Impact on Ecosystem Services – A Return on Investment

Assessing impacts on ecosystem services and the value of these services in the financial sector

July 2024

PBAF Partnership for Biodiversity Accounting Financials

Foundation for Sustainable Development

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Partnership for Biodiversity Accounting Financials

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EXECUTIVE SUMMARY

Background
Nature and nature-related (financial) risks and opportunities are increasingly gaining attention in the financial sector. A rapidly growing variety of tools is being used to assess the exposure of portfolios to impacts on biodiversity and dependencies on ecosystem services. However, the focus on *impacts* on ecosystem services and the value of these services is still limited, even though such impacts may trigger nature-related financial risks and may create opportunities for nature based solutions, benefiting both nature and society, and innovative financing mechanisms like payments for ecosystem services and blended finance.

The Netherlands Ministry of Agriculture, Fisheries, Food Security and Nature asked the Partnership for Biodiversity Accounting Financials (PBAF) and the Foundation for Sustainable Development (FSD) to execute a capacity building project focusing on the assessment of impacts on ecosystem services and the valuation of these services, and to explore how this knowledge can be integrated in financial decision making. The project combined desk research and discussions with financial institutions in three meetings of a PBAF Working group on Ecosystem services.

Ecosystem services, nature-related risks and opportunities and the regulatory context
Ecosystem services are the benefits that humans receive from nature. They highlight the intricate connection and dependence of our societies and economies on ecosystems, and their contribution to human welfare. In practice, ecosystem services can be divided in four main categories: provisioning services, regulating services, habitat services and cultural services.

An assessment of (potential, expected) impacts on ecosystem services, their value and the stakeholders affected plays a key role in the identification of nature-related financial risks and opportunities. Impacts and changes in value resulting from private finance can trigger both physical risks and transition risks not captured by more common assessments of impacts on biodiversity and dependencies on ecosystem services. Analysing these risks and opportunities is a vital step in the LEAP process (Locate, Evaluate, Assess, Prepare) of the Taskforce on Nature related Financial Disclosures (TNFD) and is necessary when reporting according to the Corporate Sustainability Reporting Directive (CSRD). Moreover, the references to ecosystem services within the targets of the Kunming Montreal Global Biodiversity Framework (GBF) and the potential role of ecosystem services valuation in unlocking private finance (e.g., through blended finance) emphasizes the need to both assess and value impacts on ecosystem services.

Investing in ecosystem services and sustainable landscapes
An analysis of the changes in ecosystems, ecosystem services and their value plays an important role in decision making regarding Nature-based Solutions (interventions to address societal challenges through the protection, sustainable management and restoration of ecosystems, benefiting both biodiversity and human well-being), providing direction to the development of such solutions and providing insight in the gains and losses compared to traditional/grey solutions.

Not all ecosystem services have a direct market value, affecting the business case of investing in nature, Nature based Solutions and sustainable landscapes. However, by assessing impacts on ecosystem services and the changes in value, the door opens to new financing mechanisms like Payments for Ecosystem Services (PES) and blended finance, combining both private and public finance. Both finance mechanisms, which need to be tailored to national and local situations, constitute important opportunities to develop ‘bankable’ projects where ‘the beneficiary pays’ for the ecosystem services supported.

Assessment of impacts on ecosystem services and their value
An assessment of impacts on ecosystem services and their value requires location specific data on the changes in ecosystem type, ecosystem extent, ecosystem condition and the context where these changes take place. In the valuation step, two broad kinds of values of ecosystem services are recognized, direct and indirect use values and a non-use values. Direct use values relate to ecosystem services which can be measured via traditional market logic and have a *Direct Market Value* (DMV) through supply and demand. Examples are water, timber or agricultural produce. Indirect use values relate to ecosystem services which cannot be extracted, like most regulating services (e.g., pollination, flood control). Indirect use value can be measured via *Indirect Market Value* (IMV), including 'shadow prices' and 'damage costs'.

The *Total Economic Value (TEV)* reflects the total bundle of ecosystem services provided by a particular ecosystem, for a specific area, per year. The TEV enables a comparison of the monetary values different scenarios, like a business-as-usual scenario compared to an investment scenario. Using the TEV-data, the *Net Present Value (NPV)* can be calculated. The NPV takes the time horizon of an investment into account. It is calculated by using projections of the flows of the total bundle of ecosystem services from a given ecosystem, over a given time period, at a certain discount rate. Both TEV and NPV can be used to assess and compare investments that result in changes in ecosystems services.

To facilitate assessing the impact of changes in land cover and biodiversity on ecosystem services in monetary terms, the Ecosystem Services Valuation Database (ESVD) was developed. Work on the ESVD started in 2008 as a contribution to the UN-supported 'The Economics of Ecosystems and Biodiversity' (TEEB) study. The ESVD is currently the largest publicly available database with standardized monetary values for all ecosystem services and all biomes on all continents.

Integration of ecosystem services impacts and value in the loan and investment process
Familiarizing financial institutions with an assessment of impacts on ecosystem services and a valuation of the services affected will require a step-by-step approach. Clearly explaining how this assessment complements an assessment of impacts on biodiversity and dependencies on ecosystem services, and how the results can be combined to identify potential risks and opportunities.

An assessment of impacts on ecosystem services and their value is limited to loans and investments for which the location is known and information is available on the expected/planned changes in ecosystem type, extent, and (preferably) condition. In practice this means a limitation to project finance and direct loans. This may change over time, when more location data of assets becomes available.

Financial institutions can conduct an assessment of impacts on ecosystem services and their value themselves, using local knowledge, maps of ecosystem types and condition and data from the ESVD. However, certain decisions regarding the selection of ecosystem type, the in- or exclusion of ecosystem services and the valuation of these services will require expert judgement by experienced experts.

The assessment fits best within the due diligence step of the loan and investment process, adding value to the analysis of potential loans and investments and informing loan and investment conditions. Data gathering can be combined with the collection of data already taking place, e.g., through the use of questionnaires and field visits.

Key performance indicators based on Total Economic Value (TEV) or Net Present Value (NPV) can be developed by financial institutions to set targets and monitor performance, both on a project/single investment level and on portfolio level. The result can be linked to other targets of financial institutions, like contributions to the sustainable development goals (SDGs) which are often directly linked to the provision of specific ecosystem services.

GLOSSARY

In this glossary, definitions and explanations are provided of the main concepts financial institutions will come across when looking into the impacts on ecosystem services and the value of these services. As far as possible, these definitions and explanations are aligned with definitions and explanations already provided by the Taskforce on Nature-related Financial Disclosures (TNFD), the Science Based Target Network (SBTN) and the Aligning Accounting Approaches for Nature project (ALIGN).

Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Dependency	A business reliance on or use of biodiversity and associated ecosystem services.
Direct dependencies	Dependencies occurring in scope 1 or the direct operations of a company.
Indirect dependencies	Dependencies occurring upstream or downstream in the value chains of a company.
Ecosystem	A dynamic complex of plants, animals, and microorganisms, and their non-living environment, interacting as a functional unit (e.g. deserts, coral reefs, wetlands, and rainforests).
Ecosystem condition/integrity[1]	The quality of an ecosystem measured in terms of its abiotic and biotic characteristics. Condition is assessed with respect to an ecosystem's composition, structure and function which, in turn, underpin the ecological integrity of the ecosystem, and support its capacity to supply ecosystem services on an ongoing basis. Measures of ecosystem condition may reflect multiple values and may be undertaken across a range of temporal and spatial scales.
Ecosystem type	A distinct set of abiotic and biotic components and their interactions (UN SEEA. 2021). Note that countries may have different classifications of ecosystem types, which may have implications for adherence to the equivalency principle, notably in the context of no-net-loss requirements. The IUCN has developed a Global Ecosystem Typology (GET) to support the development of its Red List of Ecosystems, however a standardised, universal classification system for ecosystems does not currently exist.
Ecosystem services	The contributions of ecosystems to the benefits that are used in economic and other human activity.
Materiality	An impact or dependency on biodiversity is material if consideration of its value, as part of the set of information used for decision-making, has the potential to alter that decision.
Natural Capital	The stock of renewable and non-renewable natural resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people.
Natural capital assets	Natural capital assets are specific elements within nature that provide the goods and services that the economy depends on.
Nature Based Solutions	Nature-based Solutions (NbS) are actions to address societal challenges through the protection, sustainable management and restoration of ecosystems, benefiting both biodiversity and human well-being

[1] Ecosystem condition and ecosystem integrity are often used interchangeably. While ecosystem condition refers to the overall quality of an ecosystem in terms of its characteristics, ecosystem integrity looks at the extent to which composition, structure, and function of an ecosystem fall within their natural range of variation.

1. INTRODUCTION

1.1 Background

Nature and nature-related (financial) risks and opportunities are increasingly gaining attention in the financial sector. A rapidly growing variety of tools is being used to assess the exposure of portfolios to impacts on biodiversity and dependencies on ecosystem services. However, the focus on *impacts* on ecosystem services and the value of these services is still limited, even though such impacts may trigger nature-related financial risks and may create opportunities for nature based solutions, benefiting both nature and society, and innovative financing mechanisms.

Target 19 of the Global Biodiversity Framework (GBF) of the Convention on Biological Diversity (CBD) of the United Nations calls for the promotion of innovative ways to finance ecosystem services. However, knowledge of the impact of loans and investments on ecosystem services, the (monetary) value of ecosystem services and how this can be integrated into decision-making in the financial sector is still in its early stages.

To facilitate the uptake of nature-inclusive investments, increasing knowledge of the impact on and the value of ecosystem services among financial institutions is necessary. The Netherlands Ministry of Agriculture, Fisheries, Food Security and Nature has asked the Partnership for Biodiversity Accounting Financials (PBAF) and the Foundation for Sustainable Development (FSD) to execute a capacity building project focusing on the assessment of impacts on ecosystem services and the valuation of these services, and to explore how this knowledge can be integrated in financial decision making, stimulating nature-inclusive finance and enabling the identification of new financing mechanisms.

The Partnership for Biodiversity Accounting Financials (PBAF)
The Partnership for Biodiversity Accounting Financials (PBAF)[2] supports the harmonization and mainstreaming of biodiversity data and biodiversity impact and dependency assessment in the financial sector through the development of the 'PBAF Standard'. PBAF provides practical guidance to financial institutions on biodiversity impact and dependency assessment and defines what is needed for these assessments (either or not conducted by data providers), to deliver information to financial institutions which is science based, robust, consistent, transparent and fit for purpose. With this information financial institutions can effectively manage and report on nature related risks and opportunities and contribute to the conservation and sustainable use of biodiversity. The PBAF Standard is updated periodically to reflect the progress in methodology development and the availability of data. In the 2022 version of the PBAF Standard, the use of biodiversity footprinting is discussed[3]. In 2023, the PBAF Standard was expanded to the assessment of dependencies on ecosystem services[4]

The Foundation for Sustainable Development (FSD)
The need for sustainable development is widely recognized, but human society is still far from achieving a sustainable relationship with the natural environment. On a global scale, ecosystem degradation and loss of biodiversity continue at an alarming rate. The main purpose of sustainable development is to safeguard the long-term health of the biosphere, our only life-support system in an otherwise harsh cosmic environment. An integrated approach to man-environment interactions is essential to bridge the gap between long-term ecological goals and short-term economic interests. FSD was initiated in response to these challenges.

2 PBAF was initiated by the financial sector and currently has 57 partners and supporters from 15 countries (November 2023), all financial institutions

3 PBAF, Taking Biodiversity into account, PBAF Standard v2022 – Biodiversity impact assessment – Footprinting

4 PBAF, Taking Biodiversity into account, PBAF Standard v2023 – Assessment of Dependencies on ecosystem services, June 2023

Within the context of The Economics of Ecosystems and Biodiversity (TEEB), FSD developed a database on the monetary values of ecosystem services and published it in 2010. The rationale for developing the TEEB database of monetary value estimates was to provide information on the benefits of biodiversity conservation and the costs of biodiversity loss as input for policy appraisal and global biodiversity and conservation strategies. After several years of interest and further development, the database became the Ecosystem Services Valuation Database (ESVD).

Currently, the ESVD contains over 10.000 monetary values and is thereby the largest open-access database with standardized monetary values for all ecosystem services and all ecosystems globally. The data in the ESVD comes from over 30 years of peer-reviewed academic research and official reports on the monetary valuation of ecosystem services.

1.2 Project objectives and activities

Objective
The overarching objective of this project is to build the capacity of financial institutions regarding the assessment of impacts on ecosystem services and the valuation of services, associated opportunities and risks, and the integration of this knowledge into the loan and investment process.

More specifically, the project aims to provide insight in:

- The concept of ecosystem services and the monetary valuation of ecosystem services.
- The impacts of loans and investments on ecosystem services and the (monetary) value of these services.
- How this impact and value translates into nature-related (financial) risks and opportunities.
- How this knowledge can be integrated in financial decision making.
- The opportunities for new investment mechanisms (such as blended finance).

Project activities
To facilitate knowledge exchange:

- A PBAF Working group Ecosystem Services was established. This working group complemented other PBAF working groups in 2023/2024 focusing on Positive impact, Agriculture, Asset Management and Regulation. PBAF partners and supporters (financial institutions) were invited to participate in the working group resulting in a group of 20 financial institutions from 10 different countries (participating with one or more persons). The working group met three times. Through the working group, facilitated by experts, information on the assessment of impacts on ecosystem services and their value was shared and discussed.
- The results of the working group were used as an input to this (public) report and a Q&A to be developed and published by PBAF.

Desk research was conducted to prepare for the working group meetings and to complement the information generated in working groups. The topics discussed in the working meetings were:

Meeting 1: Introduction to ecosystem services impact assessment & valuation and use cases.

- Introduction to ecosystem services impact assessment and valuation.
- The role of ecosystem services impact assessment and valuation in the assessment of nature-related financial risks and opportunities, as described in the disclosure framework of the Taskforce on Nature related Financial Disclosures (TNFD).
- The role of ecosystem services impact assessment and valuation in the Corporate Sustainability Reporting Directive (CSRD).
- Main topics of interest of the working group participants.

This inventory of topics of interest showed that participants were particularly interested in increasing their knowledge about the impacts on ecosystem services and the linkages with regulations and financial risks.

Meeting 2: Deep dive in ecosystem services valuation and impact assessment

- Technical background of insights in the methodologies of valuing and monetizing different types of ecosystem services and the relation to uptake in economic value.
- Framework of doing an ecosystem services valuation analysis.
- Illustration of an ecosystem services impact & valuation assessment by means of a practical case study.

