural capital therefore have a potential negative effect on the businesses that depend on it. Figure 1 shows the **dependencies** of the economy on natural capital and the **impacts** such as pollution and waste, which can impair the resilience of natural capital.
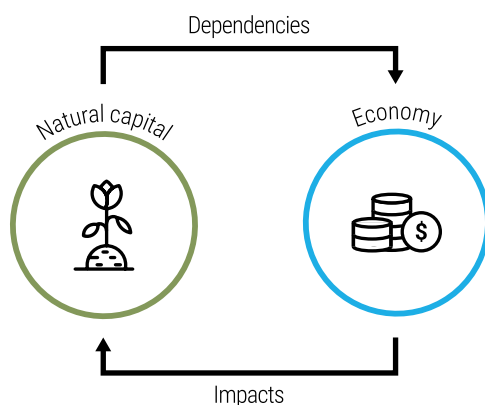
Figure 1: Nature and the economy

Human interactions with nature, whether direct such as deforestation or pollution, or indirect such as climate change, are depleting natural capital at an accelerating rate. This affects nature's capacity to continue providing the ecosystems services on which the economy depends. These **drivers of environmental change** can, through the risk to continued provision of ecosystem services, trigger disruptions to economic production, as shown in Figure 2.
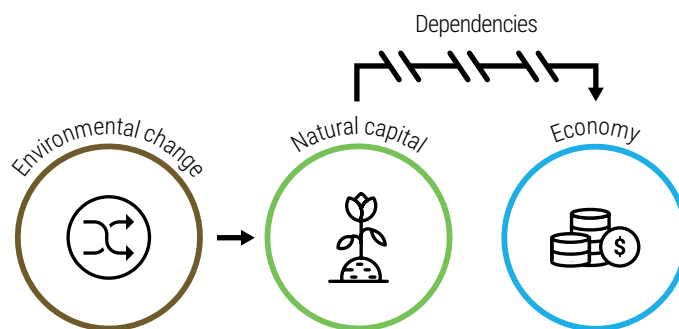
Figure 2: Disruption risks arise when environmental change affects nature's ability to provide goods and services on which the economy depends

Financial institutions are exposed to **natural capital risks** that affect the businesses that they lend to or invest in. If a bank is lending to a farm that is unable to sustain production or facing increased costs due to water shortages, or whose crop is failing regularly due to changing climate conditions, then the farmer may not be able to service loan payments temporarily or may go out of business in the long term.
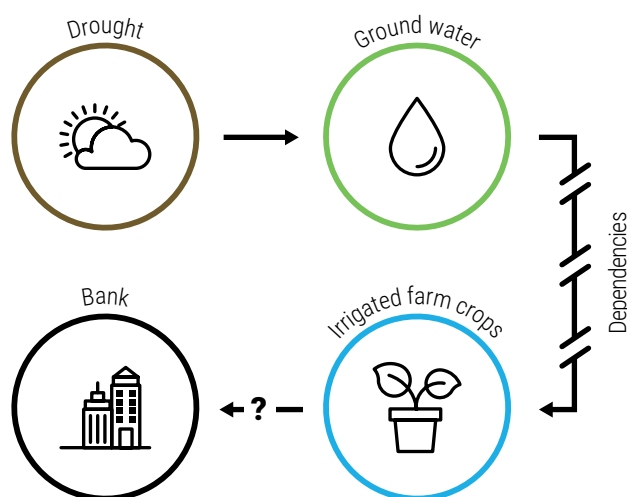
Figure 3: Example of disruption risk potentially affecting a financial institution

Environmental change, such as shifting rainfall patterns, often affects wide areas. This can create systemic risks where businesses in the affected area are all exposed to a common natural capital risk even though they may be in many different sectors of the economy. For example, the NCFA's previous work on drought stress testing showed that droughts affecting economic centres of production materially impacted businesses across a number of sectors, and this geographic concentration risk was generally underappreciated by financial institutions.

THE STATE OF NATURAL CAPITAL ASSESSMENTS

Financial institutions wishing to understand and assess their exposure to natural capital risks have been facing a lack of comprehensive and systematic information on how different businesses depend on the environment, and the consequences when that relationship is disrupted by environmental change. The information that is available is often fragmented, anecdotal, or highly context-specific. There are also few tools and methodologies for quantifying natural capital risk in financial terms or for incorporating these risks within existing risk management processes.

Even where the evidence base is more developed, natural capital assessments are often hampered by unavailable or inconsistent data both on the environment and at project/entity level. Location-specific analysis is critical for natural capital assessments as natural capital assets in one location can have very different characteristics to those in a neighbouring location. Spatial data on natural capital assets and drivers of environmental change of sufficient detail and consistency are needed, but in many cases are not available or easily accessible to analysts in financial institutions.

Natural capital risk assessments, while critical, therefore have remained an opaque and largely theoretical construct for the finance sector. The AERM project changes the situation by providing robust, standardised methodologies, processes and spatial data to broaden the application of natural capital assessments. This includes:

- Mapping how businesses across the economy depend on nature, which of these dependencies are most material, and what can lead to disruption risk for a business;
- Identifying methodologies and approaches for evaluating natural capital risks across sectors and regions relevant to the portfolios of financial institutions;
- Creating tools to understand and assess these risks;
- Developing approaches to embed natural capital considerations into lending and investment credit risk assessment and suggesting practical ways to deploy these approaches in financial analysis and decision-making.

THE FOUNDATION FOR NATURAL CAPITAL RISK ASSESSMENTS

To assist financial institutions in carrying out natural capital assessments, we have compiled a systematic and comprehensive knowledge base. This knowledge base can help answer the following questions:

- How do the businesses in my portfolio depend on nature for their production processes and those in their supply chain, and how material are these dependencies to the business?
- How does environmental change affect the ability of nature to continue providing the ecosystem services on which the businesses depend?
- What drivers of environmental change (such as climate change or pollution) have the greatest impact on businesses in my portfolio?

The knowledge base is a comprehensive source of information to understand the benefits that natural capital provides to the economy, the risks that materialise when these are disrupted by environmental change, and how these risks can be assessed in specific contexts.

The assessment of natural capital risk centres on natural capital assets and the drivers of environmental change that affects these assets. The state of these assets and severity of the drivers determines the potential risk of disruption or changes to continued provision of ecosystem services that economic sectors are materially dependent upon.

