Make nature count 2.0

Incorporating the value of nature in impact assessments of financial investments

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Foreword

The mass destruction of nature is still accepted and the norm in the business and financial world. It is actually hugely incentivized in our economic system. For example, a company that destructs a part of a rainforest or contaminates an UNESCO World Heritage Area with harmful metals can do so when it stays within, often limited, legislation.

Due to the fact that nature is not valuated in our financial system, companies and investors are actually financially incentivized to continue to invest in activities that lead to further degradation or the complete destruction of nature. On the other side of the spectrum, companies and investors that invest in activities that protect or restore nature are financially not incentivized to do so.

Continuous climate change and biodiversity loss in the last four decades have led to increasing financial risks for businesses and the financial sector and systemic risk for all of us. These risks have moved to the top of the agenda of the European Central Bank and the 116 Central Banks that are part of the Network for Greening the Financial System.

The monetary valuation of ecosystem services is not new, it has been researched by scientists for four decades. The concept gains more and more appreciation and attention by policymakers, including it in the Kunming-Montreal Global Biodiversity Framework and within the European Commission. This has also led to growing attention for the concept in the financial sector.

In this study, two investments from the ASN Biodiversity Fund of ASN Impact Investors are assessed on their impact on ecosystem services. By applying the concept of monetary valuation of ecosystem services to investments of the ASN Biodiversity Fund, we aim to obtain a better insight in local and on-the-ground impacts of investments in nature. We use these insights to be able to contribute to better informed and sustainable financial decision-making.

ASN Bank has been a pioneer and driver of change in the climate and biodiversity space. In front of you is the Make Nature Count 2.0 report, following up on our previous Make Nature Count report. We hope this report further stimulates the debate around our flawed current economic system and the way forward.

To move to a truly sustainable economic system, all ecosystem services and their associated values, and prices, should be structurally integrated into the decision-making process. Studies like the one presented in this report, and the efforts from the ASN bank through the ASN Biodiversity fund, show how this could be done.

Roel Nozeman

Head of Biodiversity ASN Bank

Executive summary

This Make Nature Count 2.0 report marks the latest step in the joint mission of ASN bank and the Foundation for Sustainable Development (FSD) to integrate ecosystem service valuation into financial decision-making. ASN Bank's long-term goal to achieve a net positive effect on biodiversity through its loans and investments by 2030, is devoted to preventing further biodiversity loss and actively fostering a net increase. FSD is in support of this journey, as a not-for-profit research and consultancy foundation, supporting the conservation and sustainable use of natural ecosystems through building knowledge and awareness of the ways people benefit from and interact with nature. One of FSD's core programs: the Ecosystem Services Valuation Database (ESVD) represents this work. This report outlines our progress, newest insights, and findings in this transformative endeavour of integrating monetary valuation of ecosystem services in investment decisions.

Building on the insights of last year's "Make Nature Count" report, this document delves deeper into the practical application of monetary valuation of ecosystem services. Our aim is to explore where this methodology fits within the evolving frameworks and regulations established over the past year. We investigate how it can be integrated into impact assessments, thereby offering crucial insights on how nature can be considered in decision-making.

The specific objectives of this project were:
1. Measure the impact of land cover changes on ecosystem services and their monetary value by applying economic data from the Ecosystem Services Valuation Database (ESVD) and other sources.
2. Understand how knowledge on ecosystem services and economic valuation can be integrated in investment policies of ASN Bank and ASN Impact Investors.
3. Support efforts of the ASN Bank as a driver of change in the financial sector and society, by fuelling discussions on ways to make Nature truly Count through innovative changes needed to structurally integrate the value of nature in financial decision-making and our economy.

Case studies

To attain these objectives, we evaluated the impact of two ongoing investment projects from the ASN Biodiversity Fund. The first project involves a farm in Spain transitioning from conventional to organic agriculture, while the second centres on a reforestation initiative in the Southern Amazon of Brazil. By applying the concept of monetary valuation of ecosystem services to investments, this report unveils the transformative potential of ecosystem services in bridging the divide between profit and principles. By expressing the value of these services in a universal, monetary language, we gain the ability to estimate the scale and direction of investment impacts on both nature and society. These insights will, in turn, contribute to more informed and sustainable decision making.

For instance, our findings from the case study in Spain conclude that transitioning from conventional to organic agriculture offers long-term benefits as the Net Present Value (NPV) for organic agriculture exceeds the NPV for conventional agriculture after 18 years. Additionally, a broader distribution of ecosystem services, including those that are less marketable, become visible via the economic valuation of ES. As we also show, it is imperative to adopt extended time horizons and adjusted discount rates to fully realize the economic potential of these services.

Similarly, our assessment of the investment in Brazil, focusing on reforestation of degraded pasturelands, demonstrates substantial short and long-term benefits. The total economic value after restoration is approximately $8 million, while this was only $600,000 before. More importantly, a much broader range of services is provided which benefit a diverse group of stakeholders. An important factor in this project is that its success hinges on innovative approaches like compensating farmers for potential losses in food production through carbon credits, highlighting the vital role of Payment for Ecosystem Services (PES) mechanisms.

In this Make Nature Count 2.0 report, we also make a clear case for the need for balancing the provisioning of different ecosystem services within an ecosystem. Something to take into account when hard choices are required in trade-offs to secure the production of essential services like food and water. However, our case study vividly underscores that an exclusive focus on provisioning services carries a considerable risk of devaluing the land to an unsustainable point. This insight resonates with the growing call for a just transition.

In this report, we offer key conclusions that emphasize the urgency of integrating ecosystem service valuation into financial decision-making. Our journey yields two primary insights, with two specific conclusions and three key recommendations:

Redefining Economic Value: Making the Business Case for Nature

1. Ecosystem services valuation provides a clear language for due diligence, offering a path to enhanced stakeholder engagement and new investment opportunities.
2. Ecosystem services valuation is key to determine most effective mitigation strategies.

The Sustainable Investment Case: Three Key Recommendations

It is imperative to:

1. Recognize the value of regulating ecosystem services;
2. Align time horizons with nature's processes;
3. Reevaluate discount rates based on land use.

While the concept of ecosystem services has its limitations and may not be the all encompassing solution we long for, it provides a language that is essential in our transition towards a nature-positive economy. It shows the impact on nature in terms we can understand, revealing both the risks and opportunities. It provides us with the understanding and insights we need to develop the path towards economies that work harmoniously with planetary boundaries.