Meeting 3: Use of ecosystem services impact assessment and building the business case

- The linkages between ecosystem services impact assessment and nature-related financial risks.
- Steps for a financial institution in an ecosystem services impact & valuation assessment.
- Planning of an ecosystem services impact & valuation assessment in the loan and investment process.
- The use of Key Performance Indicators.
- Nature-inclusive investment opportunities.

Some of the key discussions in the working groups are shared in this document. Not by quoting any of the participating financial institutions (meetings took place under 'Chatham House Rule'), but by highlighting main points of interest.

1.3 Reader

The results of the desk research and working group meetings are presented in this document. The report covers the followings chapters.

Glossary
Definitions of the most important concepts relevant to an assessment of impacts on ecosystem services and their value are included in the glossary.

Chapter 2: Ecosystem services, their value and nature-related financial risks and opportunities
The concept of ecosystem services is introduced in chapter 2, including an explanation of different types of ecosystem services, their value and how this value can be measured. In addition, the role of ecosystem services in nature-related risks and opportunities is discussed.

Chapter 3: Ecosystem services in a regulatory context
This chapter discusses the role of ecosystem services in international nature-related policy and regulation, including, among others, the Global Biodiversity Framework and the Corporate Sustainability Reporting Directive (CSRD).

Chapter 4: Assessing impacts on ecosystem services and their value
This chapter shows how an assessment of impacts on ecosystem services and the valuation of these services complements other assessments, like an assessment of impacts on biodiversity and dependencies on ecosystem services. In addition, the steps in an ecosystem services impact assessment and valuation using the Ecosystem Services Valuation Database (ESVD) are presented and explained.

Chapter 5: Integration in the loan and investment process
In this chapter, the integration of an assessment of impacts on ecosystem services in the loan and investment process is discussed, including the data need and use of the results.

Chapter 6: Conclusions and next steps
Based on the desk research and PBAF working group meetings, conclusions and next steps are formulated regarding the assessment of impacts on ecosystem services and their value and the use by financial institutions.

An overview of sources used is included in the ‘Sources’ section.

Annexes:
Annex 1 provides additional information on the SEEA-EA ecosystem accounting framework.
Annex 2 provides an overview of the valuation methodologies applied by the ESVD.

2 ECOSYSTEM SERVICES, THEIR VALUE AND NATURE-RELATED FINANCIAL RISKS

2.1 Introduction

Over recent decades, there has been a significant loss of biodiversity globally, driven by land- and sea-use change, resource exploitation, climate change, pollution and the introduction of invasive alien species. Indicators from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) show alarming trends, with a 47% decline in plant and animal species on average and 25% of assessed species under threat.

In 2003, the Millennial Ecosystem Assessment was released putting the concept of ecosystem services and the monetary valuation of ecosystem services firmly on the political agenda. This study was followed by other important studies like 'The Economics of Ecosystems and Biodiversity' (TEEB, 2016) and 'Nature's Worth to Society' (the 'Dasgupta Review', 2021), both stressing the value of and the need to value ecosystem services.

In this chapter, the concept of ecosystem services is introduced, including their classification and monetary value (sections 2.2-2.4) and the role of ecosystem services in nature-related risks (section 2.5) and opportunities (section 2.6), including the TNFD disclosure framework (section 2.7).

2.2 Ecosystem services

Ecosystem services are *the benefits that humans receive from nature*. Ecosystem services highlight the intricate connection and dependence of our societies and economies on ecosystems, and their contribution to human welfare. The concept of ecosystem services and their economic valuation helps to translate ecological information into economic and policy-relatable terms. The importance of ecosystem services as the basis of our societies and economies is acknowledged, implicitly and explicitly, in different frameworks and directives mentioned throughout this report, such as the Global Biodiversity Framework (GBF, see section 3.2.)

Categories of ecosystem services
In practice, ecosystem services can be divided in four main categories (TEEB, 2016):

- **Provisioning services** are the products or resources that can be harvested or extracted from ecosystems (food, water raw materials, genetic resources, medicinal resources and ornamental resources).
- **Regulating services** are the benefits obtained from ecosystem processes that maintain environmental conditions beneficial to individuals and society (climate regulation, air quality regulation, moderation of extreme events, regulation of water flows, waste treatment, erosion prevention, maintenance of soil fertility, pollination, biological control
- **Habitat services** are the benefits provided by protecting a minimum area of natural ecosystems to allow evolutionary processes needed to maintain a healthy gene pool and by providing essential space in the life cycle of migratory species, many of which have commercial value elsewhere (notably the nursery service of mangroves and other coastal systems).
- **Cultural services** are the experiential and intangible benefits related to the perceived or actual qualities of ecosystems (e.g., spiritual experience, cognitive development,

recreation, aesthetic enjoyment, inspiration for culture and art and the appreciation of the existence of diverse habitats and species).

The concept of ecosystem services links natural systems to social and economic systems and losses and gains in ecosystem services can be linked to *beneficiaries or stakeholders*.

On an international level, data about landscapes, ecosystem services and the linkages to economic and human activities are structured by the System of Environmental Economic Accounting - Ecosystem Accounting, the SEEA-EA framework. See annex 1 for more information.

2.3 The monetary value of ecosystem services

2.3.1 Creating a common language

The concept of ecosystem services and their monetary value helps to translate ecological information into a more common language: euros and dollars. NB: *valuation* of ecosystem services is not the same as *pricing* of ecosystem services. Monetary valuation describes changes in welfare as a result of changes in ecosystem services by showing the *order of magnitude* of (potential) gains and losses and a *direction of change*. This direction of change pinpoints which stakeholders are positively and negatively affected. The use of a monetary value allows stakeholders to speak a common language.

Public goods, externalities and a landscape approach

With the monetary valuation of ecosystem services, it is possible to make the value of nature visible in economic terms. Nature and ecosystem services are often considered *public goods* and are subject to *externalities* (Dasgupta, 2020). Public goods refers to goods and services which are accessible to all, such as fresh air. Externalities refer to consequences of actions for others, including future generations, which are unaccounted for. For example, a forest owned by a company cuts the forest to harvest the wood for timber production, an ecosystem service. Once the forest is cut, the timber can be sold and the owner of the forest benefits. However, once the forest is cut, it loses its capacity to provide other ecosystem services such as the regulation of air pollution. The loss of this ecosystem service impacts the broader community living around the forest, potentially resulting in an increase of respiratory illnesses.

Since a market logic cannot be applied to all ecosystem services, these services are often disregarded. Like the regulation of air pollution. However, the fact that market logic cannot be applied to all ecosystem services does not mean that ecosystem services cannot be measured in economic terms. Accounting for all ecosystem services affected in an area calls for a *landscape approach**,*** taking the connections between ecosystem services and ecosystems within a landscape into account as well as all stakeholders affected.

2.3.2 Use value and non-use value

Ecosystem services may have different types of value and these values will play a different role in an assessment of nature-related risks and opportunities (see sections 2.5 and 2.6). To understand the value and the valuation of ecosystem services, the different types of values are briefly discussed below.

There are two broad kinds of values of ecosystem services: '*use value'* and '*non-use value'* (see figure 1, de Groot et al., 2010). Different methodologies are used to measure the monetary value of these different types of values.

Use value

Use values are subdivided in 'direct' and 'indirect use values'. Direct use values are ecosystem services which can be measured via traditional market logic, they can be extracted directly and therefore have a *Direct Market Value* (DMV) via measuring supply and demand. Examples are water, timber or agricultural produce.

Many regulating ecosystem services cannot be extracted and therefore cannot be captured via DMV, but are nevertheless critical of economic and societal functioning and welfare. They can be measured via *Indirect Market Value* (IMV), including 'shadow prices' and 'damage costs'. NB: IMV refers to 'real' money, it has an effect on our economies. The welfare effect of regulating services (or 'public' services) is often high, but their value is often only considered once the ecosystem services are lost. For example, the avoided damage costs of coastal protection by mangroves or the avoided health care costs through the positive effect of trees filtering air pollutants.

Usually, regulating and habitat services are measured using the indirect market value and relate to public benefits (e.g. prevention or mitigation of off-site effects such as reduced erosion, runoff and climate change), while the economic value of provisioning and some cultural services can be measured through DMV and often involves private stakeholders (companies).

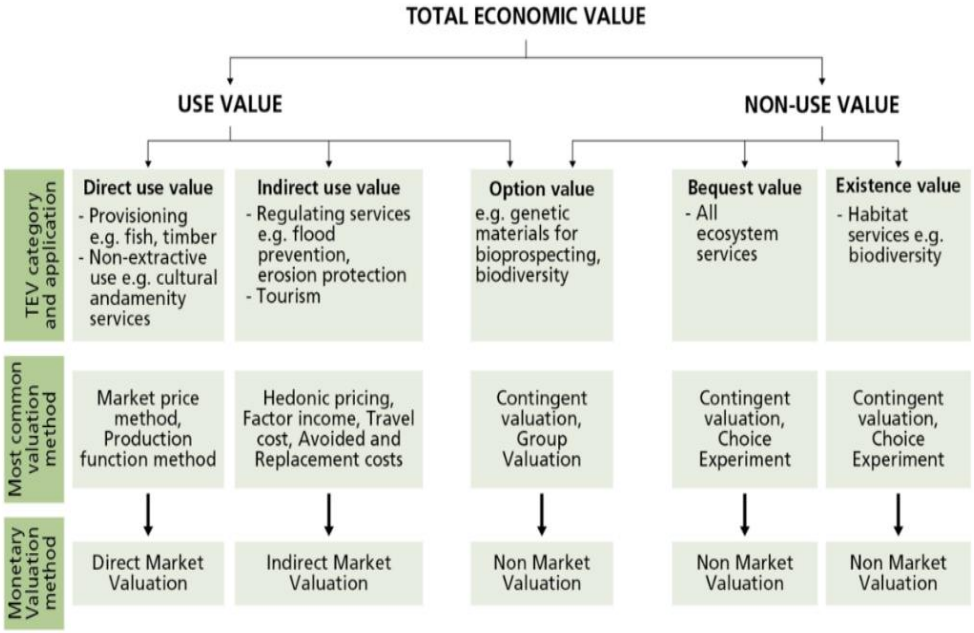

Figure 1: Types of economic values, from Groot et al., 2010

Non-use value

Non-use values relate to the importance attributed to an aspect of the environment (species, ecosystems) in addition to, or irrespective of its use values. In this case there is not a direct or indirect value that can be used to monetise the value. This *Non-Market Value* (NMV) is usually measured through questionnaires showing the Willingness to Pay (WTP) for some ecosystem services. Other ways to measure NMV is to look at donations (by individuals) or subsidies (by the community) to express the importance they place on a service. This also shows the Willingness to Pay.

The example below, a case study in Mediterranean Spain by De Groot et al (2022) in collaboration with Commonland, shows how public and private benefits and the way they are measured can differ in different land-use scenarios. The highest public benefits follow from less conventional and more natural areas, while the highest private benefits (based on 5% discount rates) follow from conventional agricultural practices. It shows that restoration of land and the subsequent increase in (public) services especially benefits the broader public, even though the services cannot be directly marketed.

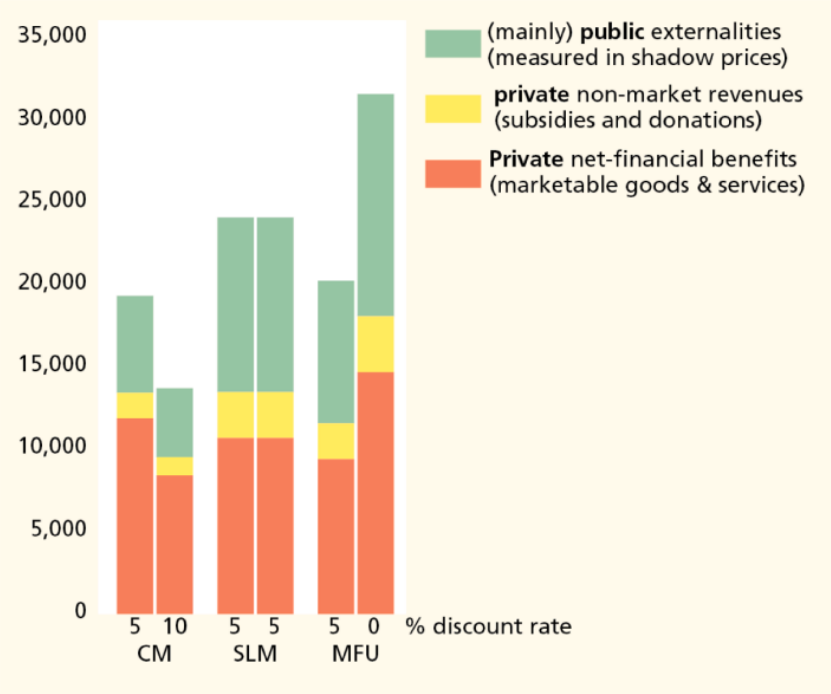

Figure 2: The distribution of benefits over private and public stakeholders. CM means conventional almond production, SLM is sustainable land management and MFU is multifunctional land use, all with different discount rates. See De Groot et all (2022) [5].

Note from the PBAF working group
A topic raised in the PBAF working group with regard to the monetary valuation of ecosystem services is that it 'commodifies' nature. By placing a price on nature, nature would become a good that can be traded on the market, a 'transaction vehicle'. This would mean that any natural area can be altered as long as a monetary transaction takes place.

Although the risk should be acknowledged, the goal of monetary valuation of nature is *not to price, but to value nature*. Monetary valuation creates a common language to indicate the order of magnitude of the value that nature represents for humans and society.

2.4 The Ecosystem Services Valuation Database (ESVD)

To facilitate assessing the impact of changes in land cover and biodiversity on ecosystem services in monetary terms, the Ecosystem Services Valuation Database (www.esvd.info) was developed. Work on the ESVD started in 2008 as a contribution to the UN-supported TEEB-study (www.teebweb.org). The ESVD is currently the largest publicly available database with standardized monetary values in dollars per hectare per year for all ecosystem services and all biomes on all continents. The rationale behind the standardization in 2020 international dollars is because it is the most commonly used currency in an international context.

The ESVD now contains almost 10,000 value records from over 1,300 studies and new values are added continuously. In recent years, the ESVD has increasingly been used in the context of private decision-making (see chapter 4 on the application of the ESVD).

[5] https://commonland.com/

The ESVD makes use of 3 internationally recognized *ecosystem services classifications*, the TEEB[6], CICES (Haines-Young & Potschin-Young (2018) and SEEA[7] classifications. For *ecosystem classifications*, the ESVD uses a modified version of the IUCN Global Ecosystem Typology (IUCN-GET) in combination with the Global Ecological Zoning framework of the FAO.