The knowledge base allows users to identify material natural capital risks to any business sector and assess the level of these risks for any location based on current environmental data.
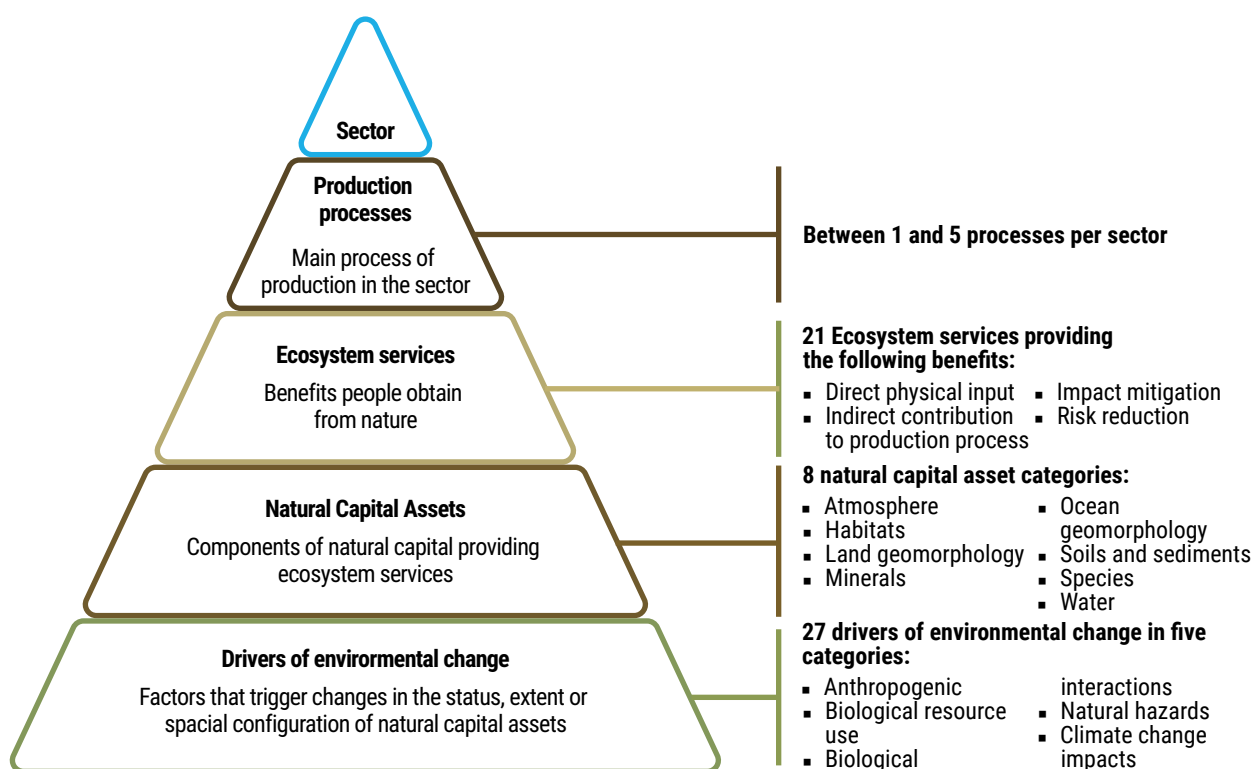
Figure 4: Linking drivers of environmental change to natural capital and the economy

HOW BUSINESSES DEPEND ON NATURAL CAPITAL

Using existing classifications of both ecosystem services and economic sectors, we reviewed the current body of relevant information on ecosystem service dependencies for all economic sectors and took stock of the current gaps in knowledge. Expert interviews were conducted with sector specialists to validate information for some dependencies given the absence of information on ecosystem service dependencies identified through literature reviews.

This resulted in a comprehensive assessment of 167 economic sub-industries, taken from the Global Industry Classification Standard, to determine which of the 21 ecosystem services they depend upon for their production processes.

Each sector dependency was then assessed, using sector research and expert interviews, to determine materiality. The addition of materiality ratings allows financial institutions to determine which ecosystem services are more critical to the production process and there-fore most relevant for further analysis.

Ecosystem service materiality assessment

To assess the importance of the contribution an ecosystem service makes to a production process, and the materiality of the impact if this service is disrupted, two aspects were considered:

1. How significant is the loss of functionality in the production process if the ecosystem service is disrupted?

    Limited loss of functionality: the production process can continue as is or with minor modifications.

    Moderate loss of functionality: the production process can continue only with important modifications (e.g. slower production or use of substitutes).

    Severe loss of functionality: Disruption in the service provision prevents the production process.

2. How significant is the financial loss due to the loss of functionality in the produc-tion process?

    Limited financial loss: Disruption to the production process doesn't materially affect the company's profits.

    Moderate financial loss: Disruption to the production process materially affects the company's profits.

    Severe financial loss: There is a reasonable possibility that the disruption in the production process will affect the financial viability of the company.

The materiality assessment reflects both these considerations. A very high material-ity rating means that the loss of functionality is severe and that the expected finan-cial impact is severe as well.

Box 1: Determining sector/dependency relationship and materiality

This work was complemented with a supply chain analysis that enables users to consider the risks that their sectors of interest may be exposed to through disruptions in their supply chain due to natural capital risk.

LINKING ENVIRONMENTAL CHANGE TO BUSINESS IMPACT

The ecosystem services that businesses depend on are provided by natural capital assets such as water or species. It is the capacity of these assets to provide services and how this capacity will be affected by drivers of environmental change that is at the heart of natural capital risk assessment. For example, nature's ability to provide filtration of pollutants depends on a complex web of micro-organisms and plants working together, and the quality of the habitats that supports them. Identifying the natural capital assets underpinning each ecosystem service and the potential drivers of environmental change that could impact them therefore enables financial institutions to understand the sources of a disruption risk that materially affects business performance. See Appendix for full list of drivers of environmental change, natural capital assets, ecosystem services, and production processes.

Factsheets were produced for each ecosystem service outlining the following information: a description of the ecosystem service-natural capital asset system, identification of the main drivers of environmental change influencing or impacting the system and the mechanism by which these impact ecosystem service provision. Summary tables in each factsheet provide a quick overview of the natural capital assets most important to service provision and the drivers of environmental change that have greatest influence on them.