The undeniable impact of our economies on the natural world is well-documented. Over the past decades, significant efforts have shown us the way. From where we currently are; our position overview in the planetary boundaries, to where we want to go; the Global Biodiversity Framework. Frontrunners have paved the path, and now it is time for all of us to catch up. It is time to build momentum to reach the crucial tipping points that we need in order to steer our economies within planetary boundaries while ensuring inclusivity and equity for all.

Studies like the one presented in this report, and the efforts from ASN bank and ASN Impact Investors through the ASN Biodiversity Fund, show how monetary valuation can be used as a tool to contribute to this mission. Therefore, we highly invite you to read this report and take in its inspiration and insights.

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1. Introduction

ASN Bank has set itself the long-term goal to have a net positive effect on biodiversity as a result of the total of its loans and investments by 2030. With this goal, the bank aims to prevent any additional loss of biodiversity and actively contributes to a net gain in biodiversity. Further detailing of the objective of a 'net positive effect' is currently explored and will be based on international discussions around 'biodiversity positive' and 'nature positive'. Progress towards this goal is monitored annually. To be able to invest in activities with the aim to protect and restore biodiversity, ASN Impact Investors have developed the ASN Biodiversity Fund.

The ASN Biodiversity Fund invests globally in projects and private and listed equity. The fund focuses on four themes: sustainable forestry, sustainable agroforestry, sustainable seas and fisheries, and ecotourism. At the same time, the ASN Biodiversity Fund promotes new 'green' employment opportunities that do not harm nature and contribute to local prosperity. The financial objective of the ASN Biodiversity Fund is a combination of long-term financial capital growth and a modest dividend yield. ASN aims to obtain a better understanding of its impact on biodiversity by means of a biodiversity footprinting methodology, among other methodologies. This is performed for all ASN Impact Investor's funds as well as for ASN Bank itself.

Besides a biodiversity footprint, ASN Bank and ASN Impact Investors employ other means to understand their impact on biodiversity and ecosystem services, using different tools and data. That is why in November 2022, ASN Bank and the Foundation for Sustainable Development (FSD) launched the 'Make Nature Count' report (Van 't Hoff et al., 2022). The aim of the first pilot study was to develop a methodology to gain a better understanding of the (potential) impact of investments on ecosystem services and the economic value of these services to society and local stakeholders. This was done by assessing the expected changes in ecosystem services for four different projects and to assess the value of the ecosystem services affected, using the Ecosystem Services Valuation Database (ESVD) (www.esvd.info). The conclusions of the first project provided valuable first insights on the possibilities to integrate the economic value of nature into financial decision-making and into our economy. The four main conclusions were:

1. Including all ecosystem services in risk assessment is essential to understand the trade-offs.
2. Monetary valuation helps to illustrate the impact of investments.
3. Nature positive investments ask for a different time perspective.
4. Integrated ecosystem valuation changes the perspective on stakeholder involvement.

In this follow-up project, we assess the impact of two current investment projects from the ASN Biodiversity Fund on ecosystem services. The first investment project focuses on the transition from conventional to organic agriculture in Spain. The second investment refers to a reforestation project where degraded pasturelands are reforested to rainforest in the Southern Amazon in Brazil. By applying the concept of monetary valuation of ecosystem services to actual investments of the ASN Biodiversity Fund, we aim to obtain a better insight in local and on-the-ground impacts of the investments on nature and how these insights can contribute to better informed sustainable financial decision-making. The objectives of this project are to:

1. Measure the impact of land cover changes on ecosystem services and their monetary value by applying economic data from the Ecosystem Services Valuation Database (ESVD) and other sources.
2. Understand how knowledge on ecosystem services and economic valuation can be integrated in investment policies of ASN Bank and ASN Impact Investors.
3. Support efforts of the ASN Bank as a driver of change in the financial sector and society, by fuelling discussions on ways to make Nature truly Count through innovative changes needed to structurally integrate the value of nature in financial decision-making and our economy.

Chapter 2 provides a description of the interconnectedness of ecosystem services and the financial sector and describes several concepts and frameworks related to this topic. Chapter 3 provides an overview of the methodology applied. Chapter 4 presents the results of both investment cases and the assessment of ecosystem services and their monetary value resulting from the investments. The conclusions and recommendations are presented in Chapter 5, where the larger picture of the integration of the value of ecosystem services in financial decision-making is discussed.

2. Ecosystem services - Risks and opportunities for the financial sector

2.1 LOSS OF BIODIVERSITY AND THE CORRESPONDING RISKS FOR FINANCIAL INSTITUTIONS

Loss of biodiversity is continuing globally at an alarming rate. The Living Planet Report of WWF (2022) concluded that we have seen a devastating 69% drop of wildlife populations, mammals, birds, amphibians, reptiles and fish, since the 1970s. The Dasgupta review, Nature's worth to society (2021), elaborated on the roots of this problem:

"The true value of the various goods and services it [nature] provides, is not reflected in market prices because much of it is open to all at no monetary charge. These pricing distortions have led us to invest relatively more in other assets, such as produced capital, and underinvest in our natural assets. Moreover, aspects of nature are mobile; some are invisible, such as in the soils; and many are silent. These features mean that the effects of many of our actions on ourselves and others, including our descendants, are hard to trace and go unaccounted for, giving rise to widespread 'externalities' and making it hard for markets to function well (Dasgupta 2021, p.2)."

The World Economic Forum has established that over half of global GDP – approximately EUR 44 trillion – is linked to nature, and addressing the nature crisis could generate 395 million jobs by 2030 (WEF, 2020). Looking at it from another angle, the OECD estimates that the costs of inaction on biodiversity loss are equally high. Between 1997 and 2011, the world lost an estimated USD 4-20 trillion per year in ecosystem services as a result of land cover change and USD 6-11 trillion per year from land degradation (OECD, 2019). These numbers have not been taken into account in investment balance sheets or annual reports, as these costs are seen as externalities to the investment and only become visible in the future, whereby the costs of past non-sustainable investments are of course now felt, and paid for, by current generations.

As a consequence of not taking the full value of nature into account, the loss of biodiversity has an increasingly negative impact on society and businesses, including the financial sector. The Dutch Central Bank and the Netherlands Environmental Assessment Agency (PBL), assessed the risk the Dutch financial sector is facing in their report "Indebted to nature" (Van Toor et al., 2020). In this report, they show that Dutch financial institutions worldwide have EUR 510 billion in exposure through companies with high dependency on one or more ecosystem services.