The largest share of data in the ESVD comes from peer reviewed academic articles and from official reports. A smaller share of values is derived from 'grey' literature. Although there are no universal standards for the quality of ecosystem services valuation studies, it is generally assumed that official reports and peer reviewed articles are of sufficient quality. However, there are also many grey literature studies which can be of good quality. These judgements are made on a study-to-study basis by ESVD ecosystem services valuation experts. Additionally, the data in the ESVD is subject to review by external ecosystem services experts, scientists who have been working in the field and have gained reputation in the field over several years. Moreover, several automated quality checks are in place to ensure that the data entered is correct. Finally, the data is open source and the ways in which the data is extracted is transparent and can be found on the ESVD.net.

Note from the PBAF working group
The legitimacy and the valuation methodologies used in the ESVD were an important point of discussion in the working group, illustrating the need for transparency and the extra value of an independent standard for the valuation of ecosystem services.

Table 1 below describes the types of values in the ESVD and the corresponding methodologies (for more explanation of the valuation methods, see Annex 2). The linkages to the different types of value described in section 2.3.2 is indicated by different colors. In maroon the methodologies which relate to Non Market Value, in green methodologies related to Indirect Market Value and in blue methodologies related to Direct Market Value.

Table 1: The different valuation methods used in the ESVD, the number of monetary values related to each valuation method and the maximum monetary value allocated to each valuation method.

Valuation methods	Count	Maximum value
Choice experiments	747	$ 78,992,969
Contingent valuation	359	$ 17,561,805
Travel costs	368	$ 6,561,337
Replacement costs	39	$ 3,704,190
Hedonic pricing	1894	$ 1,051,330
Market price	591	$ 774,767
Factor Income	357	$ 389,622
Production function	322	$ 160,283
Input output modelling	29	$ 58,664
Damage costs	653	$ 51,488
Opportunity costs	34	$ 22,017
Social cost of carbon	117	$ 8,411
Public pricing	24	$ 7,375
Group valuation	54	$ 6,359
Defensive expenditure	8	$ 3,983
Replacement costs	14	$ 2,996

The Non-Market Value (NMV) for ecosystem services which cannot be integrated in traditional market logic and relate to public benefits/stakeholders, have the largest representation in the ESVD, including the largest maximum value. Indirect Market Value (IMV), including several

6 https://www.esvd.info/classifications
7 https://seea.un.org/ecosystem-accounting

damage cost methodologies which are usually only visible after the loss or degradation of an ecosystem and also benefit the general public at large, are also very frequent in the ESVD. This indicates that much of the ecosystem services research and valuation falls outside of traditional market logic. This raises the question how to integrate this in public and private decision-making in a system were conventional economic systems prevail.

2.5 Nature related financial risks

2.5.1 Introduction

The World Economic Forum (WEF) and PwC showed that over half of the world's GDP, 44 trillion dollars, is moderately or highly dependent on ecosystems and their services (Herweijer, 2020). The Organisation for Economic Co-operation and Development (OECD) estimates that the global economy is highly dependent on pollinator services for the production of crops, having an added value ranging from USD 235 billion to USD 577 billion.

These figures underline the fact that preserving biodiversity and preventing degradation of natural systems is essential to maintain healthy ecosystems that can provide the ecosystem services which are fundamental for our economies and personal and societal well-being.

However, the costs of ecosystem degradation and biodiversity and ecosystem services losses are often not reflected on investment balance sheets or annual reports because most of these costs are still 'externalities', costs which are not borne by those causing them. As a result, the real value of nature is not taken into account even though the loss of biodiversity may result in significant financial risks. The repercussions of not fully valuing nature have been clearly highlighted in the Dasgupta review 'Nature's Worth to Society' (2021). The failure to account for the true value of nature leads to market distortions and underinvestment in natural assets. Aspects of nature, often taken for granted and invisible in market prices, lead to widespread externalities, hindering efficient market function.

Consequently, biodiversity loss poses increasing risks to society and businesses, including the financial sector. Reports such as "Indebted to Nature" (Van Toor et al., 2020) highlight the exposure of financial institutions to companies reliant on ecosystem services. For instance, Dutch financial institutions face EUR 510 billion in exposure through such companies globally, underscoring the imperative for financial institutions to integrate ecosystem services valuation into their decision-making processes to mitigate risks and promote sustainability.

To conceptualize and integrate these risks, frameworks to classify the risks have been developed.

2.5.2 Double materiality, physical risk, transition risk and systemic risk

The concept of 'double materiality' addresses both the risk that the loss of nature poses to the economy and financial systems ('outside in') as well as the impact (of organisations) on nature (inside out) (European Commission, 2019b). The concept of double materiality is embedded in the risk frameworks such as the Taskforce for Nature-related Financial Disclosure (TNFD) disclosure framework[8]. The TNFD distinguished three types of risks: physical risks, transition risks and systemic risks (see the figure below).

8 TNFD, 'The TNFD Nature-related Risk & Opportunity Management and Disclosure Framework; Beta v0.1 Release', March 2022

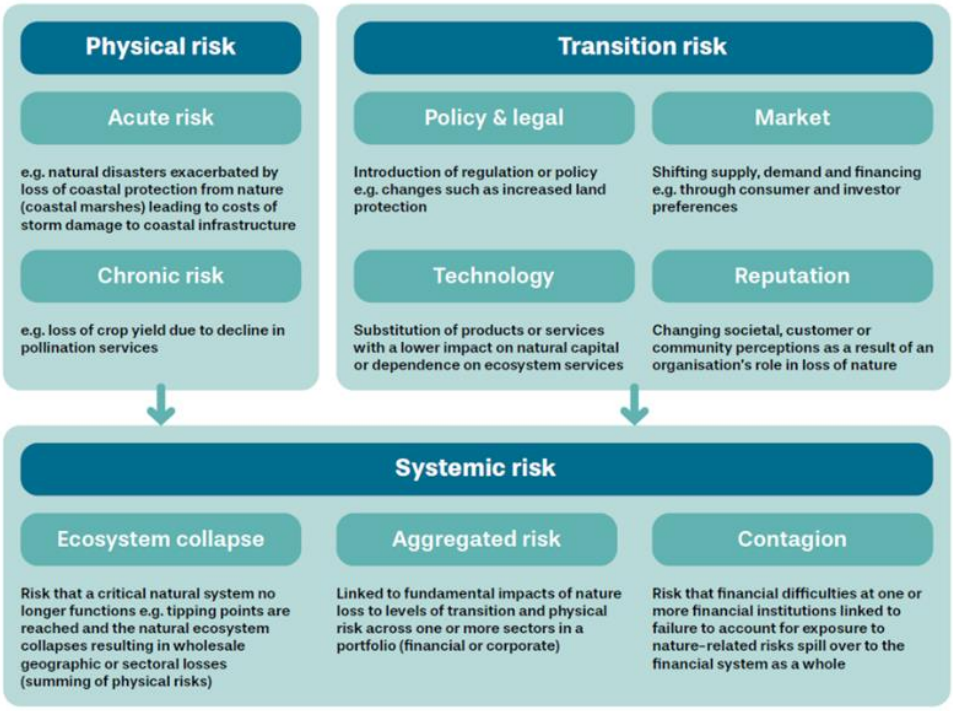

Figure 3: Nature-related financial risks (adapted from TNFD's Disclosure Framework, beta v0.1)

Physical risks
Investments are subject to physical risks when ecosystems lose the ability to provide the ecosystem services businesses depend on. An example is the loss of pollination services because of negative impacts on pollinators, affecting the yield of farmers. This reduction in ecosystem services provision can be caused by the activities of the companies affected themselves. For example, pollinators can be impacted by farmers' use of pesticides.

Example – Bending the curve (Pamuk et al, 2023)
"We find that Pollination Services Loss (PSL) reduces agricultural output, and the extent of this reduction depends on factors such as a country's dependence on pollination services (which varies by crop) and the severity of the PSL. PSL's impact on agriculture has wider economic consequences, affecting not only agricultural sectors but also nonagricultural sectors that rely heavily on agricultural inputs, such as processed food, meat, beverages, and tobacco. This can result in macroeconomic losses that vary depending on the importance of agriculture in a country's economy. For instance, a total elimination of pollination would reduce agricultural output in equilibrium by 3% in Germany and 4% in the Netherlands. We estimate this reduction in absolute terms in around USD 2bn, and USD 1.6bn annually for Germany and the Netherlands respectively."

Transition risks
Transition risks are risks financial institutions face because of changing consumer preferences and changing laws and regulations in response to the loss of biodiversity and a decrease in ecosystem services provision. Furthermore, financial institutions run reputational risks when they finance companies that have a significant negative impact on biodiversity or the ecosystem services provided by ecosystems. Sometimes these reputational risks are a precursor to regulation.

Systemic risks
Systemic risks can arise when an ecosystem, or a significant number of ecosystem services within this ecosystem, collapses, when risks aggregate across one or more sectors and when financial impacts at the level of financial institutions spill over to the financial system as a whole.

Example – Shifting precipitation patterns in the Amazon basin
The Amazon basin is slowly moving towards a drier savannah like ecosystem, with changing climate patterns. The change is currently happening slowly because most deforestation occurs in patches. But as deforestation continues, the forest loses ground and makes the regional climate drier, which is heightened by global warming. This makes the entire forest more prone to drought and wildfire as a result. If a tipping point is reached and the Amazon ecosystem shifts to a drier ecosystem, this will have enormous consequences on the millions of people depending on the Amazon rivers and forests ecosystem services for their direct livelihoods such as for fishing, tourism, but also the loss of species which could be used for medicinal purposes.

According to the Network for Greening the Financial System (NGFS, 2023), physical and transition risks can affect the economy at micro, sectoral/regional and macro levels (including effects on price stability). Economic risks can subsequently translate into financial risks that adversely affect individual financial institutions or financial systems as a whole.

Understanding and addressing these risks through the lens of double materiality is crucial for financial institutions to navigate the challenges posed by biodiversity loss and its repercussions on nature and the economy.

2.6 Nature-related financial opportunities

2.6.1 From economic benefits to financial return

Apart from potential nature-related risks, there are also clear nature-related opportunities. Every euro invested in the restoration of nature results in a return of €7 to €30 in economic benefits (Ding et al., 2017). However, since part of these economic benefits may constitute benefits which are not marketable, these benefits do not necessarily result in a financial flow or a return on an investment in nature. This dilemma is reflected in the quote by Pavan Sukhdev, who led the work on the TEEB study (The Economics of Ecosystems and Biodiversity):
"*We use nature because it is valuable, but we lose it because it is free*".

To stop biodiversity loss and nature degradation we need to rethink our economic systems to include the value of nature. This requires a role for new and innovative business models and new ways of financing nature, such as 'Payments for Ecosystem Services' (PES).

2.6.2 Nature-based Solutions

Nature-based solutions (NbS) are interventions to address societal challenges through the protection, sustainable management and restoration of ecosystems, benefiting both biodiversity and human well-being (IUCN, 2020)[9]. NbS have significant, but currently underutilized, potential to help address global challenges such as climate change, human health, food and water security, natural disasters and biodiversity loss (IUCN, 2020). The OECD estimates that the total global economic returns of restoring land and reducing degradation, greenhouse gas emissions, and biodiversity loss could be as high as $US 125-140 trillion every year[10].

Therefore, investing in NbS represents one of the most obvious nature-related financial opportunities. Ideally, every investment decision should involve considering whether there is an NbS alternative available instead of defaulting to traditional 'grey' or 'brown' investments. However, a report by the European Investment Bank (EIB) in 2023 revealed that scaling up NbS investments still lags behind, primarily due to high transaction costs and a lack of mainstream

9 IUCN, Issues brief; Ensuring effective nature based solutions, July 2020.

10 OECD (2019), Biodiversity: Finance and the Economic and Business Case for Action, OECD Publishing, Paris, https://doi.org/10.1787/a3147942-en.,

adoption. To address these challenges many initiatives are being developed, mainly focusing on providing better insights into comparing the impacts, costs, and benefits of NbS. For example, the World Bank is currently developing a database containing all known NbS interventions and their costs and benefits at the ecosystem services level.

A focus on NbS involves adopting a *landscape approach* and analyzing upstream and downstream impacts and dependencies on biodiversity and ecosystem services. This process unveils both financial risks and opportunities. The advantage of NbS lies in its potential to generate a return on investment (ROI) and have a positive impact on nature. An important precondition, however, is a valuation of the economic (co-)benefits generated and a financial flow from beneficiaries to the investor (see also section 2.6.3).

An assessment of impacts on ecosystem services and their value can be used to develop NbS and enables a comparison with traditional/grey solutions, informing decision making. For example the study 'A method to prioritize and allocate nature-based solutions in urban areas based on ecosystem service demand' (D. Longato et al, 2023) shows that mapping and assessing the demand for ecosystem services in urban areas can support the allocation of nature-based solutions to deliver ecosystem services where they are most needed. The approach developed can be used and adapted to support a variety of planning decisions dealing with the prioritization and spatial allocation of NbS.

Nature-based solutions supporting net zero climate commitments

Climate change and nature and biodiversity loss are inextricably linked with increasing levels of climate change and increasing loss of nature and biodiversity reinforcing one another. Actions to address climate change and nature and biodiversity loss can be synergistic or have trade-offs. Natural climate solutions are ecosystem-related activities that can support climate change adaptation and/or climate change mitigation while also benefiting nature and biodiversity. For example, restoration of a coastal mangrove forest provides habitat for biodiversity and adaptation against erosion.

The linked but sometimes opposing demands of climate and nature management mean that multiple metrics are needed to reflect both types of efforts appropriately. In addition to greenhouse gas emission footprints, biodiversity footprints and impact assessments of ecosystem services can be used to reflect changes in non-climate ecosystem services.

Net-zero commitments and frameworks have structures to support measurement, monitoring, and accountability of progress against targets, especially in the private sector, including the financial sector. These methodologies may guide how nature-related actions can be formally factored into net-zero implementation. For example, financial institutions that join a sector-specific net-zero alliance sign-up to follow the specific details of an alliance commitment. This could mean that the scope of a target might include or exclude parts of the financial portfolio. The type of the portfolio companies covered by the target will determine the potential to identify climate/nature-related synergies and trade-offs including nature-related mitigation actions that might be available. For example, nature-related climate solutions will generally be more available for a company that raises livestock than a professional services company. The portfolio or portion of portfolio covered by the net zero target will affect their identification.

Another inter-linkage between net zero commitments and NbS is the use of natural climate solutions as carbon credits: Organizations may be able to purchase and apply nature-based credits toward their net-zero implementation if their framework allows.

The Glasgow Financial Alliance for Net Zero (GFANZ), a global coalition of leading financial institutions committed to accelerating the decarbonization of the economy, is developing supplemental guidance to the 2022 GFANZ Net-zero Transition Plan framework[11] to support financial institutions' use of nature-related actions to implement their net-zero commitments. A

[11] GFANZ, Financial Institution Net-zero Transition Plans, Fundamentals, Recommendations, and Guidance, Final report, November 2022.

consultation draft of the supplemental guidance is planned for October 2024 with the final publication planned for Q1 of 2025.