IMPORTANCE OF NATURAL CAPITAL ASSETS TO ECOSYSTEM SERVICES				
CRITERION	**DEFINITION**	**RED**	**AMBER**	**GREEN**
Nature	Nature of the relationship between the natural capital asset and service provision	Non-linear	Linear	
Sensitivity	Sensitivity of the ecosystem service to a change in the state of the natural capital asset	High sensitivity	Medium sensitivity	Low sensitivity
Reversibility	Possibility for the impact of a change in a natural capital asset on ecosystem service provision to be reversed (subject to feasibility)	Not reversible in a human lifetime	Reversible impact with long-term (>1 year), active restoration	Natural, short-term (<1 year), reversible impact
Substitutability	Degree of dependence of the ecosystem service on the natural capital asset	Only asset able to provide the service OR highly specific asset	One of only a small number of assets able to provide the service OR a supporting asset	One of a large number of assets able to provide the service
Uncertainty	Degree of uncertainty in the relationship between the natural capital asset and service provision	High uncertainty	Medium uncertainty	Low uncertainty

Box 2: Criteria used to assess importance of natural capital assets to ecosystem service provision

INFLUENCE OF DRIVERS OF ENVIRONMENTAL CHANGE ON NATURAL CAPITAL ASSETS				
CRITERION	DEFINITION	RED	AMBER	GREEN
Nature	Nature of the relationship between the natural capital asset and service provision	Non-linear	Linear	
Sensitivity	Sensitivity of the ecosystem service to a change in the state of the natural capital asset	High sensitivity	Medium sensitivity	Low sensitivity
Reversibility	Possibility for the impact of a change in a natural capital asset on ecosystem service provision to be reversed (subject to feasibility)	Not reversible in a human lifetime	Reversible impact with long-term (>1 year), active restoration	Natural, short-term (<1 year), reversible impact
Substitutability	Degree of dependence of the ecosystem service on the natural capital asset	Only asset able to provide the service OR highly specific asset	One of only a small number of assets able to provide the service OR a supporting asset	One of a large number of assets able to provide the service
Uncertainty	Degree of uncertainty in the relationship between the natural capital asset and service provision	High uncertainty	Medium uncertainty	Low uncertainty

Box 3: Criteria used to assess the influence of drivers of environmental change on natural capital assets

DATA ON NATURAL CAPITAL ASSETS AND DRIVERS OF CHANGE

As natural capital risk is ultimately a function of changes in the capacity of natural capital assets to provide the services that businesses depend on, it is important to know not only which natural capital assets are most important to service provision, and which drivers of environmental change affect it, but the current state of these assets and drivers in the locations in which businesses operate.

The project has therefore compiled inventories of all available spatial data relevant to natural capital assets and drivers of environmental change at a global level and for the project's three priority countries (Colombia, South Africa and Peru). A number of screening criteria, such as update frequency and temporal coverage, were recorded for each dataset to enable financial institutions to assess the suitability and robustness for decision making. From these inventories, the datasets most suited to natural capital risk analysis have been identified.

KEY INSIGHTS FROM THE KNOWLEDGE BASE

Analysis of business dependencies on natural capital highlights the high dependence on nature of primary sectors such as agriculture, aquaculture and fisheries and forest products. Other sectors with multiple material dependencies include energy – particularly hydropower production – water utilities, oil and gas, and mining (see Figure 5). These sectors are highly dependent on nature to provide a wide range of goods and services to enable their production processes, and these dependencies are also highly material. A disruption in nature's ability to provide the ecosystem services upon which these sectors depend will have a significant impact on their business operations and on their profitability.
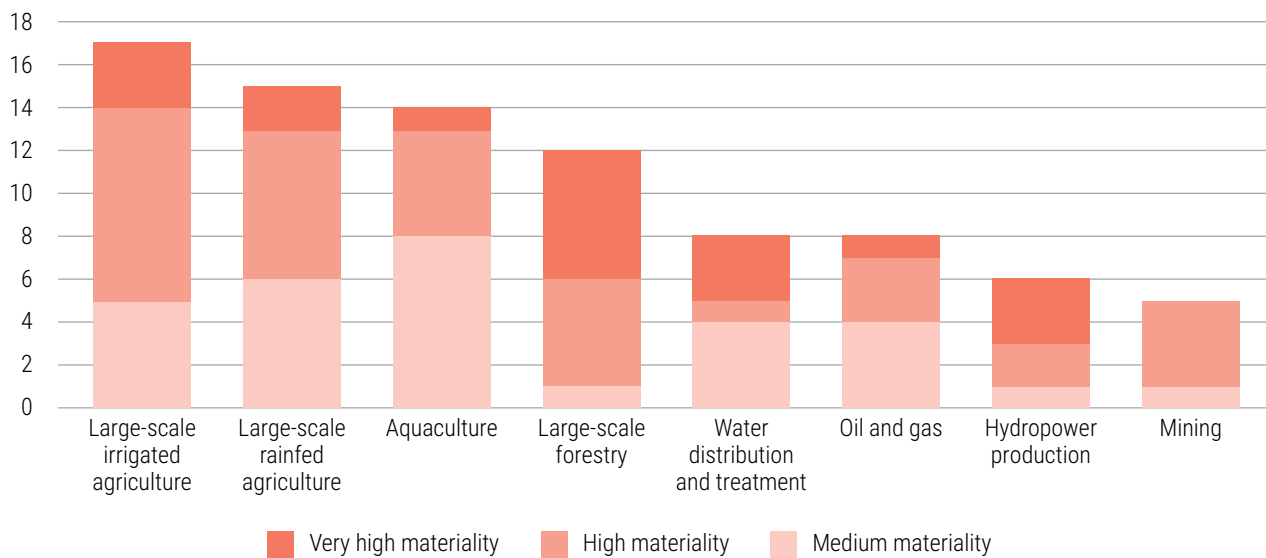
Figure 5: Production processes with the highest number of material dependencies on nature