BOX 1: MAIN ECOSYSTEM SERVICES TYPES (CATEGORIES) AND THEIR DEFINITION

Ecosystem services are defined as "the direct and indirect contributions of ecosystems (biodiversity and nature), to human wellbeing" and comprise the following four main categories:

- Provisioning services are the products or resources that can be harvested or extracted from ecosystems (e.g., food and raw materials).
- Regulating services are the benefits obtained from ecosystem processes that maintain environmental conditions beneficial to individuals and society (e.g., climate regulation, air quality, flood protection, biological control, pollination).
- 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 enrichment, cognitive development, recreation, aesthetic enjoyment, and the appreciation of the existence of diverse habitats and species).

Van Toor et al. (2020) distinguished three types of risks: physical risks, transition risks and reputation risks. Investments are subject to physical risks if natural systems are less able to provide the services that the business depends on, whereby the deterioration of biodiversity and the reduction in ecosystem service provision is often caused by the activities of the companies themselves. Furthermore, financial institutions run reputation risks when they finance companies that have a (major) negative impact on biodiversity. Sometimes these reputation risks can also be seen as a pre-cursor for regulation, which feeds into transition risks. Transition risks are risks financial institutions are facing because of changing laws and regulations in response to decreasing biodiversity and possibly a decrease in ecosystem service provision. Recently, Central banks added the category of systemic risk, acknowledging that when one ecosystem, or a significant number of services within this ecosystem, collapses, it potentially impacts investments far beyond the project-border, in space and time.

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.

An overview of the different types of risks and the relation with economic and financial risk is included in the figure below (NGFS, 2023).

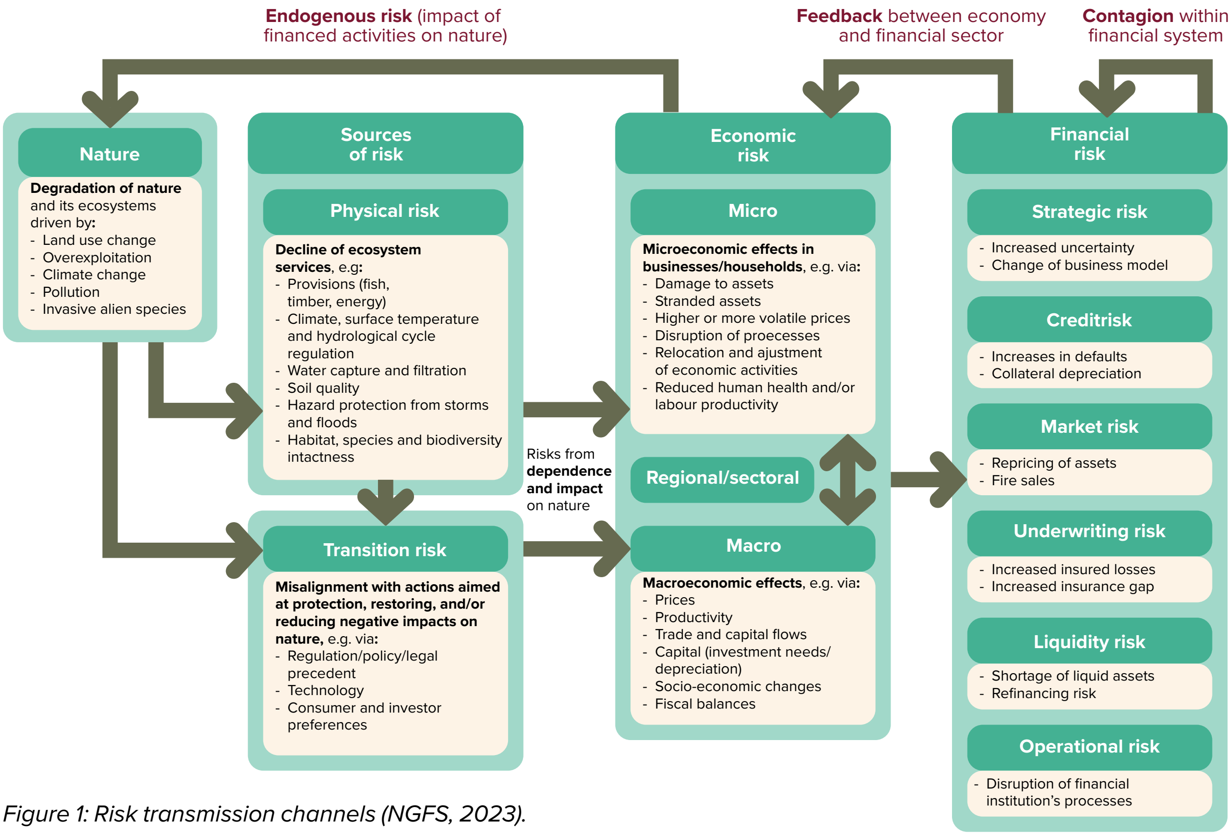

Figure 1: Risk transmission channels (NGFS, 2023).

2.2 OPPORTUNITIES FOR A NATURE-POSITIVE ECONOMY

Aside from potential risks, there are also opportunities originating from investments related to biodiversity. Financing the restoration of nature is fundamental for our economies, as every euro invested returns €7 to €30 in economic benefits (Ding et al., 2017). Moreover, nature restoration is crucial for creating resilience of our social and economic systems as we experience a proliferation and intensification of droughts, wildfires and floods. Nature-positive opportunities can be seen as activities that create positive outcomes for both organisations and nature through positive impacts or the mitigation of negative impacts on nature (TNFD, 2023).

To operate within the boundaries of our planet we need to transition our economy to a 21st century economic system that acknowledges and values these boundaries. The doughnut economy, developed by Kate Raworth, provides a model for a new economy that operates within our social and planetary boundaries (see figure 2).

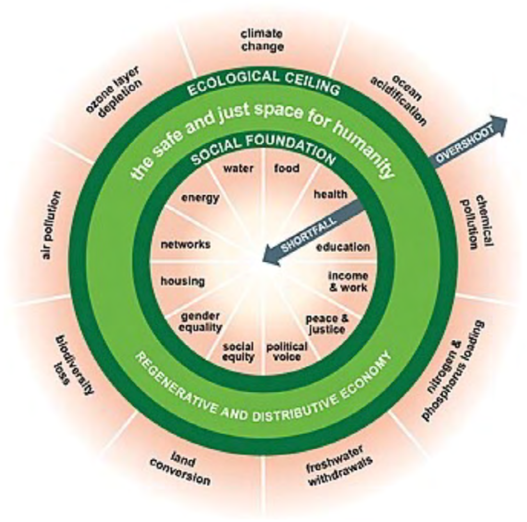

Figure 2. The model of the doughnut economics.

To benefit from these new opportunities, it is crucial that matching financial mechanisms are being developed. Two possible perspectives for nature-positive financial mechanisms are: Payments for Ecosystem Services (PES) and blended finance.