Note from the PBAF working group
The fact that not all ecosystem services fit in traditional market logic has important implications for the business case of nature-based solutions. Regulating ecosystem services that benefit broader societal groups may not generate any financial flows. Financial institutions participating in the working group stressed the fact that this limits the opportunities for private finance to invest in nature-based solutions and the restoration and conservation of nature. Financial involvement of stakeholders that benefit from nature-based solutions the ecosystem services the beneficiaries NbS

2.6.3 Ecosystem services and financing mechanisms

In the pursuit of sustainable development and conservation efforts, financing mechanisms play a key role in aligning economic interests with environmental priorities. What financial mechanisms can contribute to the generation of financial returns, building on changes in ecosystem services, and contribute positively to nature conservation and restoration? In this section, two examples of such financial mechanisms are briefly discussed: payments for ecosystem services and blended finance.

Both financing mechanisms potentially play an important role in financing the transition to a nature positive future (*transition finance*), building on the value of ecosystem services. Extended investment horizons and recalibrated discount rates may be required to accurately reflect the true economic worth of ecosystem services generated over time.

The same is true for *landscape finance*[12]. To calculate the economic value of holistic landscape restoration, a long term integrated value perspective is needed that accounts for natural, social and financial returns. An example is the 20-year net present value of landscape restoration, developed by Commonland (Bertels, J. et al, 2023).

Payment for Ecosystem Services (PES)
Payment for Ecosystem Services (PES) is a market-based instrument that can be used to finance nature conservation. PES programmes allow for the translation of the ecosystem services that ecosystems provide for free into financial incentives for their conservation, targeted at the local actors who own or manage the natural resources. Such programmes have been increasingly established across the globe in the last few years (IPBES, 2024).

In practice, PES often involves a series of payments to land or other natural resource managers in return for a guaranteed flow of ecosystem services (or, more commonly, for management actions likely to enhance their provision) over-and-above what would otherwise be provided in the absence of payment. Payments are made by the beneficiaries of the services in question, for example, individuals, communities, businesses or government acting on behalf of various stakeholders (DEFRA, 2013).

PES provides an opportunity to put a price on previously un-priced ecosystem services like climate regulation, water quality regulation and the provision of habitat for wildlife and, in doing so, brings them into the wider economy. The novelty of PES arises from its focus on the ‘beneficiary pays principle’, as opposed to the ‘polluter pays principle’.

There are three broad types of PES schemes (DEFRA 2013):

- Public payment schemes through which government pays land or resource managers to enhance ecosystem services on behalf of the wider public;
- Private payment schemes, self-organised private deals in which beneficiaries of ecosystem services contract directly with service providers

[12] Landscape finance is the provision and management of all the financial resources necessary to carry out activities and processes that enable long-term holistic restoration.

- Public-private payment schemes that draw on both government and private funds to pay land or other resource managers for the delivery of ecosystem services.

Through PES, a financial return can be created for those ecosystem services that do not have a direct market value, like most regulating services. In this way, PES can build the business case for investments in nature conservation and restoration.

Example: PES around Lajke Naivasha, Kenya
A well-known example of payments for ecosystem services is the payment for watershed services around Lake Naivasha (Kenya). Upstream small scale landowners/farmers are compensated to manage their land is such a way that good quality water is provided to downstream users (the ecosystem service beneficiaries), notably the major floriculture/horticulture industry based around the lake.

Land management changes by the landowners resulted in positive changes in water quality, a reduction of soil erosion and surface water run-off and increased tree cover. It shows how economic incentives for both ecosystem service buyers and sellers can be used to achieve significant land- and water-management improvements. (Thomas Chiramba et al, 2011)

Blended finance
Blended finance combines public, private, and philanthropic funds. This collaborative approach not only reduces financial risks but also opens avenues for funding transformative conservation and restoration projects. Blended finance is one of the most impactful ways to mobilize private investments while using limited sums of public funding, representing an opportunity to raise additional finance for funding the goals and targets of the Kunming-Montreal Global Biodiversity Framework (GBF) [13].

Opportunities to develop blended finance transactions for biodiversity are highly context-specific, as is the case for other biodiversity finance solutions (e.g. payment for ecosystem services schemes, ecotourism or agroforestry models, etc.). The opportunities for blended finance may be higher when investments in nature benefit public services, like regulating services or cultural services. Local government and philanthropic funds may be inclined to provide co-funding to when these ecosystem services related co-benefits are identified and valued.

Example: Seychelles' sovereign blue bond
An example highlighting blended finance's potential impact is Seychelles' pioneering sovereign blue bond, backed by the Global Environmental Facility (GEF) and the World Bank. This initiative, raising $15 million from international investors, paved the way for sustainable marine and fisheries projects, benefiting (among others) the sustainable provision of fish, an important marine ecosystem service. Its success demonstrated the potential of capital markets and the collaborative spirit inherent in blended finance (GEF, 2018).

2.7 The Taskforce on Nature-related Financial Disclosures (TNFD)

In September 2023, the TNFD launched its risk management and disclosure framework, including additional guidance for financial institutions. The framework includes the so-called LEAP-approach. This approach offers a structured approach for companies and financial institutions to identify and assess their nature-related issues. The approach is made up of four different phases, consisting of Locate, Evaluate, Assess and Prepare (TNFD, 2023). This LEAP-approach can be used to identify stakeholders and how these are affected by business activities and/or investments. Identifying stakeholders is an important process since it provides

[13] Developing blended finance capacity for nature on a national level, Van Pul et al, April 2023.

insights in who are actually affected and how. Applying this knowledge into (financial) decision-making will lead to better informed decisions. The TNFD recommendations also closely relate to the CSRD, since the TNFD framework is regularly referenced in the ESRS 4 (the reporting standard on biodiversity and ecosystems).

The LEAP approach recognizes the important role that ecosystem services play in the impact and dependency pathways (see figure 3).

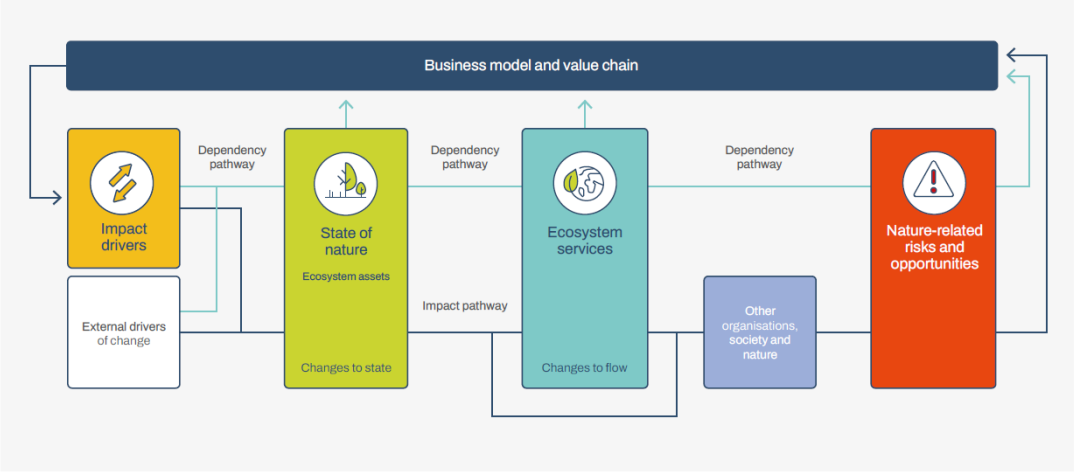

Figure 4: Connections between dependencies and impacts on nature and nature-related risks and opportunities – Impact and dependency pathways (TNFD, 2023)

The TNFD recommends the use of two core global metrics in the disclosure by financial institutions, focusing on (1) the financial exposure to high risk sectors and (2) the financial exposure to sensitive locations. Sensitive locations are defined as follows[14]:

Sensitive locations are locations where the assets and/or activities in an organization's direct operations – and, where possible, upstream and downstream value chain(s) – interface with nature in (one or more can be relevant):

2. Areas important for biodiversity.
3. Areas of high ecosystem integrity.
4. Areas of rapid decline in ecosystem integrity.
5. Areas of high physical water risks.
6. Areas of importance for ecosystem service provision, including benefits to Indigenous Peoples, Local Communities (IPLCs) and affected stakeholders.

The latter means that ecosystem service provision in areas where assets/business operate needs to be assessed in order to decide if the area is a sensitive are. The impact and dependency on these ecosystem services will determine whether this results in nature-related financial risks. Such risks can be physical risks (e.g., loss of ecosystem services that the companies invested in depend on) and transitional risks (e.g., impacts on ecosystem services that IPLCs and other stakeholders depend on, leading to reputational risks and/or the implementation of government policy). See also section 2.5.

14 TNFD, Sector guidance, Additional guidance for financial institutions, Version 1.0, September 2023.

3 ECOSYSTEM SERVICES IN A REGULATORY CONTEXT

3.1 Introduction

All businesses depend on the provision of ecosystem services, either directly or indirectly, in their value chains. A loss or even a reduction of ecosystem services could affect a company's operations and profitability. This will affect the financial risk of the loans and investments of financial institutions. Moreover, investing in companies that negatively impact ecosystem services on which local stakeholders depend may lead to reputational damage. Similarly, investing in actions that positively affect the provision of ecosystem services can lead to financial opportunities. In the years to come, many of these financial risks and opportunities will be triggered by policy and actions in the transition towards a nature positive future following the 2022 Kunming Montreal Global Biodiversity Framework, (EU) regulation.

This chapter provides an overview of the regulatory context of an assessment of impacts on ecosystem services and their value.

3.2 The Global Biodiversity Framework

The Kunming-Montreal Global Biodiversity Framework (GBF) was adopted during the fifteenth meeting of the Conference of the Parties (COP15) of the Convention on Biological Diversity (CBD) in Montreal in 2022. The GBF sets out a pathway to achieve the global vision of living in harmony with nature by 2050. All parties to the CBD commit to develop national policy and regulation to implement the GBF.

One of the long-term goals of the GBF (goal B) is that "biodiversity is sustainably used and managed and nature's contributions to people, including ecosystem functions and services, are valued, maintained and enhanced, with those currently in decline being restored (..) (Convention on Biological Diversity 2022, p.8)", underlining the importance of ecosystem services analyses and the inclusion of the value of these services into (financial) decision-making.

Although the GBF is implemented by member states, several targets relate directly to business and financial institutions:

- **Target 11** describes the need to restore, maintain and enhance ecosystem services, through nature-based solutions and/or ecosystem-based approaches.
- **Target 15** requires large and transnational businesses and financial institutions to assess and disclose biodiversity-related risks and dependencies and impacts on biodiversity.
- **Target 19** describes the need to mobilise a yearly US$200 billion per year including leveraging private finance and private investments in biodiversity. The target explicitly mentions "stimulating innovative schemes such as payment for ecosystem services" and "optimizing co-benefits and synergies of finance targeting the biodiversity and climate crises".
- **Target 18** aims to gradually eliminate or reform incentives (including subsidies) harmful for biodiversity by at least $500 billion annually by 2030. This involves reducing these incentives in a fair, effective, and equitable manner while scaling up positive incentives for biodiversity conservation and sustainable use.
  Although target 18 is not directed directly at businesses and financial institutions, they will be affected by the elimination of incentives harmful for biodiversity and the scaling

up of positive incentives. The latter could also lead to nature-related financial opportunities.

An assessment of (impacts on) ecosystem services will be a key part of the actions needed to contribute to targets 11 (restore, maintain and enhance ecosystem services) and target 15 (assess and disclose biodiversity-related risks, impacts and dependencies).

Target 19 could accelerate the implementation of Payment for Ecosystem Services (PES) schemes and could focus on Nature based Solutions (NbS) as one of the synergies of finance targeting the biodiversity and climate crisis. This will strengthen the business case for financial institutions to invest in nature. The same is true for the removal of subsidies harmful to biodiversity and the increase in positive incentives, part of target 18.

National Biodiversity Strategies and Action Plans
Parties (countries) to the Convention on Biological Diversity are expected to develop National Biodiversity Strategies and Action Plans (NBSAPs) based on the GBF. These NBSAPs serve as the main vehicle for implementation of the framework and need to be revised or updated in alignment with the framework's goals and targets. This also means that the focus on the financial sector, ecosystems and ecosystem services will be reflected in national policies and regulations.

3.3 EU Regulation

A number of directives and regulations on European level have a direct link to (impacts on) ecosystem services, including the CSRD, the Nature Restoration Law, the EU Taxonomy, and the SFDR.

The EU Taxonomy
The EU Taxonomy which entered into force on July 12th 2020 is a cornerstone of the EU's sustainable finance framework and an important market transparency tool. It aims to direct investments to the economic activities needed for the transition, in line with the European Green Deal objectives. The taxonomy is a classification system that defines criteria for economic activities that are aligned with a net zero trajectory by 2050 and broader environmental goals, including biodiversity. The EU taxonomy provides financial institutions and businesses with a common definition of economic activities that can be considered environmentally sustainable. In this way, it plays an important role in scaling up sustainable investment and protecting private investors from greenwashing.

The EU Taxonomy distinguishes six environmental objectives, the last of which has a direct relation with the (continued) provision of ecosystem services:

- Climate change mitigation
- Climate change adaptation
- The sustainable use and protection of water and marine resources
- The transition to a circular economy
- Pollution prevention and control
- The protection and restoration of biodiversity and ecosystems

The latter enables investors to invest in activities that protect and restore biodiversity and ecosystems, benefiting ecosystem services. An assessment of impacts on ecosystem services and their value will enable investors to see what ecosystem services and what stakeholders benefit, strengthening the business case of the investment.

The Corporate Sustainability Reporting Directive
The Corporate Sustainability Reporting Directive (CSRD) is a set of reporting standards aimed at improving the quality and consistency of corporate sustainability reporting, including a focus on biodiversity and ecosystems (ESRS E4). Compliance with the CSRD requires an assessment of impacts and dependencies on biodiversity. For example, and assessment and valuation of ecosystem services is needed to comply with a number of disclosure requirements. Examples are (references to ecosystem and ecosystem services are underlined):

Disclosure requirements related to [draft] ESRS 2 IRO-1 – 'Description of the processes to identify and assess material biodiversity and ecosystem-related impacts, risks and opportunities':

- AR4: The **materiality assessment** under [draft] ESRS E4 includes the undertaking's (see AR4):
    - (c) impacts on the extent and condition of ecosystems (classified as per the IUCN Global Ecosystem Typology 237 and defined within the UN SEEA EA accounting framework (e.g., land degradation, desertification and soil sealing);
    - (d) impacts and dependencies on ecosystem services (as defined within the UN SEEA EA accounting framework).