For example, looking in more detail at the dependencies of hydropower production in Figure 6 shows the complex links to nature that enable the uninterrupted production of energy from hydropower.
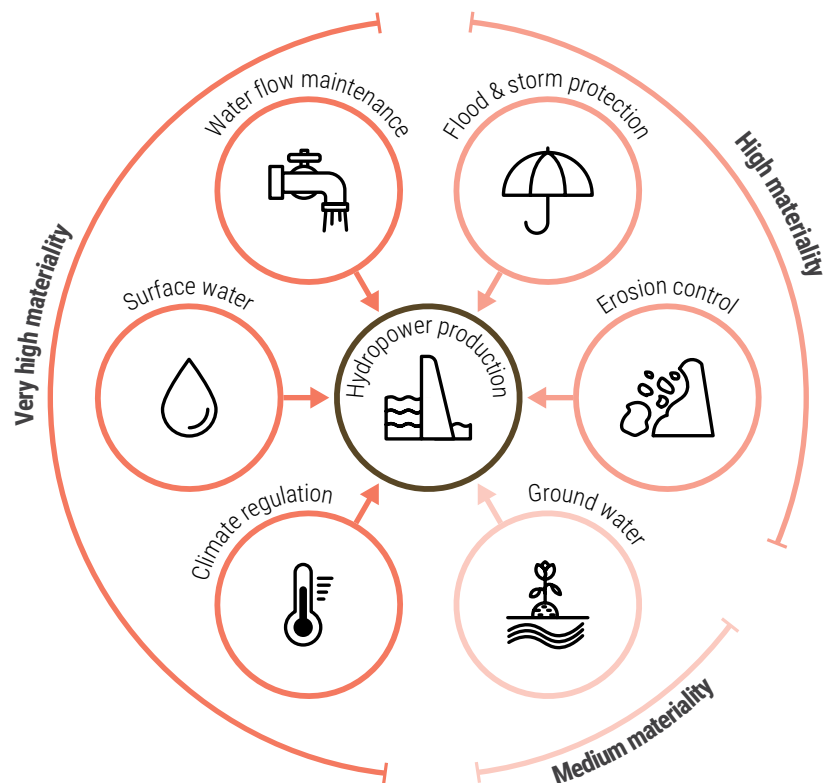
Figure 6: Material dependencies of the hydropower production process

Exploring Natural Capital Opportunities, Risks and Exposure
The foundation for natural capital risk assessments

The most important ecosystem services to the economy, in that they are material to a large number of sectors, are those related to water – ground water provision, surface water provision, and water-flow maintenance. Climate regulation, both at a local and global level, is also a highly material ecosystem service for many business sectors. Finally, nature's role in reducing and managing a range of risks and hazards such as floods and landslides is also highlighted as material to large parts of the economy (see Figure 7).
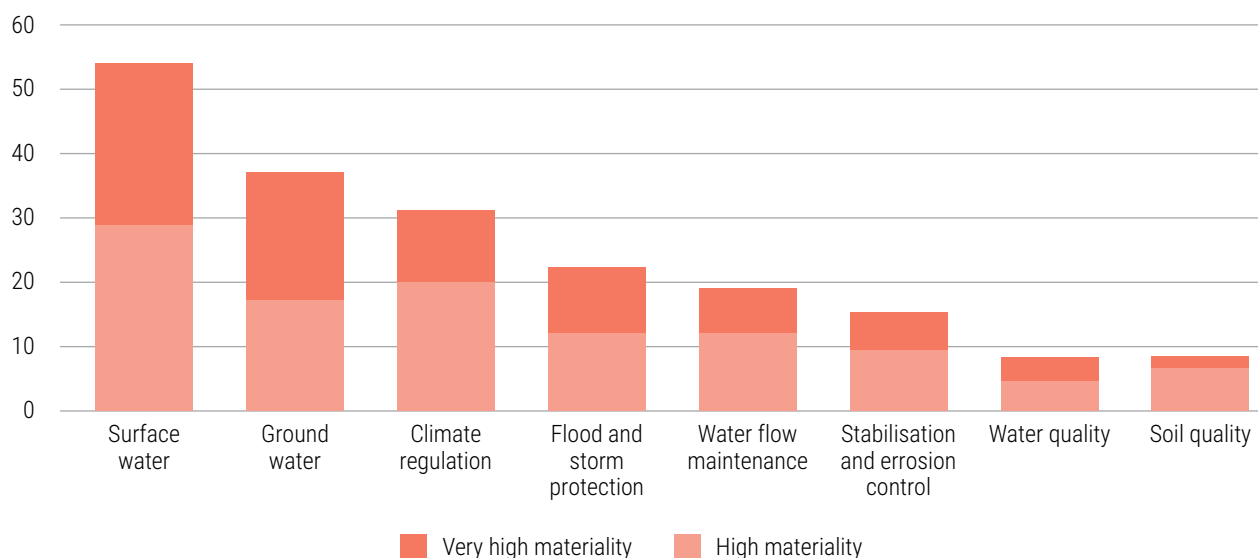
Figure 7: Ecosystem services material to the highest number of production processes

One of the key findings of the analysis is that, although there are many types of ecosystem services that businesses depend on, the natural capital assets that underpin them are much fewer in number, meaning that environmental change at the level of a single natural capital asset can influence a large number of ecosystem services and businesses. The assets that underpin the provision of the highest number of ecosystem services are species, habitats, and atmosphere (see Figure 8).

NATURAL CAPITAL ASSET

ECOSYSTEM SERVICE

Climate regulation
Mediation of sensory impacts
Soil quality
Bio-remediation
Fibres and other materials
Maintain nursery habitats
Disease control
Pest control
Filtration
Pollination
Water flow maintenance
Dilution by atmosphere and ecosystems
Water quality
Buffering and attenuation of mass flows
Animal-based energy
Genetic materials
Flood and storm protection
Mass stabilisation and erosion control
Ventilation

Species
Habitats
Atmosphere

Figure 8: Ecosystem services provided, at least in part, by species, habitats and/or atmosphere

Analysis of the most influential drivers of environmental change reveals the multiple damaging effects of human influence on natural habitats and the economic consequences that follow. Indeed, habitat modification in the form of deforestation, urbanization, and the impacts of climate change among others, affects nature at both the local and global scale with wide ranging impacts on water, species, and the atmosphere. These impacts, in turn can affect the ability of nature to provide essential services such as climate regulation, water provision, pollination and disease control. Through impacts on multiple ecosystem services, habitat modification can impact almost every sector of the economy (see Figure 9).