PES is a finance mechanism where both public and private actors, most often landowners or farmers, are incentivized by means of a financial payment to ensure the proliferation of an ecosystem. An example of a well-functioning PES scheme is to be found in China. Where in the wake of devastating flooding along the Yangtze River, China decided to pay more than 120 million farmers to restore forest and grassland on steep slopes. This effectively reduced the risk of future floods (Mandle et al., 2019).

Blended finance is a finance mechanism where private and public financial streams are combined within one investment. Blended finance can help to reduce risks for private investors when investing in nature conservation or restoration, thereby attracting more private finance for such projects. It also provides the opportunity to be used as a multi-stakeholder financing tool, since the benefits and costs of the impact of the investment for different stakeholders (including scope 1, 2, 3, up and down the value chain) are represented in the financial product. A blended-finance example can be found with the Global Environmental Facility (GEF). With the support of the GEF and the World Bank, the Republic of Seychelles launched the world's first sovereign blue bond in 2018 to support sustainable marine and fisheries projects. The bond, which raised $15 million from international investors, demonstrated the potential for countries to harness capital markets for financing the sustainable use of marine resources. The Seychelles blue bond was partially backed by a $5 million guarantee from the World Bank and further supported by a $5 million concessional loan from the GEF, which partially covered interest payments for the bond (GEF, 2018).

Finally, to further understand the different opportunities for nature-positive investing, the Taskforce on Nature-related Financial Disclosures (TNFD) developed a framework to categorise these opportunities in more detail, as seen in figure 3 below. According to the TNFD, opportunities can arise on two areas. The first relates to opportunities that can occur through the strategic transformation of business models, products, services, markets and investments that actively work to halt or reverse the loss of nature. The second focuses on the opportunities that occur when organisations avoid, reduce, mitigate or manage nature-related risks, for example, connected to the loss of nature and its associated ecosystem services that an organisation and society depend on.

Business performance

Markets

Changing dynamics in overall markets, such as access to new markets or locations, that arise from other opportunity categories as a result of changing conditions, including consumer demands, consumer and investor sentiment and stakeholder dynamics

Resource efficiency

Actions an organisation can take within its own operations or value chain in order to avoid or reduce impacts and dependencies on nature (for example, by using less natural resources), while achieving co-benefits such as improved operational efficiency or reduced costs (for example, micro-irrigation, which maximises plant health, reduces water use and reduces costs)

Products and services

Value proposition related to the creation or delivery of products and services that protect, manage or restore nature, including technological innovations

Capital flow and financing

Access to capital markets, improved financing terms or financial products connected to positive nature impacts or the mitigation of negative impacts

Products and services

Changes in perception concerning a company's actual or perceived nature impacts, including the consequent impacts on society and engagement of stakeholders

Sustainability performance opportunity categories

Sustainable use of natural resources

Substitution of natural resources by recycled, regenerative, renewable and /or ethically responsibly sourced organic inputs

Ecosystem protection, restoration and regeneration

Activities that support the protection, regeneration or restoration of habitats and ecosystems, including areas both within and outside the organisation's direct control

Figure 3. Nature-related opportunity categories (TNFD, 2023).

2.3 SETTING THE SCENE

2.3.1 The broader context

Assessing the extent of the different risks and opportunities requires insights in the impacts and dependencies of investments and loans on nature-related projects. In the past years important steps have been made in assessing these impacts and dependencies. Different concepts, initiatives, guidance documents and frameworks on these topics have been published. Examples are TNFD`s LEAP approach (Locate, Evaluate, Assess and Prepare), the Global Biodiversity Framework (GBF), the PBAF Standard on Dependencies, the Network for Greening the Financial System (NGFS)'s conceptual framework and the mitigation hierarchy. The GBF, TNFD's LEAP approach and the mitigation hierarchy will be discussed in more detail below. In order to work towards the most successful adaptation of all of these frameworks they should be approached from a just transition perspective.

Just transition

All these different frameworks and initiatives aim at moving towards a more sustainable future. An important aspect of this transition is making sure that the transition is a so called 'just' transition (European Commission, n.d.). A just transition implies that a transition should happen in a fair and inclusive way, ensuring both the well-being of societies and nature, therefore including social-economic, ecological and financial dimensions. Examples are equal opportunities for all socio-economic groups, acknowledgement of local land rights of indigenous populations, or avoiding the outsourcing of pollution and ecological damage from developed countries to developing countries. Very important in the context of ecosystem services, is the fair distribution of (monetary) welfare gains and losses among different groups in society. The identification of stakeholders through an ecosystem services impact assessment (for example through the LEAP-approach as is discussed below) helps in doing so. An ecosystem services perspective provides insights in stakeholder dynamics through the identification of ecosystem services gains and losses as a result of business activities and/or investments and how this impacts different stakeholder groups.

Global Biodiversity Framework

The GBF was adopted during the fifteenth meeting of the Conference of the Parties on biodiversity (CoP 15) in Montreal in 2022. It sets out a pathway to achieve the global vision of living in harmony with nature by 2050 (see figure 4). All parties of the COP 15 committed to setting national targets to implement the GBF. The difference with other frameworks is that the GBF is an agreement between countries (parties to the Convention on Biological Diversity, the CBD) to commit to a set of targets, whereas other frameworks are mainly helpful tools. 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 these values into (financial) decision-making.

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

- Target 15 requires large and transnational businesses and financial institutions to assess and disclose risks, dependencies and impacts on biodiversity which will be required by 2030.
- Target 18 aims to eliminate, phase out or reform incentives, including subsidies, harmful for biodiversity, in a proportionate, just, fair, effective and equitable way. By 2030, these harmful incentives ought to be substantially and progressively reduced by at least $500 billion per year, starting with the most harmful incentives, and scale up positive incentives for the conservation and sustainable use of biodiversity.
- Finally, target 19 describes the need to mobilise a yearly US$200 billion per year including leveraging private finance and private investments in biodiversity.