- AR 6. The undertaking shall consider conducting its **materiality assessment** in line with the first three phases of the LEAP approach by the Taskforce on Nature-related Financial Disclosures (TNFDsee a discussion of the LEAP approach in 4.4).

- AR 9. Based on the results of Phase 1 and 2, the undertaking shall consider assessing material risks and opportunities in Phase 3 along the following categories:
    - **physical risks**: ii. chronic risks (e.g., loss of crop yield due to decline in pollination services, increasing scarcity or variable production of key natural inputs, ecosystem degradation due to operations leading to, for example, coastal erosion and forest fragmentation, ocean acidification, land loss to desertification and soil degradation and consequent loss of soil fertility, species loss).
    - (b) **transition** risks, including:
      iii. market: e.g., shifting supply, demand and financing, volatility or increased costs of raw materials (e.g., biodiversity-intense inputs for which price has raised due to ecosystem degradation);
      iv. reputation: e.g., changing societal, customer or community perceptions as a result of an organisation's role in loss of biodiversity, violation of nature-related rights through operations, negative media coverage due to impacts on critical species and/or ecosystems, biodiversity social conflicts over endangered species, protected areas, resources or pollution;
    - (d) **opportunities**, including:
      ii. sustainability performance categories: 6) ecosystem protection, restoration and regeneration; 7) sustainability use of natural resources.

Sustainable Finance Disclosure Regulation
The Sustainable Finance Disclosure Regulation (SFDR) imposes mandatory ESG disclosure obligations on financial institutions regarding sustainability risks, considering adverse sustainability impacts in investment processes and the provision of sustainability-related information with respect to financial products. The impact on biodiversity is one of the focal points of the SFDR thereby also touching on the changes in ecosystem services resulting from these impacts.

The Nature Restoration Law
The European Commission's proposal for a Nature Restoration Law is a key element of the EU Biodiversity Strategy, which calls for binding targets to restore degraded ecosystems, in particular those with the most potential to capture and store carbon and to prevent and reduce the impact of natural disasters. The Nature Restoration Law explicitly refers to ecosystem services (carbon capture and storage, and protection to natural disasters), emphasizing the need for an assessment of these services.

4 ASSESSING IMPACTS ON ECOSYSTEM SERVICES AND THEIR VALUE

4.1 Introduction

This chapter provides an overview of the steps in an assessment of impacts on ecosystem services and the valuation of these services. It is essential to recognize that such assessments are often integral to a broader process within financial institutions aimed at identifying nature-related (financial) risks and opportunities, also including an analysis of impacts on biodiversity/nature and dependencies on ecosystem services.

While a biodiversity impact assessment covers the ecological impact of an investment, an assessment of impacts on ecosystem services covers the changes in economic value for humans induced by ecological impact. Both are needed to halt and reverse biodiversity loss in a just and inclusive way and to effectively address nature-related risks and opportunities.

The process of assessing nature-related financial risks and opportunities is discussed in section 4.2, showing how an assessment of impacts on ecosystem services complements a biodiversity impact assessment and an assessment of ecosystem services dependencies.

In section 4.3, the steps in an ecosystem services valuation approach are described, detailing the data requirements in each step.

4.2 The process of assessing nature-related financial risks and opportunities

Financial institutions that conduct a social and environmental analysis of a loan or investment and/or an assessment of nature-related financial risks will usually include:

- An assessment of (potential) impacts on biodiversity.
- An assessment of dependencies on ecosystem services.
- An assessment of the presence of protected areas, threatened species and key biodiversity areas.

An assessment of impacts on ecosystem services, the value of these services and the stakeholders affected is in most cases not yet part of such an analysis. However, to really understand the impact of a loan or investment and the related risks and opportunities, such an assessment should be part of the process.

The ‘LEAP approach’ (Locate, Evaluate, Assess and Prepare) was developed by the TNFD to guide businesses and financial institutions in the identification and disclosure of nature-related financial risks and opportunities[15]. This process is used in this section to show where an assessment of impacts on ecosystem services, the value of these services and the stakeholders affected fits and complements the other assessments.

15 TNFD, Recommendations of the Taskforce on Nature-related Financial Disclosures, September 2023

Locate
In the Locate step of the LEAP process, financial institutions assess their exposure to high risk sectors and assets, both by looking at impacts and dependencies on nature and by looking at sensitive locations.

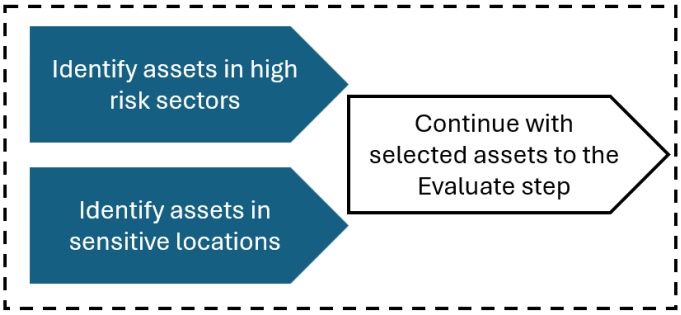

Figure 5: Schematic overview of the identification of assets in high risk sectors and sensitive locations in the Locate step of the LEAP process

Tools currently used in this step include (for an explanation of these tools the websites can be consulted):

- ENCORE: impacts and dependencies on a sector and sub-industry level[16]
- SBTN Materiality tool: and
- SBTN High Impact Commodity List
- TNFD high risk sector list (Annex 1 in the guidance for financial institutions)
- WWF Biodiversity Risk Filter[17]
- Footprinting tools

In this first step, an assessment of impacts on ecosystem services is usually not yet conducted. However, the Locate step will show whether location data are available for the companies and assets a financial institution invests in. These location data are needed to enable an assessment of changes in ecosystem services and their value.

Sensitive locations and ecosystem services
In the Locate step, 'sensitive areas' are defined as

- Areas important for biodiversity.
- Areas of high ecosystem integrity.
- Areas of rapid decline in ecosystem integrity.
- Areas of high physical water risks.
- Areas of importance for ecosystem service provision, including benefits to Indigenous Peoples, Local Communities (IPLCs) and affected stakeholders

The identification of sensitive areas requires the use geographic information about global biodiversity, like the location of protected areas and key biodiversity areas. IBAT is one of the tools providing (part of) this information[18].

16 ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) is a free, online tool that helps organisations explore their exposure to nature-related risk and take the first steps to understand their dependencies and impacts on nature.

17 The Biodiversity Risk Filter, developed by WWF, is a corporate and portfolio-level screening tool to help companies and investors to prioritise action on what and where it matters the most to address biodiversity risks for enhancing business resilience and contributing to a sustainable future (https://riskfilter.org/biodiversity/home).

18 IBAT (Integrated Biodiversity Assessment Tool) includes the World Database on Protected Areas, IUCN Red List of Threatened Species, and the World Database of Key Biodiversity Areas.

To identify areas of importance for ecosystem service provision, the Ecosystem Services Valuation Database (ESVD, see section 2.4) can potentially provide valuable information.

Evaluate
In the Evaluate step of the LEAP process, the impacts and dependencies of the selected assets are analysed in more detail to enable a better assessment of potential financial risks and opportunities in the 'Assess' step. Tools used in this step are similar to the tools used in the Locate step, but the need for company and location specific data is higher.

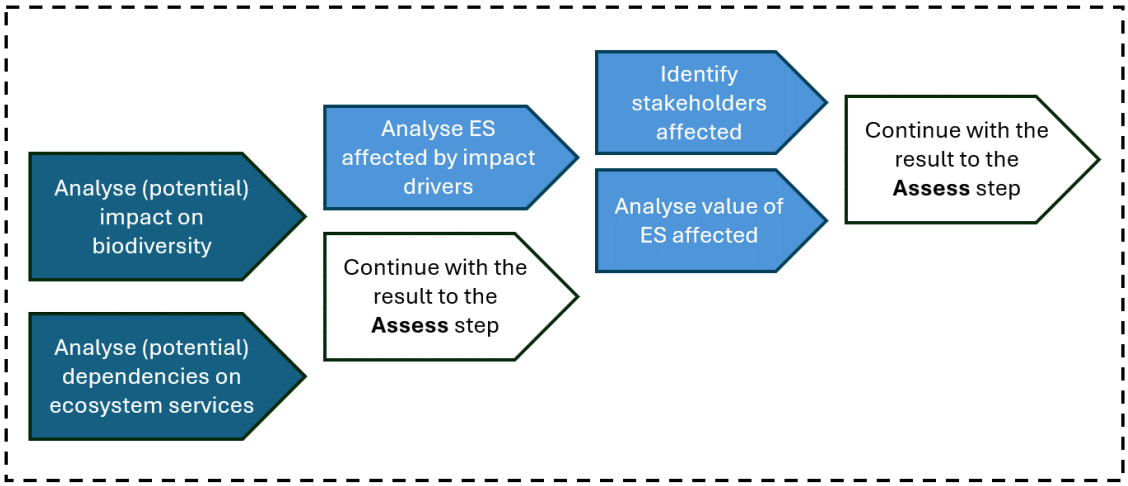

Figure 6: Schematic overview of the analysis of ecosystem services affected, the value of these services and the identification of stakeholders affected in the Evaluate step of the LEAP process

The results of the analysis of impacts on biodiversity and the analysis of dependencies on ecosystem services both feed into the 'Assess' step. The impacts on biodiversity may trigger transition risks (e.g., reputational risks or the introduction of legislation) and the dependencies on ecosystem services may constitute a physical risk when the provision of ecosystems services cannot be guaranteed.

However, *the loss of biodiversity resulting from the loan or investment may also affect the ecosystem services provided*, potentially resulting in transition risks (loss of reputation, loss of license to operate because local stakeholders are affected) and triggering physical risks when the ecosystem services affected overlap with the ecosystem services the investee (one of the 'stakeholders' in the figure) depends on.

This is where an assessment of impacts on ecosystem services and the value of these services fits within the LEAP process and complements the other assessments. By analysing the expected impact on ecosystem services resulting from (the drivers of) biodiversity loss and combining this information with the value of the services affected, the risks and opportunities related to these changes become clear.

Assess and Prepare
In the Assess and Prepare step, the (financial) risks and opportunities are analysed as well as the steps needed to manage them. The analysis of ecosystem services and stakeholders affected, including the value of these services, will provide insight in possible co-benefits (ecosystem services that also benefit from the loan or investment) and opportunities for co-finance (e.g., opportunities for public co-financing when public services benefit).

The figure below shows how the analysis of ecosystem services and stakeholders affected fits within the Assess and Prepare step of the LEAP process.

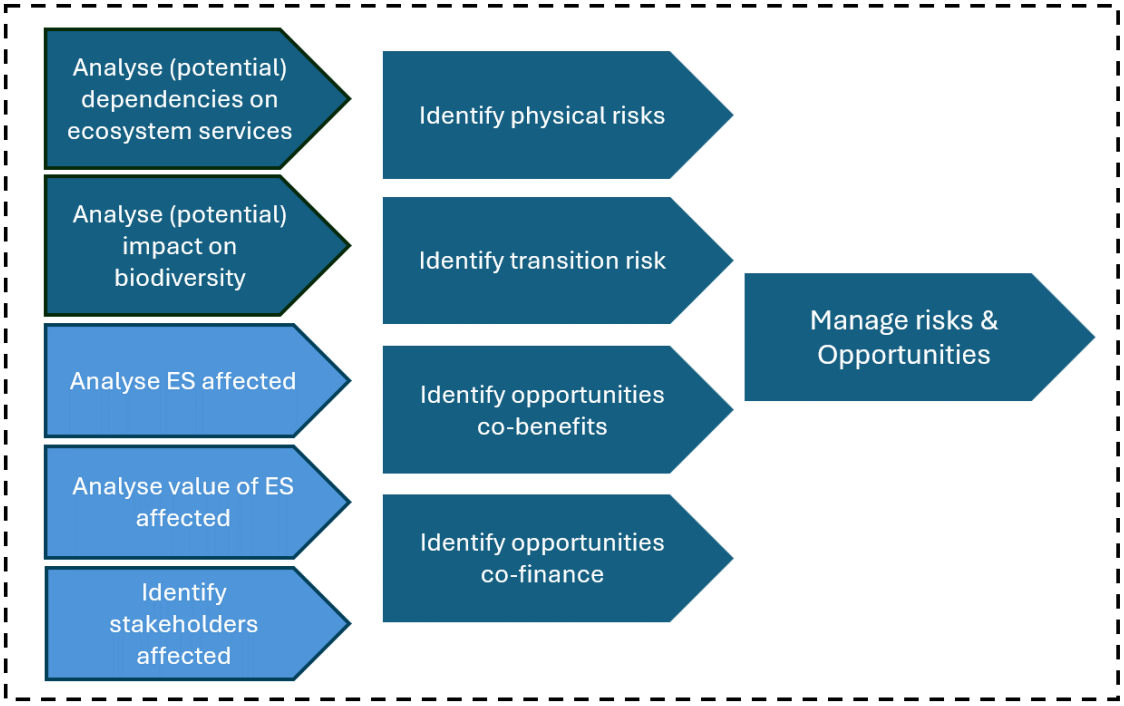

Figure 7: Schematic overview of the analysis of ecosystem services affected, the value of these services and the stakeholders affected in the Assess and Prepare step of the LEAP process

4.3 Analysis of impacts on ecosystem services and their value

4.3.1 Introduction

Loans and investments can impact ecosystem services both positively and negatively. A change in biodiversity or the condition of an ecosystem (e.g., through land use change or pollution) can change the ability of an ecosystem to provide services. In this section, the process for determining the changes in ecosystem services and their monetary value is described for a change in land cover/ecosystems. This includes changes *within* ecosystems (e.g., changing from conventional to organic coffee production) and changes *between* ecosystems (e.g., reforestation of an agricultural land). The process includes four steps, each of which is further explained below and illustrated with an example from the 'Make Nature Count (MNC) 1.0 and 2.0' projects, an ESVD-ASN Bank collaboration (Van 't Hoff et al, 2022 & De Jong, van 't Hoff, 2023).

Figure 8 below shows the five different steps of an impact assessment based on the monetary valuation of ecosystem services using the ESVD:

1. Identification of data need and location context.
2. Alignment of the ecosystem type(s) with the classification in the ESVD.
3. Calculation of standardised monetary values of the services provided.
4. Calculation of the changes in monetary value for two scenarios using Total Economic Value (TEV) and Net Present Value (NPV).