DRIVER OF ENVIRONMENTAL CHANGE | **NATURAL CAPITAL ASSET** | **ECOSYSTEM SERVICE** | **PRODUCTION PROCESS** | **SECTOR**

Habitat modification

Habitats
Species
Atmosphere
Water
Minerals

Consumer Staples
Materials
Industrials
Consumer Discretionary
Utilities
Energy
Health Care
Information Technology
Telecommunication Services
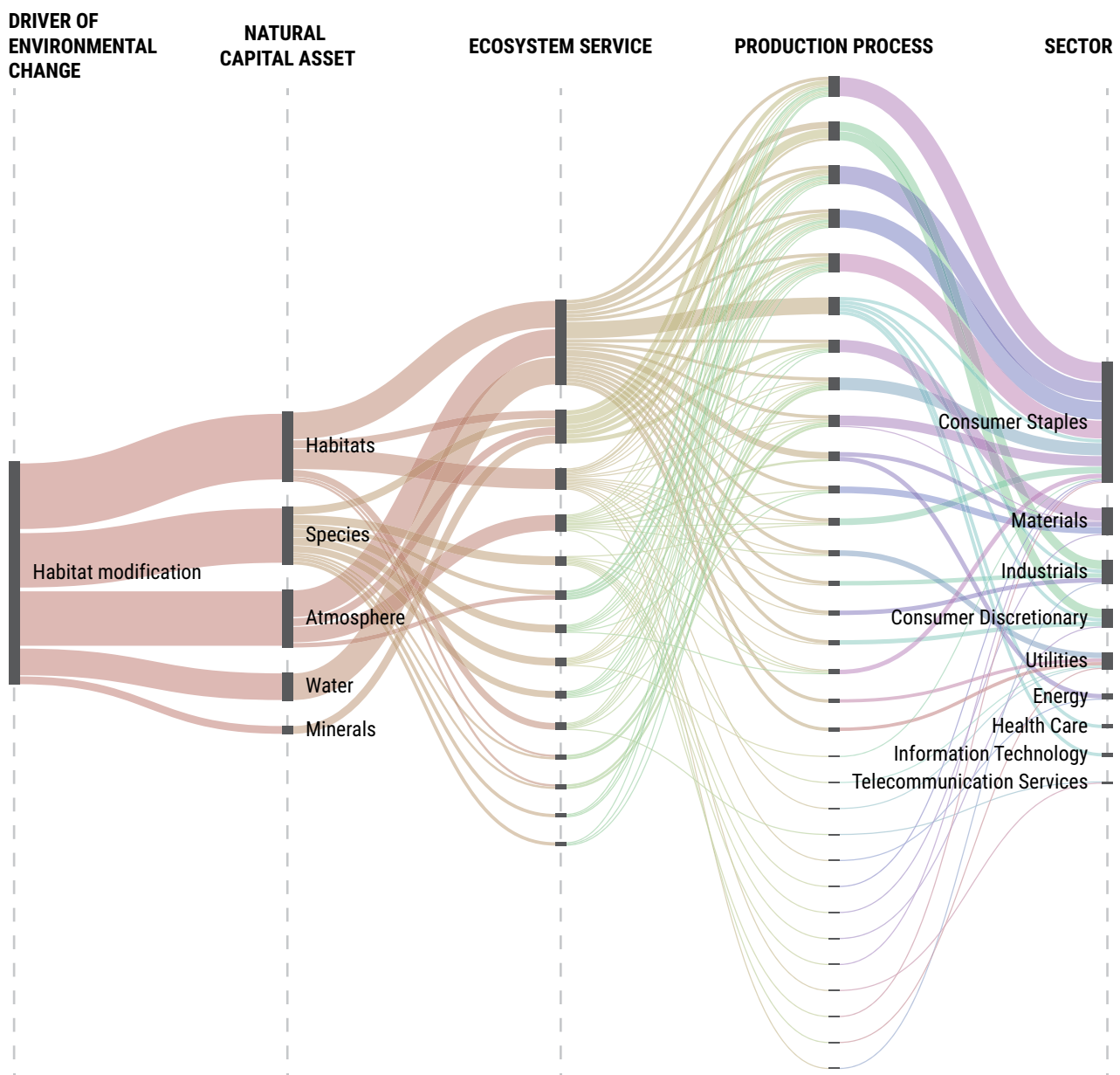
Figure 9: A single driver of environmental change can have material impacts on a number of different industries through many combinations of asset, service and production process

Note: Line thickness indicates the number of links from one level to the levels above and below (e.g. from ecosystem service to natural capital asset and production process). Colours are added for clarity only.

ENCORE - EXPLORING NATURAL CAPITAL OPPORTUNITIES, RISKS AND EXPOSURE
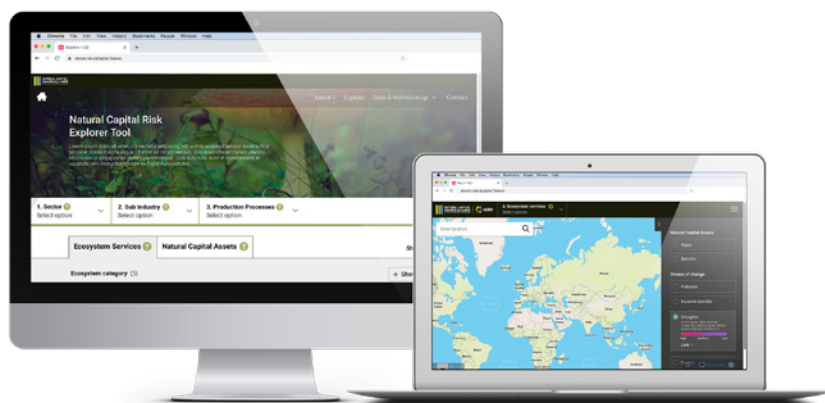
[ENCORE – Exploring Natural Capital Opportunities, Risks and Exposure](#) is a web-based tool that enables users to visualize the exposure of economic sectors to natural capital risks according to their geographical location.

ENCORE will enable users to better understand the risks that environmental degradation cause for businesses by allowing users to access all the information described in this report linking different industries to specific ecosystem assets and the drivers of environmental change, such as climate change, that affect them.

Users can select individual sectors, choose a type of natural capital asset, or focus on a driver of change and explore all the interlinkages and the risks they relate to.

Users can view all of these risks spatially through fully customisable maps of the different natural capital risk factors affecting business.

NATURAL CAPITAL DEPENDENCY RISK ASSESSMENT IN PRACTICE

An assessment of natural capital dependency risks can be approached in different ways. The following provides two examples of analysis that can be undertaken by financial institutions with ENCORE:

EXAMPLE 1: IDENTIFYING SECTORS IN A PORTFOLIO WITH HIGH NATURAL CAPITAL RISK

Step 1: Select/map sector classification

ENCORE uses the Global Industry Classification Standard (GICS) for classifying economic sectors which is then broken down into production processes. While this is a common classification, especially for investors, many other classifications exist. Financial institutions can either re-map their current classification into GICS or map the production processes to their current sector classification.