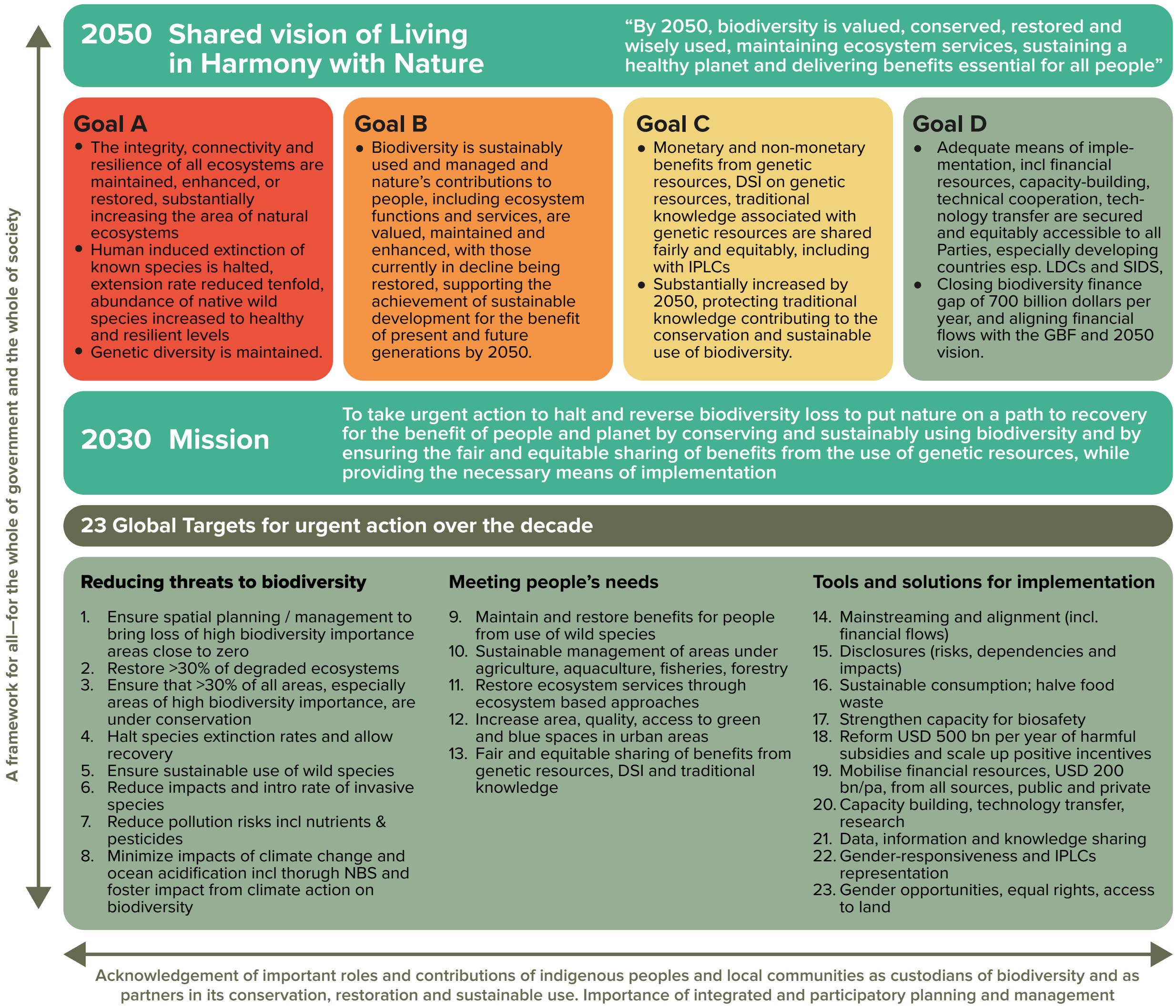

Figure 4. Schematic overview of the Global Biodiversity Framework (UNEP FI, 2023). The complete text of the GBF is available at cbd.int/gbf/

Taskforce for Nature-related Financial Disclosures - Recommendations

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 (see figure 5). This approach offers a structured system 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). The 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-step since it provides insights in who are actually affected and how. Applying this knowledge into (financial) decision-making provides insight in risks and opportunities on both micro and macro level. The TNFD recommendations also closely relate to the Corporate Sustainability Reporting Directive (CSRD), a new EU reporting directive that will be effective from book year 2024 onwards. It will, among other things, require (large) companies to report on their impacts and dependencies on nature and biodiversity. The LEAP-approach aligns with the first step of the CSRD, assessing these impacts and dependencies.

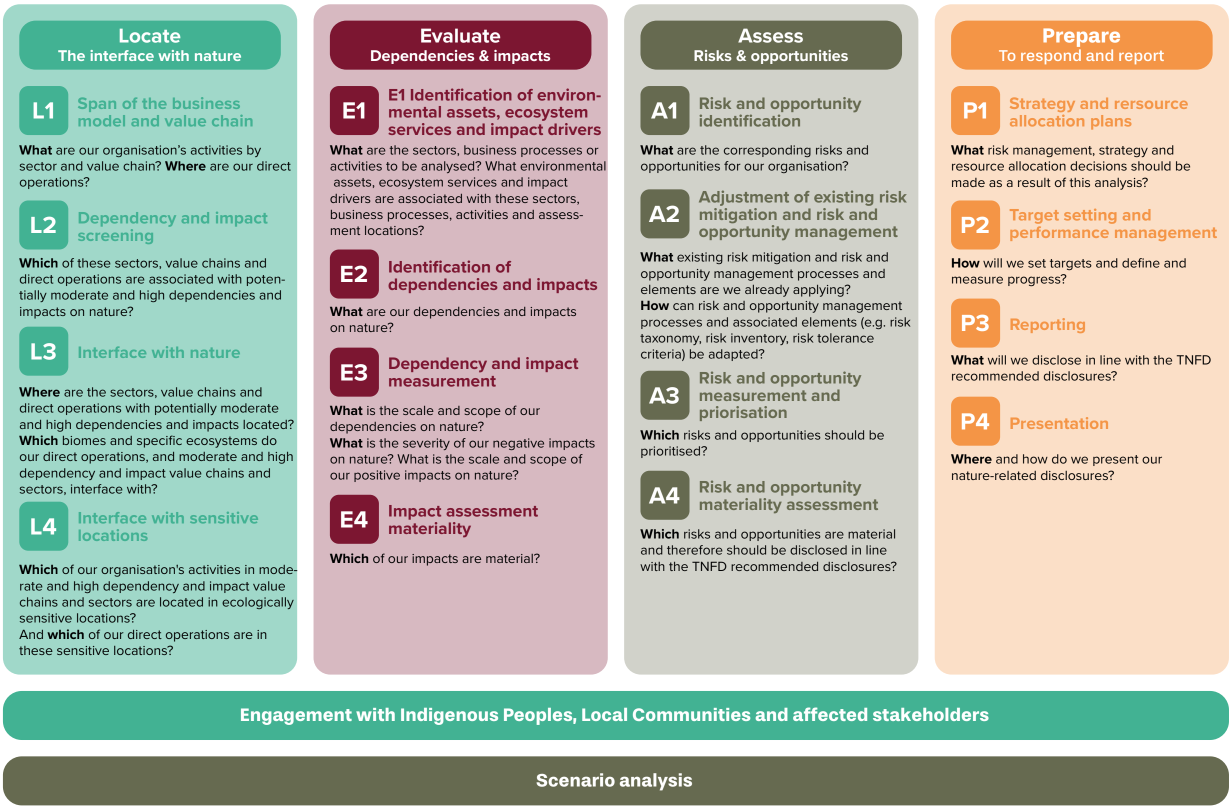

Figure 5. The LEAP approach (TNFD, 2023).