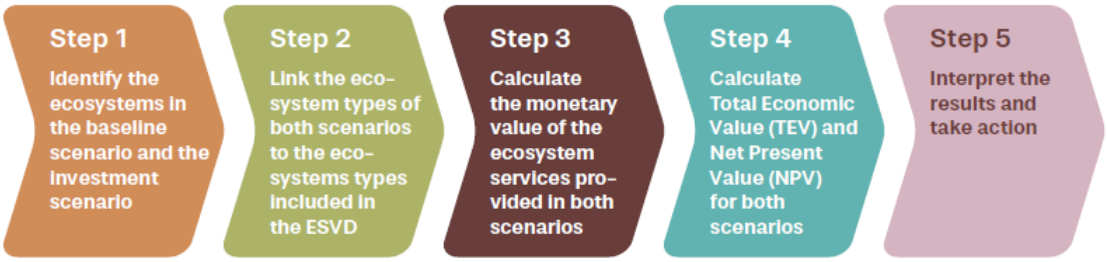

Figure 8: Five step process to assess changes in ecosystem services and their value.

4.3.2 Step 1: data need and understanding the context

In the first step, data is collected on the project/activity (potentially) financed. This includes data on the type, extent (size) and condition of the ecosystem at the project location, and the expected changes in ecosystem or land cover (e.g., from agricultural land to forest). Based on this data, the 'baseline' or 'business as usual' scenario is established, as well as an 'investment' or 'future' scenario. The business as usual scenario assumes no change in ecosystems. The investment scenario describes the expected changes in ecosystem or land cover. Multiple scenarios can be used, reflecting different investment decisions. To understand what stakeholders could be affected in the different scenarios, a stakeholder mapping can complement this step. The data requirements for this first step are summarised in the table below.

Data requirement	Type of data	Examples of data source
Ecosystem types at the location	Map or qualitative: classification/description of the ecosystem types at the location	Any spatial ecosystem map such as the Copernicus land cover map[19], ESA land cover map[20], ABC-MAP Local project/site manager
Extent of the ecosystem	Quantititative: in hectares, km^2 or any other unit	Local project/site manager
Change in land cover	Qualitative: a description of the scenarios	Local project/site manager
Condition of the ecosystem (preferred, not required)	Quantitative or qualitative: Mean species abundance, Ecosystem Integrity Index or any other indicator	ABC-MAP Local project/site manager
Drivers of change	Quantitative or qualitative: description of the 5 main drivers of change	Local project/site manager
Affected stakeholders	Qualitative: description of relevant stakeholders	Local project/site manager

- The result of this step is an overview of the ecosystems in both scenarios, including type, size and (if available) condition, and an overview of local stakeholders (if a stakeholders mapping was conducted).

Example Make Nature Count 1.0

Project description of the 'Shaded coffee in Nicaragua'

A Nicaraguan coffee production company has a shaded coffee system of 138 hectares. In addition, the company owns 52 hectares of native cloud forests. The location of the shaded coffee system is near the city of Matagalpa, the fourth largest city of Nicaragua (the

19 https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_Landcover_100m_Proba-V-C3_Global

20 https://viewer.esa-worldcover.org/worldcover/

approximate location is known by us). This final case study is not about an existing land cover change, but on a hypothetical land cover change from a conventional coffee system to a shaded coffee system.

Relevant project information included the ecosystem types (conventional coffee, shaded coffee and tropical cloud forests), extent (190 hectares), land cover change (agroforestry), condition (degraded), drivers of change (degradation and land cover change) and stakeholders (landholders and local communities). Based on the information, two scenarios were created:

BaU scenario – Conventional coffee: This scenario describes the current situation before the project. In the absence of the project activities, the project area (190 hectares) consists of conventional coffee plantations with existing conventional practices. A conventional coffee plantation typically involves clearing large areas of land, which can lead to soil erosion and loss of habitat, resulting in a reduced level of biodiversity. Moreover, the use of pesticides and fertilizers can pollute water sources, affecting freshwater ecosystems. This can lead to the loss of ecosystem services, such as regulation of air quality by the forest that was cleared and the loss of pollination services by pollinators affected by the use of pesticides.

Change scenario – Shaded coffee with patches tropical cloud forests: This scenario describes the reforestation project by converting the 190 ha into shaded coffee (138 ha) and tropical cloud forests (52 ha). On the shade-grown coffee plantation, trees and other vegetation are maintained, preserving habitats and strengthening biodiversity. The trees provide shade, they capture water, improve soil quality and reduce the need for chemical inputs. This results in an ecosystem that can provide a variety of ecosystem services, such as carbon sequestration, water regulation, pest control, and pollination.

4.3.3 Step 2: Aligning data with the ESVD

In the second step, the information on ecosystem types is linked to the ecosystems classification used in the Ecosystem Services Valuation Database (ESVD). This alignment is based on two related criteria: (1) Most closely resembling biome/ecosystem type in the ESVD and (2) the availability of monetary values in the ESVD. If only a limited number of monetary values are available for the ecosystem that matches best, monetary values from closely related ecosystems in the ESVD can be added to assist with the calculation.

- The result of this step is a link between the ecosystem identified in step 1 and the ecosystems used in the ESVD, an overview of the ecosystem services provided in these ecosystems according to the ESVD and the number of monetary values available per ecosystem service.

Example Make Nature Count 1.0
The relevant ecosystems were conventional coffee, agro-forestry coffee and tropical cloud forests. For all three ecosystem types there was data on several ecosystem services available in the ESVD. For conventional coffee systems it was discussed that only some ecosystem services were relevant, namely the production of food (coffee) and climate regulation. In the shaded coffee scenario, there was local data available on production level and for some additional ecosystem services there was data available in the ESVD. Additionally, data from literature was used to complement the data in the ESVD. Because of limited data availability on tropical cloud forests, data on tropical rain forests in South-America was used as it was assumed and discussed with experts to fit in terms of ecosystem type and monetary values. Some ecosystem services were excluded from the analysis based on expert judgement from a team of specialists.
Step 3: Calculating of standardized monetary values

In step 3, the monetary value of the ecosystem services provided in both scenarios is calculated. To do this within a project context, the average per hectare value per ecosystem type and ecosystem service is calculated based on the available monetary values in the ESVD. Outlier values (extreme high or low values) which do not fit the context of the project are removed by means of expert judgement or based on identified outlier exclusion rules. This also means that this step is often taken in cooperation with experts form the ESVD database.

Calculating standardized monetary values requires a thorough understanding of the ESVD. Currently, the ESVD is used by consultancies, companies, governments and financial institutions, sometimes in collaboration with the ESVD team.

- The result of this step is an overview of the per hectare values of the ecosystem services provided by the relevant ecosystems in both scenarios. It forms the basis for step 4.

Example Make Nature Count 1.0
Table 2 shows that the per hectare values for the different scenarios based on the average values in the ESVD. It gives a baseline understanding which is used to calculate the total economic value and the net present values in step 4.

Table 2: Per hectare/year values for the different ecosystem services in the different scenarios. Note that some cells are highlighted in blue. These refer to ecosystem services for which there was no data, but are likely to be provided.

Ecosystem Services	Scenario 1: Conventional coffee	Scenario 2: Tropical rainforest	Scenario 2: Agro-coffee
Provisioning services	**$ 4,642**	**$ 1,734**	**$ 4,642**
Food	$ 4,642	$ 176	$ 4,642
Water	$ -	$ 391	$ -
Raw materials	$ -	$ 656	$ -
Genetic resources	$ -	$ 508	$ -
Medicinal resources	$ -	$ 4	$ -
Ornamental resources	$ -	$ -	$ -
Regulating services	**$ 449**	**$ 1,405**	**$ 2,045**
Air quality regulation	$ -	$ -	$ -
Climate regulation	$ 449	$ 706	$ 1,556
Moderation of extreme events	$ -	$ 25	$ -
Regulation of water flows	$ -	$ 14	$ -
Waste treatment	$ -	$ 10	$ -
Erosion prevention	$ -	$ 457	$ -
Maintenance of soil fertility	$ -	$ -	$ -
Pollination	$ -	$ 193	$ 56
Biological control	$ -	$ -	$ 434
Habitat services	**$ -**	**$ 357**	**$ -**
Maintenance of life cycles	$ -	$ -	$ -
Maintenance of genetic diversity	$ -	$ 344	$ -
Existence, bequest values	$ -	$ 14	$ -
Cultural services	**$ -**	**$ 145**	**$ -**
Aesthetic information	$ -	$ -	$ -
Opportunities for recreation and tourism	$ -	$ 36	$ -
Inspiration for culture, art and design	$ -	$ 109	$ -
Spiritual experience	$ -	$ -	$ -
Information for cognitive development	$ -	$ -	$ -
Total	**$ 5,091**	**$ 3,641**	**$ 6,687**

4.3.4 Step 4: Calculating the Total Economic Value and the Net Present Value

Finally, in step 4, the monetary value of the total bundle of ecosystem services is calculated for both scenarios (baseline and investment). The difference in value shows the expected impact of an investment in terms of monetary gains and losses of the ecosystem services affected.

The TEV reflects the total bundle of ecosystem services provided by a particular ecosystem, for a specific area, per year. Usually, the TEV is expressed for a specific ecosystem in value/ha/year. To compare the different scenarios, the TEV/ha/year is multiplied by the total area of the specific ecosystems in the two scenarios. The TEV is a static value, which does not incorporate fluctuations in changes in ecosystem services flow over time (e.g., a forest will take time to fully grow and provide all the ecosystem services it is expected to provide). Ideally, the TEV would be calculated for each intermediate step (e.g., per year) between the start and the end of the project/activity financed.

Example Make Nature Count 1.0
The table and figure illustrate the different ways of displaying the outcomes of the TEV calculations.

Table 3: TEV of two systems in int$/ha/yr. TEV of shade-grown system (column 4, 138 ha) and the tropical rainforest (column 3, 52 ha), together 190 ha form scenario 2: future situation. The TEV of the scenario 1: Current situation (conventional coffee) is ha 190. The grey color shows the services which are provided by the ecosystem, but for which no data exists in the ESVD. The green cells show the positive and the red cells the negative difference if a conventional coffee plantation was converted to a shaded coffee system with rainforests.

Services	Scenario 1: Conventional coffee	Scenario 2: Tropical rainforest	Scenario 2: Agro-coffee	Difference
Provisioning services	**0.9 M**	**90.2 K**	**0.6 M**	**-0.2 M**
Food	0.9 M	9.1 K	0.6 M	-0.2 M
Water	$0	20.3 K	$0	20.3 K
Raw materials	$0	34.1 K	$0	34.1 K
Genetic resources	$0	26.4 K	$0	26.4 K
Medicinal resources	$0	0.2 K	$0	0.2 K
Ornamental resources	$0	$0	$0	$0
Regulating services	**61.9 K**	**73.1 K**	**0.3 M**	**0.3 M**
Air quality regulation	$0	$0	$0	$0
Climate regulation	0.1 M	36.7 K	0.2 M	0.2 M
Moderation of extreme events	$0	1.3 K	$0	1.3 K
Regulation of water flows	$0	0.7 K	$0	0.7 K
Waste treatment	$0	0.5 K	$0	0.5 K
Erosion prevention	$0	23.8 K	$0	23.8 K
Maintenance of soil fertility	$0	$0	$0	$0
Pollination	$0	10.0 K	7.7 K	17.8 K
Biological control	$0	$0	59.8 K	59.8 K
Habitat services	**$0**	**18.6 K**	**$0**	**18.6 K**
Maintenance of life cycles	$0	$0	$0	$0
Maintenance of genetic diversity	$0	17.9 K	$0	17.9 K
Existence. bequest values	$0	0.7 K	$0	0.7 K
Cultural services	**$0**	**7.5 K**	**$0**	**7.5 K**
Aesthetic information	$0	$0	$0	$0
Opportunities for recreation and tourism	$0	1.9 K	$0	1.9 K
Inspiration for culture. art and design	$0	5.7 K	$0	5.7 K
Spiritual experience	$0	$0	$0	$0
Information for cognitive development	$0	$0	$0	$0
Total	**0.9 M**	**0.2 M**	**0.9 M**	**0.2 M**

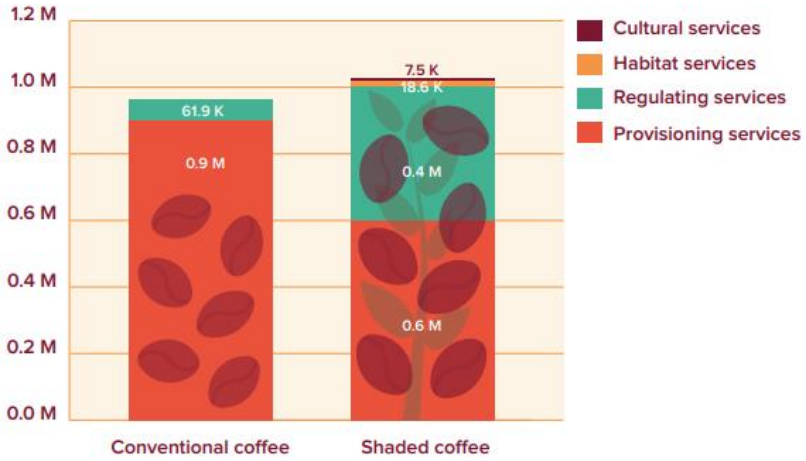

Figure 9: The TEV of the private and public benefits on concession area in int$2020/ha/yr. Private benefits constitute only provisional services while public benefits consist of regulating, habitat and cultural services.

The table displays the monetary values per ecosystem, providing a clear indication the direction of change and order of magnitude per scenario. Ecosystem services negatively affected may constitute a transition or reputational risk. The figure shows the TEV per ecosystem services type, pinpointing towards the stakeholders affected. For example, the increase in regulating services is beneficial for surrounding communities (reduced air pollution) and the global community (increased carbon sequestration). This information can be used to identify potential financing mechanisms, like blended finance schemes including public funding.

Net present value
Using the TEV-data, the *Net Present Value (NPV)* can be calculated. The NPV takes the time horizon of the investments into account. It is calculated by using projections of the flows of the total bundle of ecosystem services from a given ecosystem, over a given time period, at a certain discount rate. The discount rate expresses the preference between the value of money today and in the future. A high discount rate means we place less value on future costs and benefits. The standard discount rate used in the Make Nature Count 2.0 study was 5%. It is not uncommon to use a lower discount rate (between 0-5%) for natural ecosystems and for conservation and restoration projects because the benefits of nature often accrue over a longer time span and are likely to increase over time.