Step 2: Select top sectors (optional)

In order to focus the analysis, we suggest that institutions limit the analysis to the top 5 to 10 sectors by value in their portfolio.

Step 3: Identify likely causes of disruption

Disruption risk is a function of the ability of natural capital assets to continue providing the services on which businesses depend. For each sector or production process selected, ENCORE can be used to identify the natural capital assets that provide the ecosystem services on which they depend and the drivers of environmental change that influence these natural capital assets.

Step 4: Assess disruption risk

For each of the natural capital assets and drivers of environmental change identified above, the tool provides spatial data showing where disruption risk is highest. Users can focus on the geographical areas where the businesses in their portfolio have production centres to visualise natural capital risk for these locations. High disruption risk identified in this way can be flagged for further analysis and appropriate risk management or mitigation measures.

EXAMPLE 2: DROUGHT AND ITS POTENTIAL IMPACT ON CREDIT RISK IN AGRICULTURE

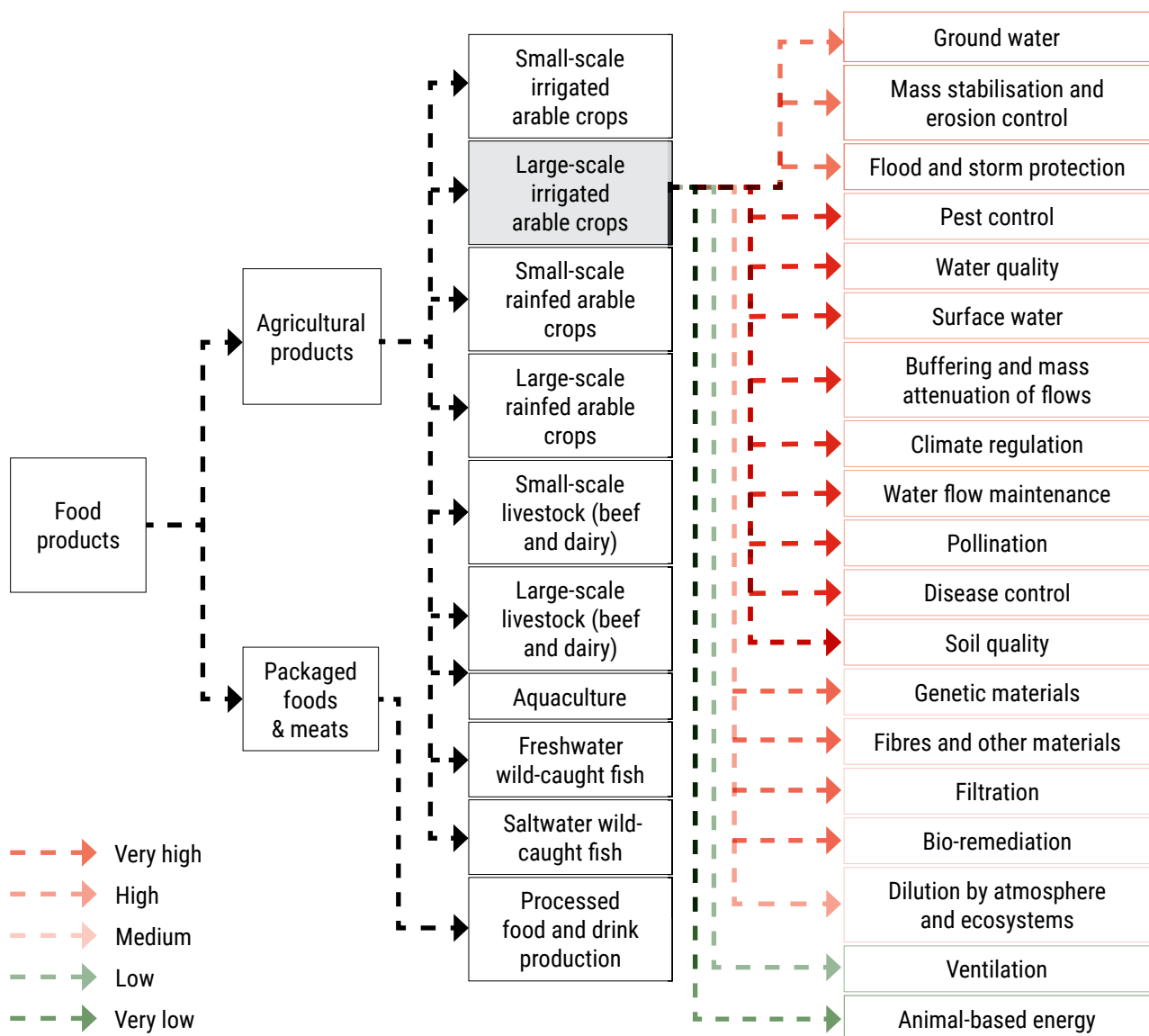## Step 1: Select driver of environmental change

Choose a driver of environmental change based on expected or current risk factors. For example, if operating in a country that is experiencing higher volatility of rainfall, a relevant driver of change might be drought.

Step 2: Select natural capital asset

The driver of change will influence various natural capital assets and therefore the provision of many ecosystem services provided by these assets. For example, drought is linked to provision of water and is considered of high materiality for agriculture production processes.