The mitigation hierarchy

Finally, a tool that is widely used with regards to mitigating the negative impact on biodiversity is the mitigation hierarchy (see figure 6). This tool encompasses four different steps related to achieving no overall negative impact on biodiversity: avoidance, minimisation, rehabilitation/restoration and offsetting. The first step, avoidance, aims to avoid creating impacts from the outset. Secondly, minimisation includes measures taken to reduce the duration, intensity and/or extent of impacts that cannot be completely avoided. Thirdly, restoration aims to improve degraded or removed ecosystems following exposure to impacts that cannot be completely avoided or minimized. Lastly, offsetting aims to compensate for any residual, adverse impacts after full implementation of the previous three steps of the mitigation hierarchy. Avoidance is always preferred to minimisation, whereas minimisation is always preferred to rehabilitation/restoration and so on.

An ecosystem services analysis can help in assessing the effectiveness of the different mitigation steps by showing the impact on ecosystems. This provides a guide in the determination of most effective measures, thereby contributing to achieving to the global goal of halting and reversing biodiversity loss by 2030.

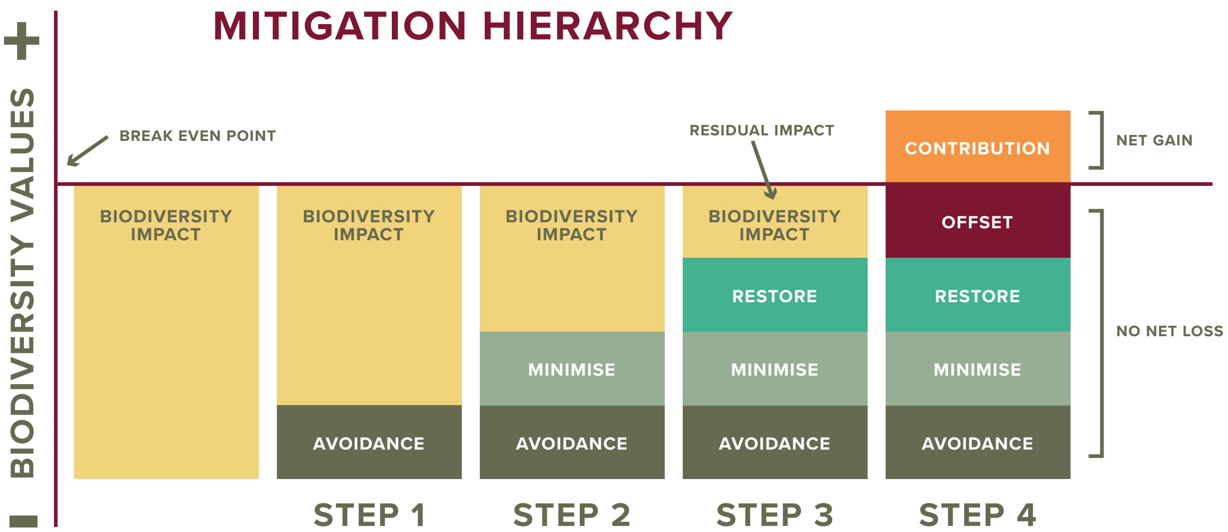

Figure 6. Mitigation hierarchy (Ecologybydesign, n.d.).

2.3.2 The work of ASN Bank

ASN Bank is one of the leading organisations in the field of assessing the impact and dependencies of investment and loans on nature and biodiversity. The ambition of ASN Bank is to have a net positive effect on biodiversity as a result of the total of their loans and investments by 2030. Since its inception in 1960, ASN Bank has developed strong sustainability policies. The bank only invests in projects and companies that meet these sustainability policies. With the ambition to contribute more to nature than taking from it, ASN Bank focuses on achieving a net positive impact, meanwhile realizing that the netting of negative and positive impacts is not acceptable from a biodiversity and ecosystem services point of view. From that viewpoint, the objective of reaching a 'net gain' must be seen as an aspirational goal triggering action.

To achieve this goal and to get a better insight in their impact on biodiversity, ASN Bank developed, together with CREM and PRé Sustainability, the Biodiversity Footprint Financial Institutions (BFFI) to assess expected impacts on biodiversity of loans and investments. It also used the ENCORE-tool to screen for dependencies for a part of its portfolio. ASN Bank is currently developing a roadmap for next steps and actions towards their 2030 goal.

Moreover, the Partnership for Biodiversity Accounting Financials (PBAF) was initiated by ASN Bank and a group of six Dutch financial institutions in 2019 with the aim to develop a sector standard for biodiversity impact and dependency assessment (PBAF Netherlands, 2020). In October 2023, PBAF had 57 signatories (all financial institutions) from 15 countries.

2.4 ECOSYSTEM SERVICES VALUATION DATABASE (ESVD)

2.4.1 Ecosystem Services Valuation

The importance of ecosystem services as the bases of our societies and economies is acknowledged, implictly and explicitly, in all above-mentioned frameworks and directives. The concept of ecosystem services highlights the intricate connection and dependence of our societies and economies on ecosystems, and their contribution to human welfare in general. Ecosystem services and their subsequent economic valuation helps to translate ecological information into economic and policy-relatable terms. A better understanding of the monetary value of ecosystem services allows relevant stakeholders to speak a common language and come to better informed decisions (see box 2 for the broader context of monetization). The valuation of ecosystem services is also relevant because it provides a comprehensive and structured overview of the (potential) gains and losses, and their order of magnitude, in individual and societal welfare as a result of changes in biodiversity and ecosystems.

However, assessing and quantifying changes in ecosystem services and their monetary value due to the impact of land cover changes and/or changes in biodiversity is labour intensive, costly and empirical data is not easily available.