Example Make Nature Count 2.0

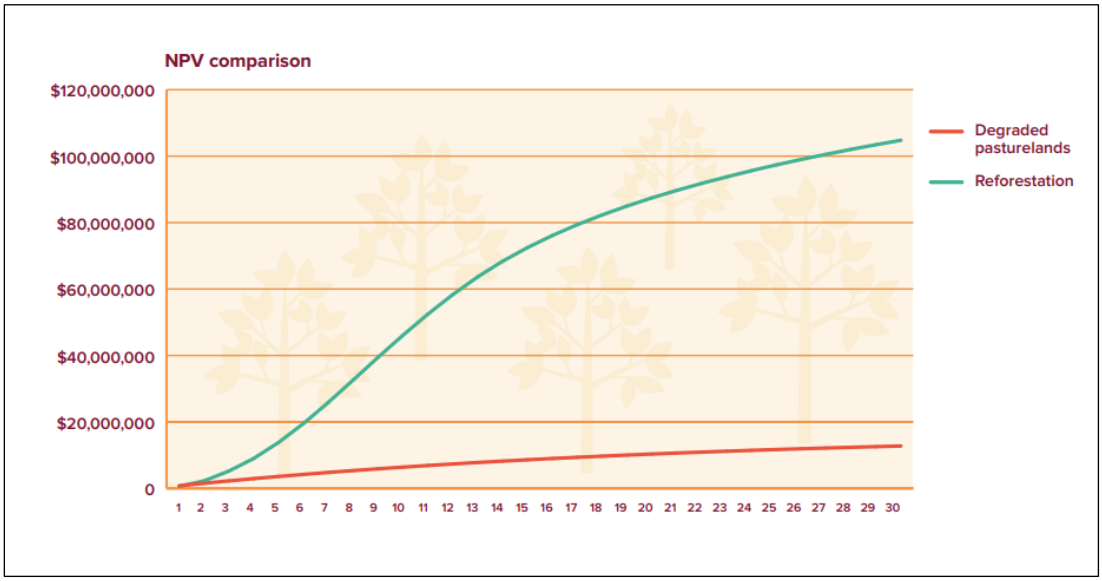

Figure 10: Net Present Value comparison of the Make Nature Count 2.0 project, in which degraded pasture land (2,000 ha) was reforested into tropical rain forests. For both scenarios a time horizon of 30 years and a discount rate of 5% was used.

Note that figure 10 shows another project than figures 9 and table 2 because no NPV calculation was performed in our first Make Nature Count study for the shaded coffee project. The NPV indicates the value of an investment over the longer term and in this case shows a clear difference between the two scenarios. Conventional thinking on discount rates depreciates the value of nature in the long term, indicating it will be worth less over time. However, this may be incorrect as nature is resilient, natural processes take time to develop and nature may decrease (financial) risk over time. For example, in times of global warming, storms and hurricanes will become more intense and will become more frequent in the future. Mangroves can play a vital role in the protection of a city or community including economic activities, indicating that the ecosystem service value of storm protection should not decrease, but increase over time.

- The result of this step is twofold:

The Total Economic Value of the bundle of ecosystem services provided by the ecosystems in the two scenarios, allowing a comparison of the total value of the two scenarios showing the order of magnitude per scenario. Additionally, the TEV allows to compare which ecosystem services increase and which decrease as a result of the scenario.
The Net Present Value of the two scenarios, showing how the value of the two scenarios changes over a given time period, at a certain discount rate.

4.3.5 Step 5: Interpret the results and take action

In the final step of the assessment, the results are interpreted and decisions are made on follow-up actions. The information on the expected changes in the provision of ecosystem services and their value can be used to consult and involve local stakeholders potentially affected, to identify financial risks and opportunities, to tailor loan and investment conditions to the SDGs, and to report on nature-related (financial) risks and opportunities (CSRD, TNFD).

Key performance indicators
The TEV and NPV results can be used as Key Performance Indicators (KPI's) within the decision-making process of financial institutions, like.

- *Total Economic Value (TEV) change*
  The change in TEV before and after the investment, indicating the change in the economic value of ecosystem services, including magnitude and direction of change and the type of stakeholders affected.
  This KPI will show whether the investment has a positive impact on the selected ecosystem services. This information is very relevant in the due diligence phase. If the TEV is negative, which stakeholders are affected? Can this negative impact be mitigated?
- *Net Present Value change*:
  The NPV can be calculated with varying discount rates to illustrate the long-term financial benefits of the investment under various scenarios.

Other examples of KPIs to develop targets and track performance regarding the impact on ecosystem services of loans and investments are:
- The percentage of total project finance that show a positive change in Total Economic Value.
- The percentage of projects financed in which IPLCs benefit from changes in ecosystem services.
- The number of projects financed that positively impact on two or more regulating services.
- The percentage of projects financed where changes in ecosystem services reduce physical risks.

By using these key performance indicators, a financial institution can monitor its impacts on ecosystem services on a portfolio level, either or not zooming in on a selection of ecosystem services. Moreover, the indicators can be used to develop ecosystem services related targets.

5 INTEGRATION IN THE LOAN AND INVESTMENT PROCESS

5.1 Introduction

Similar to the decision why and when to conduct an assessment of impacts on biodiversity and dependencies on ecosystem services, a financial institution also needs to decide why and when to conduct an assessment of impacts on ecosystem services and their value, of the stakeholders affected, what is needed for this and how the result can be used. The 'why' of conducting an assessment of impacts on ecosystem services and their value has been discussed in the chapters 2 and 3. In this chapter, the focus is on the integration of an ecosystem services impact assessment and valuation in the loan and investment process: the 'when' (to conduct the assessment), 'what' (data is needed) and 'how' (to use the result).

5.2 When to conduct the assessment?

To integrate an assessment of impacts on ecosystem services and their value into financial decision making, it must be clear when such an assessment should be conducted. There are two sides to this question of 'when':

- When is it possible to conduct an assessment of impacts on ecosystem services and their value?
- At what stage(s) in the loan and investment process has the assessment the potential to influence financial decision making?

When is it possible to conduct an assessment?
To assess the potential impact on ecosystem services and the value of these services, the asset location must be clear. As explained in chapter 2, the ecosystem services provided will vary with different ecosystems. The same is true for the value of the services provided; the same services may have different values at different locations. To conduct an analysis, two types of location data is needed:

- The ecosystem affected
  The ecosystem type before the loan/investment and the (expected) ecosystem type following the loan/investment. For example, an area of intensive agriculture is converted into a temperate forest.
- The size of the area affected
  Together with the change in ecosystem type, the size of the area affected will play a role in determining the change in ecosystem services value.

The level of granularity of location data

- Ecosystem (local knowledge fund or consultant) + Hectares

This means that in practice, an assessment of impacts on ecosystem services and their value will be restricted to a selection of loans and investments, like project finance and direct loans.

In what phases of the loan and investment process does the assessment fit?
The different phases in the loan and investment process include (from the PBAF publication 'PBAF, Taking biodiversity into account, PBAF Standard v2022, Biodiversity impact assessment - Overview of approaches, June 2022):

1. Scoping & Identification
2. Due diligence
3. Defining conditions loan/investment agreement

4. Active ownership
5. Exit ((end of loan, sale of a stock)
6. Reporting

For each phase, the role of ecosystem services valuation is briefly discussed, including examples of the questions a financial institution may want to answer.

Note from the working group
Financial institutions participating in the working group agree that an analysis of impacts on ecosystem services is most valuable in the due diligence phase. It provides valuable information about the ecosystem services potentially affected and the consequences for local communities, informing the identification of physical and transition risks and opportunities.

The result can be used to decide on the need for better data (e.g., on the stakeholders affected) and to develop loan and investment conditions that address the risks and opportunities identified. Moreover, the results can be used to identify linkages to social targets, like the sustainable development goals (SDGs), strengthening the business case for the investment.

Phase 1 Scoping & Identification
In the scoping and identification phase, the investment universe is determined, based on exclusion and investment criteria. In many cases, the location of the underlying assets is not yet known. An assessment of potential impacts on ecosystem services and their value does not play a role.

Phase 2 Due diligence
In the due diligence phase, data on (expected) social and environmental impacts is collected to decide on an investment. Gathering location data of the assets for which financing is considered will usually be part of this phase, making this the logical step for an analysis of impacts on ecosystem services, their value and the stakeholders that may be affected. This is valuable information in the due diligence step and may influence the loan/investment decision.

Examples of questions to be answered:

- What is the expected impact on ecosystem services? Are these public benefits or private benefits? Is the impact significant looking at the changes in value?
- Do the ecosystem services affected coincide with the ecosystem services the project/company depends on? How could this affect the activities financed (physical risks)?
- What other stakeholders may be affected, including Indigenous Peoples and Local Communities (IPLCs)?
- Are the negative impacts acceptable? Can they be avoided or mitigated?
- Can ecosystem services and stakeholders affected result in transition risks (e.g., reputation, legislation).
- Can positive impacts (co-benefits) be optimised and geared towards other targets of the financial institution, like contributions to the sustainable development goals?
- Do the co-benefits identified lead to new finance opportunities like public/private (blended) finance opportunities when public services (e.g. regulating services like water purification, pollination) benefit from the loan/investment?

The answers to these questions can influence the result of the due diligence step and the decision what conditions to formulate for the loan/investment agreement (phase 3).

Phase 3 Defining conditions loan/investment agreement
The information gathered in the due diligence step can be used to decide on the conditions of the loan/investment agreement.

Examples of questions to be answered:

- Considering the analysis of stakeholders affected, what stakeholders need to be consulted and involved in the activities financed?
- Do stakeholders that are negatively affected need to be compensated in any way?
- Can stakeholders that are positively affected support the activities financed? How can this be effectuated?
- What measures need to be implemented to avoid or mitigate negative impacts and benefit the most from positive impacts (co-benefits)?

Phase 4 Active ownership
In the active ownership phase, the actual impacts on ecosystem services can be monitored as well as the impact on the project/company and other stakeholders.

Examples of questions to be answered:

- How can the impacts on ecosystem services and the stakeholders affected be monitored (use of key performance indicators, see section 4.3.5)?
- Is progress towards ecosystem services related targets in line with expectations/planning?
- Are the conditions included in the loan/investment agreement being met?
- Do the conditions lead to the anticipated effect?
- What interventions are needed if the anticipated effect is not realised?
- Are the impacts on stakeholders in line with the expectations?

Phase 5 Exit ((end of loan, sale of a stock)
In the exit phase, the results planned and agreed with the investee can be compared to the results realised. Lessons learned can integrated in the loan and investment process and shared externally (contributing to the 'transform' step in the sector).

Examples of questions to be answered:

- Does the realised impact meet the impact agreed with the investee?
- What do the lessons learned mean for the loan and investment step (due diligence step, conditions loan/investment agreement, active ownership)
- How can other financial institutions benefit from the lessons learned?

Phase 6 Reporting
In the reporting phase, key performance indicators can be used to report on ecosystem services related targets and co-benefits realised (including linkages to the SDGs). Moreover, the results can be used to report on nature-related financial risks and opportunities and the way these risks and opportunities are managed, in line with the TNFD disclosure framework (see chapter 3).

Examples of questions to be answered:

- Is progress towards ecosystem services related targets in line with expectations?
- How have the impacts on ecosystem services contributed to other social and environmental targets (including SDGs)?
- How has the analysis of impacts on ecosystem services and their value contributed to managing nature-related financial risks and opportunities? Wha does this mean for future loans and investments?
- How have Indigenous Peoples and Local Communities benefited from the analysis and the steps following this analysis?

5.3 What is needed to conduct the assessment?

When it is clear where the assessment fits in the loan and investment process, the next question is what tools and data are needed to conduct the analysis. The answer follows from the nature-related risks and opportunities assessment process discussed in section 4.2 and the 5-step process of conducting an impact assessment and valuation presented in section 4.3.

Tools and data needed in each phase of the loan and investment process are summarised in the table below. Depending on the data needed, data can be collected:

- Online, e.g., ecosystem type maps
- Through questionnaires, e.g., location data from investees
- Through field research, e.g., interviews local experts regarding stakeholders affected
- From commercial and non-commercial data providers, e.g., location data and assessment of changes in ecosystem services and their value.

Most of this data gathering is likely to be combined with data gathering already taking place, like the use of questionnaires and field research in the due diligence phase.

Phase	**Data need**	**Sources (examples)**
Scoping & Identification	n.a.	
Due diligence	Asset Location	Investee Commercial data providers
	Ecosystem type before the investment	Investee Local experts/ecologists Ecosystem type maps (European Environment Agency, commercial maps)
	Ecosystem type following the investment	Investee Local experts/ecologists
	Ecosystem condition	Biodiversity Intactness Index Ecosystem Integrity Index
	Ecosystem services affected	ESVD Local experts/ecologists
	Value of ecosystem services affected	ESVD
	Ecosystem services dependencies investee	ENCORE WWF Biodiversity Risk Filter Commercial data providers
	Physical risks	Investee Local experts/ecologists
	Stakeholders benefiting from the services affected	Investee Local experts
	Stakeholders negatively affected	Investee Local experts
	Stakeholders positively affected	Investee Local experts
	Reputational risks	Investee Local experts
	Legislative risks	Local experts Local government
	Co-finance opportunities	Local experts Local government Local financial institutions
Defining conditions	Mitigation measures ecosystem services affected	Local experts/ecologists

loan/investment agreement		
	Involvement local stakeholders	Investee Local experts
Active ownership	Key performance indicators	Financial institution Investee Local experts
Exit ((end of loan, sale of a stock)	Impact data	Investee Local experts
	Lessons learned	Investee Local experts
Reporting	Impact data	Investee Local experts

5.4 How can the results of the assessment be used?

An assessment of the impact of an investment on ecosystem services and the value of these services results in the following outputs:

1. An overview of loans and investments for which the asset location is known and a change in ecosystem type is expected.
2. A comparison of the provision of ecosystem services and their value (Total Economic Value and Net Present Value) between two scenarios: before the investment and following the investment.
3. The (type of) stakeholders that are most likely affected by the investment and in what way.

Each output can be used by a financial institution in its management of nature-related social and financial risks and opportunities:

1. Loans and investments for which the asset location is known and a change in ecosystem type is expected
This result is an important input to the 'Locate' step of the TNFD LEAP process (see section 3.4) and can be used to identify loans/investments for which a more detailed assessment of physical and transition risks and opportunities is needed. In this way it can and should be part of the risk management strategy of a financial institution. Such a strategy is part of the 'Prepare' step of the LEAP process.

2. The provision of ecosystem services and their value before and following the investment
Information on the changes in ecosystem services and their value resulting from a loan/investment is an important input to the 'Evaluate' step of the LEAP framework. It shows what ecosystem services are (potentially) affected and the (change in) value shows how significant this impact is. This information is used in the 'Assess' step of the LEAP process to identify related risks and opportunities.