Step 3: Assess ecosystem service disruption risk

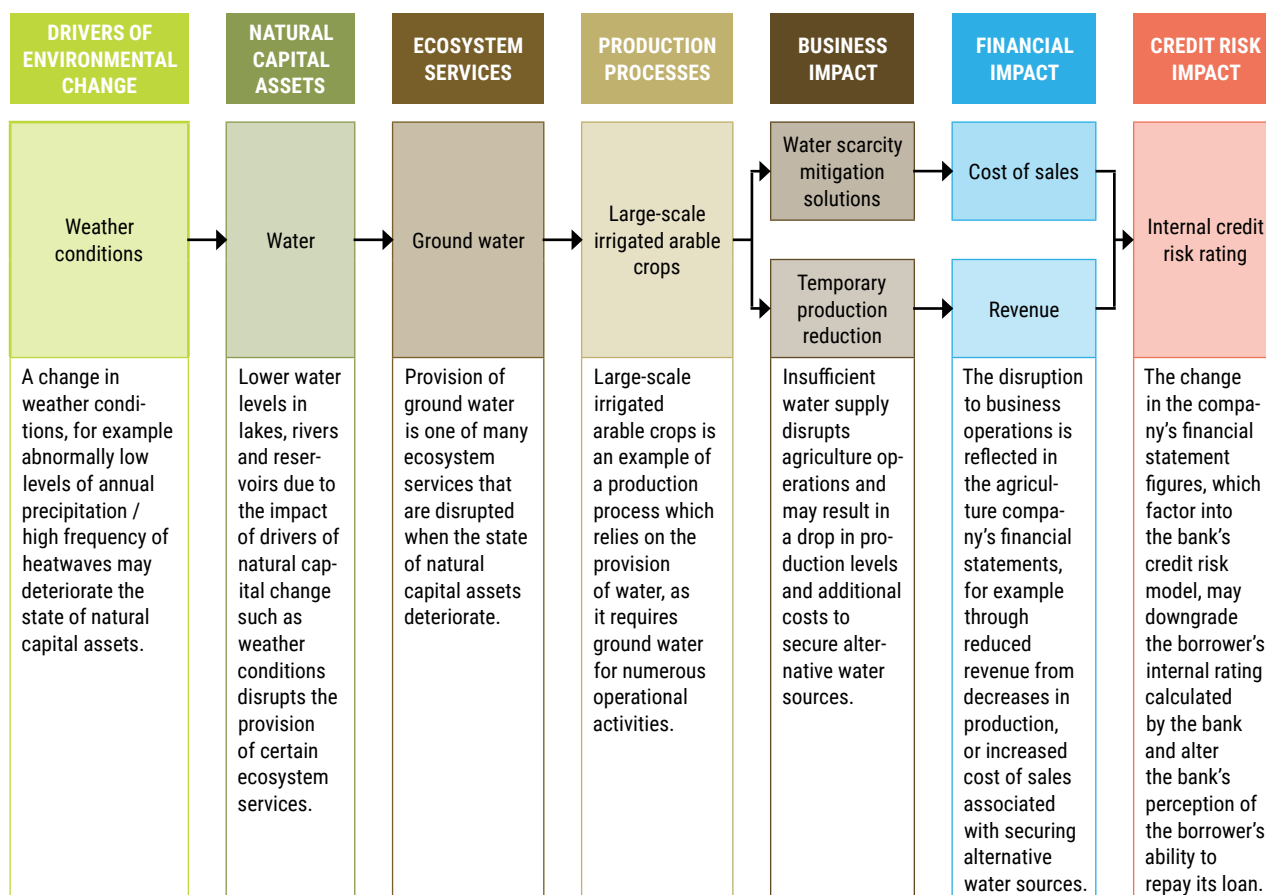Once material ecosystem services have been identified, the potential financial implications of the resulting water stress can be assessed.

Figure 10: Linking the food industry to material ecosystem services: example of the large-scale irrigated arable crops production process

Exploring Natural Capital Opportunities, Risks and Exposure
Natural capital dependency risk assessment in practice

Step 4: Integrate into credit risk model

Once the financials have been determined, the information can be integrated within traditional financial analysis such as a credit risk model.

DRIVERS OF ENVIRONMENTAL CHANGE	NATURAL CAPITAL ASSETS	ECOSYSTEM SERVICES	PRODUCTION PROCESSES	BUSINESS IMPACT	FINANCIAL IMPACT	CREDIT RISK IMPACT
Weather conditions	Water	Ground water	Large-scale irrigated arable crops	Water scarcity mitigation solutions / Temporary production reduction	Cost of sales / Revenue	Internal credit risk rating
A change in weather conditions, for example abnormally low levels of annual precipitation / high frequency of heatwaves may deteriorate the state of natural capital assets.	Lower water levels in lakes, rivers and reservoirs due to the impact of drivers of natural capital change such as weather conditions disrupts the provision of certain ecosystem services.	Provision of ground water is one of many ecosystem services that are disrupted when the state of natural capital assets deteriorate.	Large-scale irrigated arable crops is an example of a production process which relies on the provision of water, as it requires ground water for numerous operational activities.	Insufficient water supply disrupts agriculture operations and may result in a drop in production levels and additional costs to secure alternative water sources.	The disruption to business operations is reflected in the agriculture company's financial statements, for example through reduced revenue from decreases in production, or increased cost of sales associated with securing alternative water sources.	The change in the company's financial statement figures, which factor into the bank's credit risk model, may downgrade the borrower's internal rating calculated by the bank and alter the bank's perception of the borrower's ability to repay its loan.

Figure 11: Possible analysis of drivers of environmental change and their impact on credit quality

Once the drivers of environmental change, the state of natural capital assets in the relevant region and links to ecosystem service provision have been reviewed, the financial institution can consider risk management actions to address the newly uncovered risk

CONCLUSION

Environmental change is global and accelerating, affecting all financial institutions through their operations and financing decisions. Financial institutions need to be prepared for this new reality, if they want to identify and manage these emerging risks.

ENCORE is the first tool that allows financial institutions to easily assess their exposure to natural capital risk in a systematic and comprehensive manner. This is especially important at a time when financial institutions are under increasing scrutiny in terms of the impact of climate change and other environmental issues on their portfolios.

We call on financial institutions to start exploring natural capital risk today. Only by understanding their exposure, assessing it, and ultimately integrating these considerations in their operations can financial institutions ensure that they are ready for a world of accelerating environmental change.

ACKNOWLEDGEMENTS

ABOUT THE NATURAL CAPITAL FINANCE ALLIANCE

The Natural Capital Finance Alliance (NCFA) is a finance sector led initiative, providing expertise, information and tools on material aspects of natural capital for financial institutions. It works to support these institutions in integrating natural capital considerations into their risk management processes and products as well as helping them to discover new opportunities. The NCFA secretariat is run jointly by the UN Environment Finance Initiative and Global Canopy.

For more information, contact the NCFA at: info@naltural capital.finance

ABOUT THE UN ENVIRONMENT WORLD CONSERVATION MONITORING CENTRE

The UN Environment World Conservation Monitoring Centre (UNEP-WCMC) is a world leader in biodiversity knowledge. We work with a global network of scientists and policymakers to place biodiversity and natural capital at the heart of environment and development decision-making. By improving access to high-quality information and analyses, we empower global leaders to make enlightened choices for people and the planet.