BOX 2: THE VALUE OF VALUING NATURE

To measure the 'true value' of nature in monetary terms is by definition impossible but the cost of not taking the value of nature into account in every day decision-making is huge. After 25 years of development in the field of valuing ecosystems, Daily and Ruckelshaus (2022) published an overview in the Journal 'Nature' of how these valuations advanced since then and what the value of monetization proved to be:
"A quarter of a century ago, Costanza et al. put forward an estimate for the economic value of global ecosystem services. The authors valued these at US$33 trillion per year. Objections to the exercise were raised on many grounds, from those involving technical matters to ethical concerns about pricing nature. Yet Costanza and colleagues' bigger aim went far beyond merely producing a number. They wanted to reframe the way people think about nature, especially in the context of economic decision-making." All the other efforts that were being made until that point *"highlighted key elements of what needed to change, and addressed how fast and why the alterations were necessary. But a burning question remained largely unanswered: how to move from knowledge to action."* With the introduction of monetary valuation of ecosystem services, the change in economic and financial decision making could be made. Governments and local communities started to include nature in decision-making for example through developing Payment for Ecosystem Services (PES) schemes, or redirected funding towards an ecological approach on problem solving. *"The many efforts to value ecosystem services help to advance this kind of funding for nature beyond the usual kind, provided by philanthropy."* (Daily and Ruckelshaus, 2022)

Natural Capital Accounting

The concept of ecosystem services and its subsequent economic valuation has recently become more prevalent in public and private decision-making. In 2021, the United Nations adopted the System of Environmental Economic Accounting - Ecosystem Accounting (SEEA-EA) approach (UN Statistical Commission, 2021). The SEEA-EA 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. In 2021, 36 countries have begun implementing ecosystem accounts (UN Statistics Division, 2021). 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. Although this effort is focused on the integration of ecosystem services in public decision-making, there are still many countries that have not yet started implementing the SEEA-EA approach. Additionally, these frameworks can be applied well 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 they operate on different spatial and temporal scales. Finally, since these models focus on ecosystem accounting, only ecosystem services that can be valued through (observed) market prices can be included. Services based on welfare approaches (shadow prices) are not (yet) included, while in the context of financial decision-making they represent highly interesting and relevant information for risk management and business development.

2.4.2 Monetary data: The 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) and 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, including all different approaches to monetary valuation. 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 1,200 studies and new values are added continuously. With the ESVD, the annual monetary value of individual ecosystem services can relatively easily be translated into a Total Economic Value (TEV), representing the actual or potential sustainable total flow of ecosystem services for an ecosystem or area per year. To analyse the net-benefits (or costs) of an investment, it is important to have information about the (net) present value of the future benefits (or costs) of the project. With data from the ESVD, the Net Present Value (NPV) of an ecosystem can be calculated for different scenarios of change in ecosystem services, using projections of the changes in TEV (resulting from changes in flows of ecosystem services) over a given time period at a certain discount rate. In recent years, the ESVD has increasingly been used in the context of private decision-making, proving its use for a broad range of public and private stakeholders.

2.4.3 Use(r)s of the ESVD

Data from the ESVD can be used in many different ways including (environmental) impact assessments and integrated Cost Benefit Analyses, and thereby contribute to better informed decision-making. The ESVD has been used by a variety of stakeholder groups such as:

International Governmental Organizations

With the impact of climate change, land degradation and biodiversity loss becoming increasingly visible, organizations like FAO, IPCC, UNEP and others are in need of data on the societal costs of these environmental problems as well as the economic benefits of investing in prevention, mitigation and adaptation.

Governments (local, regional national and supra-national decision-making bodies)

At all levels of public decision making, similar questions as those mentioned above are relevant but in addition, national, regional and local governments are in need of better data on the impact of programs and projects that affect society at large. Most projects in the private sector mainly account for the effects of their investments on their own private financial returns, whereas governments (aim to) also focus on societal welfare. The ESVD is of great value to make these broader welfare effects more visible. Moreover, the implementation of the Global Biodiversity Framework through National Biodiversity Strategies and Action Plans (NBSAPs) will require governments to take ecosystem functioning and the value of ecosystem services into account.

Financial sector

To support the transition to a nature-positive economy, the financial sector is crucial. The loss of biodiversity increasingly impacts society and businesses, including the financial sector. As mentioned before, in September 2023 the Taskforce on Nature related Financial Disclosures (TNFD) published its recommendations on a nature-related risk management and disclosure framework (TNFD, 2023) in which they underpin the importance of ecosystem services in measuring and reporting on nature-related risks and opportunities. The framework takes a 'double materiality' approach, focusing on impact materiality (inside out) and financial materiality (outside in).

Business sector and consultants

The business community is facing the double materiality risks that the decline of biodiversity is triggering, forcing businesses to take nature loss and the degradation of ecosystem services into account. Furthermore, societal pressures towards more sustainable businesses, upcoming legislation and regulation, such as the Corporate Sustainability Reporting Directive (CSRD) and the Corporate Sustainability Due Diligence Directive (CSDDD) are a strong incentive for businesses to develop more sustainable business models and practices. Understanding their impact on nature through the concept of ecosystem services valuation plays an essential role in developing the most effective models and practices.

NGOs

An important function of NGOs is to critically follow the actions of governments and their effects on the environment and human wellbeing and take the role as 'frontrunner' to put new ideas into practice and show that these can work. The ESVD has proven to be a solid and freely accessible database to help strengthen their arguments with more complete information about the costs of biodiversity loss and benefits of biodiversity conservation and ecosystem restoration.

See www.esvd.info for further information and examples of users and practical applications of the ESVD.

2.4.4 On the commodification of nature

A common argument that arises with regards to the monetary valuation of nature is that it commodifies nature, thereby neglecting other types of values such as intrinsic or relational values. One could say that by doing so, nature is reduced to a transaction vehicle and any natural area can be replaced as long as a monetary transaction takes place. We acknowledge this limitation and we find it key to note that the goal of monetary valuation of nature is not to price, but to value nature. Monetary valuation thereby becomes a way of communicating, a common language to indicate the order of magnitude of the value that nature represents for humans and society. This helps to understand the trade-offs in the system that the investment or activities will trigger. The concept of ecosystem services is a way to break this understanding down in smaller pieces to strengthen our understanding of the system as a whole.

A topic that is closely related to this debate is the concept of biodiversity credits. Biodiversity credits are measurable and tradeable units of biodiversity. It differs from biodiversity offsets, since biodiversity credits are not used to compensate for a negative impact on biodiversity, but more as a means for companies and institutions to (voluntarily) support nature-positive action. The goal of biodiversity credits is therefore to draw private finance into nature conservation and restoration. The Wallacea Trust methodology defines a biodiversity credit as a *“1% uplift or avoided loss in biodiversity per hectare, as measured by the median percentage change in a basket of biodiversity metrics that together reflect the conservation objectives for the project region (Wallacea Trust 2023, p.5)”*. The main argument against the use of biodiversity credits is that it commodifies nature while nature is location-specific, complex and has a very local identity. Since there is no single metric to describe biodiversity, it makes it nearly impossible to price biodiversity in a way that adequately represents the value of it. Additionally, it also raises questions whether the use of biodiversity credits will lead to the desired outcome of improving, restoring and conserving nature, as nature functions in location specific ecosystems as a whole. Parts (specific ecosystem services) cannot be substituted for one location by another. Furthermore, the line between biodiversity credits and offsets is blurred and there are no clear guidelines or regulations in place.