3. Stakeholders that are most likely affected by the investment and in what way
Insight in the stakeholders affected is key to the identification of physical and transition risks, an important part of the 'Assess' step of the LEAP process. For example, by combining the overview of ecosystem services affected with an analysis of dependencies on ecosystem services (using a database like ENCORE) will show if physical risks are triggered for the investee (company/project).

Insight in other stakeholders affected, including Indigenous Peoples and Local Communities (IPLCs), is key to identify potential transition risks, like reputational risks and legislative risks. Moreover, it will provide insight in possible risks to a project's or company's social license to operate. This license to operate can be key to the success of the project/company.

Similarly, insight in the stakeholders affected allows a financial institution to identify potential opportunities, including co-benefits that support one or more of the sustainable development goals and funding opportunities when stakeholders that benefit are willing to financially contribute to the activities financed. Like payments for ecosystem services and blended finance opportunities (see also section 2.6.3).

6 CONCLUSIONS AND NEXT STEPS

6.1 Conclusions

Based on the desk research and working group meetings, the following conclusions are formulated:

Ecosystem services and nature-related financial risks and opportunities
An assessment of impacts on ecosystem services, their value and stakeholders affected plays a key role in the identification of nature-related financial risks and opportunities. Impacts and changes in value resulting from private finance can trigger both physical risks and transition risks not captured by 'traditional' assessments of impacts on biodiversity and dependencies on ecosystem services.

Analysing these risks and opportunities is a vital step in the LEAP process of the TNFD and is necessary when reporting according to the CSRD. Moreover, the references to ecosystem services within the targets of the GBF and the potential role of ecosystem services valuation in unlocking private finance through blended finance emphasizes the need to both assess and value impacts on ecosystem services.

The argument that monetary valuation of ecosystem services runs the risk of 'commodifying' nature, turning nature into a good that can be traded on the market is invalid. Although the risk should be acknowledged, the goal of monetary valuation of nature is not to price, but to value nature and to create a common language to indicate the value that nature represents for humans and society.

Investing in ecosystem services and sustainable landscapes
Not all ecosystem services have a direct market value, affecting the business case of investing in nature and sustainable landscapes, e.g., through landscape finance. However, by assessing impacts on ecosystem services and the changes in value, the door opens to new financing mechanisms like payments for ecosystem services and blended finance. Both mechanisms, which need to be tailored to national and local situations, constitute important opportunities to develop 'bankable' projects where 'the beneficiary pays'.

An analysis of the (expected/planned) changes in ecosystems, ecosystem services and their value can play an important role in decision making regarding Nature-based Solutions, providing direction to the development of nature-based solutions and providing insight in the gains and losses compared to traditional/grey solutions.

Assessment of impacts on ecosystem services and their value
An assessment of impacts on ecosystem services and their value requires location specific data on the changes in ecosystem type, ecosystem extent, and ecosystem condition and the context where these changes take place. This limits the selection of loans and investments for which such an assessment is feasible.

To establish and enhance confidence in the way ecosystem services are valued, standardization and quality control by an independent third party is needed. A potential standard can build on the System of Environmental Economic Accounting - Ecosystem Accounting (SEEA-EA), an integrated and comprehensive statistical framework for organizing data about habitats and landscapes, measuring the ecosystem services, tracking changes in ecosystem assets, and linking this information to economic and other human activity.

Case studies with ecosystem services valuation, like those conducted in the Make Nature Count studies by ASN Bank and ESVD, show that changes in the provision of ecosystem services

resulting from changes in habitat type, extent and condition may take time to fully develop, influencing the way these changes are financed, e.g. the discount rate used.

Changes in land cover always leads to a change in the ecosystem services provided. This influences a large number of stakeholders who benefit and/or have an interest in these services. At the moment, it is still difficult to link ecosystem services to specific stakeholders because location-specific information regarding stakeholders is often missing.

Integration of ecosystem services impacts and value in the loan and investment process
The discussions in the PBAF Working group show that although many financial institutions are familiar with ecosystem services dependencies and dependencies assessments (e.g., using the ENCORE knowledge base), knowledge of and experience with an assessment of impacts on ecosystem services is virtually absent. The relation between such an assessment and a biodiversity impact assessment and ecosystem services dependencies assessment, already conducted by a growing number of financial institutions, is not yet well understood.

Familiarizing financial institutions with the concept of impacts on ecosystem services will require a step-by-step approach carefully positioning this concept next to the current focus on impacts on biodiversity and dependencies on ecosystem services. Explaining how a focus on impacts on ecosystem services and valuation complements the other assessments and how the results can be combined to better identify potential risks and opportunities. PBAF could play a valuable role in this respect by developing a dedicated Q&A and potentially integrating the assessment of impacts on ecosystem services in the PBAF Standard. Moreover, PBAF should continue the discussion with financial institutions on this topic.

An assessment of impacts on ecosystem services and their value is limited to loans and investments for which the location is known and information is available on the expected/planned changes in ecosystem type, extent, and (preferably) condition. In practice this means a limitation to project finance and direct loans. This may change over time, when more location data of assets becomes available.

Financial institutions can conduct an assessment of impacts on ecosystem services and their value themselves, using local knowledge, maps of ecosystem types and condition and data from the Ecosystem Services Valuation Database. However, certain decisions regarding the selection of ecosystem type, the in- or exclusion of ecosystem services and the valuation of these services may require expert judgement by experienced experts.

Financial institutions participating in the working group agree that an assessment of impacts on ecosystem services and their value fits best within the due diligence step of the loan and investment process, adding value to decision making and informing loan and investment conditions. In the due diligence phase, data gathering can be combined with data gathering already taking place, e.g., through the use of questionnaires and field visits.

Key performance indicators based on Total Economic Value (TEV) or Net Present Value (NPV) can be developed to set targets and monitor performance, both on a project/single investment level and on portfolio level. The result can potentially be linked to other targets of financial institutions, like contributions to the sustainable development goals (SDGs).

6.2 Next steps

The following next steps will be taken by PBAF and FSD to stimulate the assessment of impacts on ecosystem services and their value by financial institutions:

PBAF
An important next step following the PBAF working group on ecosystem services, is the development of a Q&A on ecosystem services impact assessment and their value. By doing so, PBAF will offer a low-entry starting point for financial institutions that want to learn about such

an assessment and the role in the identification of nature-related financial risks and opportunities.

PBAF will discuss with its partners and supporters (financial institutions) whether the PBAF working group on ecosystem services should be continued, developing and discussing practical case studies, or if the focus on ecosystem services should be integrated in working groups that can benefit from such assessments, like the PBAF working group on positive impact.

PBAF will explore the opportunities to present the results of the working group and desk research in a side event during the Conference of the Parties in Colombia in 2024 (COP16).

FSD

FSD will continue to develop practical guidance (including case studies) for financial institutions on the assessment of impacts on ecosystem services and their value, building on this publication and including an explanation of the data need, data sources and the ways to integrate an assessment in the due diligence process.

FSD will explore the opportunities to develop an overview of stakeholders most likely affected per ecosystem service per biome type. This will help the process of identifying who needs to be involved in assessing risks and opportunities, in deciding on the monetary value of ecosystem services and the development of innovative financial products, including landscape finance.

FSD will continue to expand the datapoints in the ESVD database to make it easier to assess the (range of) monetary value(s) of ecosystem services of the various biomes and ecosystems in different parts of the world.

FSD will explore the feasibility of creating an independent, external authority verifying the methodologies used to value ecosystem services. This authority can build on work by the SEEA-EA, the Align project, the TRANSPARENT project, Capitals Coalition (the 'Value commission') and IPBES (the Intergovernmental Platform on Biodiversity and Ecosystem Services).

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ANNEX 1 – THE SEEA-EA FRAMEWORK

In 2021, the United Nations adopted the System of Environmental Economic Accounting - Ecosystem Accounting (SEEA-EA) approach (UN Statistical Commission, 2021). The SEEA-EA framework constitutes an integrated and comprehensive statistical framework for organizing data about habitats and landscapes, measuring the ecosystem services, tracking changes in ecosystem assets, and linking this information to economic and other human activity.

The accounts provide a structured approach to assessing the dependence and impacts of economic and human activity on the environment. In 2021, 36 countries have begun implementing ecosystem accounts (UN Statistics Division, 2021). It allows countries to measure, report and disclose (changes in) their ecosystems and the corresponding ecosystem services annually and in a structured and harmonized way.

This broader SEEA EA framework requires the measurement of the bio-physical characteristics of ecosystems, i.e. the condition or health of an ecosystem and the extent. This forms the basis of understanding the provision of ecosystem services and the impacts and dependencies for different stakeholder groups (see annex 1 for an elaboration of the SEEA framework and an example). The SEEA-EA organized its environmental information to make it coherent with economic information which is organized according to the System of National Accounts (SNA), with the aim to integrate environmental information in existing national statistical frameworks.

The SEEA-EA framework can be applied on a national level, but there are limitations in application on local levels. Moreover, the models are not easily transferable to a private decision-making process as the models operate on different spatial and temporal scales. Finally, since these models focus on ecosystem accounting, only ecosystem services which can be valued through (observed) market prices can be included. Services based on welfare approaches (shadow prices) are not (yet) included even though they represent highly interesting and relevant information for risk management and business development. Other tools and databases can be used for private decision-making, like the Ecosystem Services Valuation Database (ESVD).

The System of Environmental Economic Accounting - Ecosystem Accounting (SEEA-EA) framework is built is built on five core ecosystem accounts[21]:

1. **Ecosystem extent** accounts record the total area of each ecosystem, classified by ecosystem type in the specified area (e.g., nation, province, river basin, protected area, etc.). The accounts are measured over time in the areas by ecosystem type, thus illustrating the changes in extent from one ecosystem type to another over the accounting period.
2. **Ecosystem condition** accounts record the condition of the ecosystems in terms of selected biophysical characteristics at specific points in time. Over time, they record the changes to their condition and provide valuable information on the health of ecosystems.
3. **Ecosystem services physical flow** account record the supply of ecosystem services in physical terms.
4. **Ecosystem services monetary flow** accounts record the supply of ecosystem services and the use of those services by stakeholders such as households, inhabitants etc.
5. **Monetary ecosystem asset** accounts record information on stocks and changes in stocks (additions and reductions) of ecosystem assets. This includes accounting for ecosystem degradation and enhancement.

[21] https://seea.un.org/ecosystem-accounting

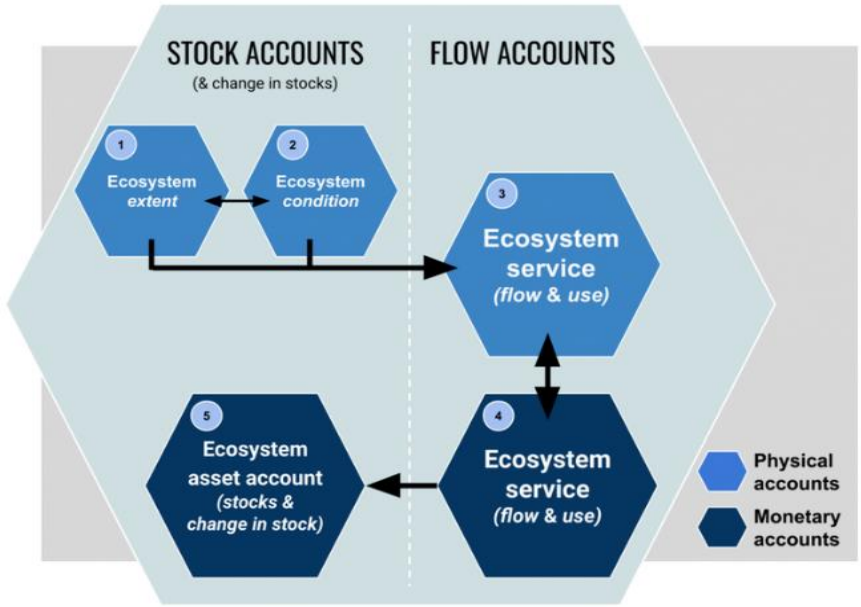

Figure A1: The SEEA-EA framework (from https://seea.un.org/ecosystem-accounting)

Monetary valuation is addressed in steps 4-5 of the accounting framework. Since the condition and extent of an ecosystem are key for the provision of ecosystem service, steps 1 and 2 are key for the integration into decision-making

In step 3 -5, the framework also clearly describes the link with stakeholders, i.e. the beneficiaries of the ecosystem services.

ANNEX 2 – MONETARY VALUATION METHODS ESVD

The table below provides an overview of the different valuation methods used in the ESVD. More information: 'Update of global ecosystem service valuation database (ESVD), 2020[22].

Table A1: Valuation methods used in the ESVD

Valuation method	Acronym	Approach
Choice Modelling (Discrete Choice Experiment; Conjoint Analysis)	CE	Ask people to make trade-offs between ecosystem services and other goods or income to elicit willingness to pay
Contingent Valuation	CV	Ask people to state their willingness to pay for an ecosystem services through surveys
Damage Cost Avoided	DC	Estimate damage avoided due to ecosystem service
Defensive Expenditure	DE	Expenditure on protection of ecosystem services
Group Valuation (Participatory Valuation)	GV	Ask groups of stakeholders to state their willingness to pay for an ecosystem service through group discussion
Hedonic Pricing	HP	Estimate influence of environmental characteristics on price of marketed goods
Input-Output Modelling	IO	Quantifies the interdependencies between economic sectors in order to measure the impacts of changes in one sector to other sectors in the economy. Ecosystems can be incorporated as distinct sectors.
Market Prices (Gross Revenue)	MP	Prices for ecosystem services that are directly observed in markets
Net Factor Income (Residual Value; Resource Rent)	FI	Revenue from sales of ecosystem-related good minus cost of other inputs
Opportunity Cost	OC	The next highest valued use of the resources used to produce an ecosystem service
Production Function	PF	Statistical estimation of production function for a marketed good including an ecosystem services input
Public Pricing	PP	Public expenditure or monetary incentives (taxes/subsidies) for ecosystem services as an indicator of value
Replacement Cost	RC	Estimate the cost of replacing an ecosystem service with a man-made service
Restoration Cost	RT	Estimate cost of restoring degraded ecosystems to ensure provision of ecosystem services
Social Cost of Carbon	SC	The monetary value of damages caused by emitting one tonne of CO2 in a given year. The social cost of carbon (SCC) therefore also represents the value of damages avoided for a one tonne reduction in emissions.
Travel Cost	TC	Estimate demand for ecosystem recreation sites using data on travel costs and visit rates
Value Transfer (Benefits Transfer)	VT	Estimate the ecosystem services value for a "policy site" using existing information from a different "study site(s)".

[22] Rudolf de Groot, Luke Brander, Stefanos Solomonides. 2020. Update of global ecosystem service valuation database (ESVD). FSD report No 2020-06 Wageningen, The Netherlands (58 pp).Brander et al (2020)