Our team comprises experts in biodiversity and ecosystem services for marine, freshwater and terrestrial environments, together with social scientists, ecological modellers, economists, lawyers, geographic information system specialists, policy analysts, data managers and software programmers.

We have unrivalled understanding of the institutional landscape surrounding biodiversity policy and ecosystem management, built on strong connections with government, intergovernmental platforms, private sector organisations and civil society bodies. Together with our visiting fellows we offer an internationally diverse team - many are recognized leaders in their field - with a worldwide reach.

Based in Cambridge UK, UNEP-WCMC is a unique collaboration between UN Environment and the UK registered non-profit, WCMC. Established over 35 years ago, the Centre has built a worldwide reputation for reliable and effective ways to apply our knowledge and expertise to address the needs of our clients and partners, providing knowledge that makes a world of difference.

AUTHORS

This report was prepared by Anders Nordheim (UNEP FI), Martin Halle (NCFA), and Katie Leach (UNEP-WCMC), with inputs from Lisa Petrovic (NCFA), Annelisa Grigg (UNEP-WCMC), Matt Jones (UNEP-WCMC), and James Hulse (NCFA).

ADDITIONAL CONTRIBUTIONS

PricewaterhouseCoopers LLC undertook the work on assessing the materiality of ecosystem services to each production process.

The Norwegian University of Science and Technology (NTNU) undertook the work of mapping sector supply chains using multi-regional input-output models.

APPENDIX

DEFINITIONS

Ecosystem service	The most important ecosystem services to the economy, in that they are material to a large number of sectors, are those related to water – ground water provision, surface water provision, and water flow maintenance. Climate regulation, both at a local and global level, is also a highly material ecosystem service for many business sectors. Finally, nature's role in reducing and managing a range of risks and hazards such as floods and landslides is also highlighted as material to large parts of the economy (see Figure 10)
Economic sector	Economic sectors were classified according to the Global Industry Classification Standard (GICS; https://www.msci.com/gics) which comprises a four-level hierarchical structure with 11 sectors, 24 industry groups, 68 industries and 167 sub-industries. Sub-industries were then linked to specific production processes to capture dependencies within each process which may not be captured at the sub-industry level, for example the chemicals sector includes a number of processes, such as fractional distillation, with potentially different ecosystem service dependencies. The use of production processes within sectors, as opposed to just sectors, allows the economy to be re-mapped using a different economic classification if needed.
Driver of environmental change	Factors that trigger changes in the status, extent, or spatial configuration of natural capital assets
Natural capital	The stock of ecosystems that yields a renewable flow of goods and services that underpin the economy and provide inputs and direct and indirect benefits to businesses and society
Natural capital asset	The specific components of natural capital, such as water, atmosphere or land, that provide ecosystem services
Natural capital dependency	A business reliance on or use of natural capital
Natural capital impact	The negative or positive effect of business activity on natural capital
Natural capital risk	For the purpose of this project, natural capital risk was defined as the risk of reduction or interruption of the benefits that humans and their economy receive from nature, as a result of environmental change

LIST OF ENCORE CATEGORIES

Production processes	Airport services	Marine ports and services
	Alcoholic fermentation and distilling	Marine transportation
	Alumina refining	Membrane technology
	Aquaculture	Metal processing
	Biomass energy production	Mining
	Cable and satellite installations on land	Natural fibre production
	Catalytic cracking, fractional distillation and crystallization	Natural gas combustion
	Construction	Nuclear and thermal power stations
	Construction materials production	Oil and gas drilling
	Cruise line provision	Oil and gas exploration surveys
	Cryogenic air separation	Oil and gas refining
	Distribution	Oil and gas services
	Electric/nuclear power transmission and distribution	Oil and gas storage
	Electronics and hardware production	Oil and gas transportation
	Environmental and facilities services	Paper packaging production
	Fibre-optic cable installation (marine)	Polymerization
	Financial services	Processed food and drink production
	Footwear production	Production of forest and wood-based products
	Freshwater wild-caught fish	Production of forest products (non-paper)
	Gas adsorption	Production of leisure or personal products
	Gas distribution	Production of paper products
	Gas retail	Provision of health care
	Geothermal energy production	Railway transportation
	Glass making	Real estate activities
	Hotels and resorts provision	Recovery and separation of carbon dioxide
	Houseware and specialities production	Restaurant provision
	Hydropower production	Saltwater wild-caught fish
	Incomplete combustion	Manufacture of semiconductor equipment
	Infrastructure builds	Small-scale forestry
	Infrastructure holdings	Small-scale irrigated arable crops
	Infrastructure maintenance contracts	Small-scale livestock (beef and dairy)
	Integrated oil and gas	Small-scale rainfed arable crops
	Iron extraction	Solar energy provision
	Iron metal production	Solids processing
	Jewellery production	Steel production
	Large-scale forestry	Synthetic fertilizer production
	Large-scale irrigated arable crops	Synthetic fibre production
	Large-scale livestock (beef and dairy)	Telecommunication and wireless services
	Large-scale rainfed arable crops	Tobacco production
	Leisure facility provision	Tyre and rubber production
	Life science, pharma and biotech manufacture	Vulcanisation
	Life science, pharma and biotech tools and services	Water services (e.g. waste water, treatment and distribution)
	Managed health care	Wind energy provision
	Manufacture of life science, pharma and health care equipment	
	Manufacture of machinery, parts and equipment	

Ecosystem services	Animal-based energy Bio-remediation Buffering and attenuation of mass flows Climate regulation Dilution by atmosphere and ecosystems Disease control Fibres and other materials Filtration Flood and storm protection Genetic materials	Ground water Maintain nursery habitats Mass stabilisation and erosion control Mediation of sensory impacts Pest control Pollination Soil quality Surface water Ventilation Water flow maintenance Water quality
Natural capital assets	Atmosphere Habitats Land geomorphology Minerals	Ocean geomorphology Soils and sediments Species Water
Drivers of environmental change	Diseases Droughts Earthquakes Fire Flooding Landslides Habitat modification Human modification of genetic material Human movement Industrial or domestic activities Industrial or domestic construction Intensive agriculture and aquaculture Invasive species	Ocean acidification Ocean current and circulation Overfishing Overharvesting Overhunting Pests Pollution Population changes Sea level rise Sea surface temperature Storms Volcanoes Water abstraction Weather conditions