In this project, we are in no regard using the concept of ecosystem services valuation in relation to biodiversity credits. We only use it as a language to indicate the order of magnitude of the value that nature represents for humans and society. This is also the reason why the monetary values mentioned in this report are rounded amounts and calculated in 2020 international dollars, rather than in current Euro values.

3. Methodology

3.1 SELECTION OF THE INVESTMENT CASES

First, two different investment cases of the ASN Biodiversity Fund were selected that would be eligible for an assessment of changes in ecosystem services affected by the investment.

Based on the first 'Make Nature Count' report (Van 't Hoff et al., 2022), there were two specific selection criteria. These were:

- Availability of information on the land cover categories and condition before and after the investment. Preferably internationally accepted natural land cover categories, such as the IUCN Global Ecosystem Typology (IUCN GET), were used. However, other descriptions of land cover were also found suitable. The description should be as detailed as possible, preferably at the ecosystem level.
- Availability of information on the investment location, specifically on the land cover change and ownership of the area. This allows for determining, among other things, the type of ecosystem when this is not described. The provisioning of ecosystem services and the flow of benefits provided is very context specific, therefore information on the location is very important. This criterion allows for a better assessment of the impacts and dependencies of investments on ecosystems and associated ecosystem services.

These criteria were then applied to all ASN Biodiversity fund investments. This resulted in the selection of two investment funds as part of the ASN Biodiversity fund: SLM Silva Europe Fund and the Amazon Biodiversity Fund (ABF). After discussing this project with both SLM and ABF, we obtained information on two investment cases from their ASN related portfolio. SLM Silva Europe Fund shared a case about the transition of a Spanish farm 'El Roble' from conventional to organic agriculture. The Amazon Biodiversity Fund provided a case about reforestation of degraded pasturelands in the Southern Amazon region. Both investment cases are discussed in detail in Chapter 4.

3.2 ASSESSMENT PROCEDURE

For both cases, we applied the same assessment procedure to determine the monetary value of ecosystem services affected. This procedure was largely similar as in the 'Make Nature Count' report, with some significant improvements, such as the incorporation of a time factor in the provisioning of ecosystem services. This means that we incorporated a gradual increase in the provisioning of ecosystem services in the case of nature restoration and the planting of crops, instead of assuming that all ecosystem services are delivered immediately. Additionally, we investigated the impact of different discount rates on the outcomes (see step 4 below). The elaboration on these two points stems from discussions in the field on appropriate timelines, discount rates and which adjustments are necessary in order to build a nature positive and economically viable business case. The procedure consists of four steps. Each step is explained below.

Step 1: Understanding and describing the context of the case study and determining the different land cover change scenarios

In order to align the project data with the ESVD, it is crucial to understand the context of the study area and to extract the relevant project information provided by the funds. Based on the data provided, we developed two different land cover scenarios. For each case study, the Business as Usual (BAU) scenario assumes no change in current land cover. The investment scenario describes the changes in land cover that are expected to take place due to the investment. The more detailed and location-specific the information, the more detailed the different land cover scenarios can be.

Step 2: Aligning the provided land cover data with land cover and biome/ecosystem definitions used in the ESVD

Paramount was to match the local land cover information with the ESVD biomes and ecosystems classification. Based on locally provided information, a relevant subset of the ESVD data was created. Creating the data subset is based on two criteria: (1) Most closely resembling the biome/ecosystem types used in the ESVD and (2) the availability of monetary values in the ESVD.
Depending on the availability of data for the best matched ecosystem, i.e. if there is a very limited number of monetary values for an ecosystem, closely related ecosystems can also be used. In these cases, the monetary

values from the best matched ecosystem will be supplemented by monetary values from closely related ecosystems. Oftentimes, there is a trade-off between biome/ecosystem availability and the number of available values.

Step 3: Calculating the standardized monetary values of ecosystem services provided by the relevant biome/ecosystems for different land cover scenarios

To create summary statistics from the ESVD data subset, average values in International dollars per hectare per year for a given biome/ecosystem were calculated. To calculate a summary value, we took the average values of different standardized monetary values per ecosystem service for a biome/ecosystem. We removed outlier values (extreme high or low values) based on expert judgement from our own team of specialists. A value could be considered an outlier if it reflects a substantial part (approximately >50%) of the summary statistics. Additionally, for part of the ESVD data, an outlier exclusion rule of 1.5 interquartile range (IQR) was applied. However, because values and therefore also outliers are very context-specific, it should be noted that it is difficult to apply a standard rule.

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

Finally, we calculated the changes in monetary value of the total bundle of ecosystem services provided by the case study area to illustrate the implications of an investment in terms of monetary gains and losses for private and public stakeholders.

The Total Economic Value (TEV) reflects the actual or potential sustainable use of the total bundle of ecosystem services provided by a particular ecosystem, for a specific area, per year. Usually, TEV is expressed for a specific ecosystem in value/ha/year. To compare the different land use scenarios, the TEV/ha/year is multiplied by the total area of that specific ecosystem, or land use type, in the case study area.

The TEV enables comparison of the monetary values of the chosen scenarios before and after the intervention. It is therefore a static value, which does not or only limitedly incorporate fluctuations in changes in ecosystem services flow over time. Ideally, the TEV should be calculated for each intermediate step (year) between the start and end of the project.

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 (i.e., the TEV), 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 case studies is 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. That is why some even argue for a negative discount rate for nature restoration projects time. We thus implicitly over-estimate the NPV for agricultural systems and under-estimate the NPV for natural systems. To show the effect that discount rates have on the outcome of the analyses, we decided to also show the outcome under different discount rates.

BOX 3: PUBLIC VERSUS PRIVATE BENEFITS FROM ECOSYSTEM SERVICES

Ecosystem services can be categorised in 4 different categories: provisioning (e.g. food, feed, fiber, drinking water), regulating (benefits of ecological processes such as carbon-sequestration and pollination), habitat (to maintain biodiversity) and cultural services (the non-material benefits such as recreational and inspirational benefits) (de Groot et al., 2010).

Provisioning services can generally be priced in markets and its benefits usually are for private stakeholders. Regulating and habitat services are often invisible and unaccounted for because they are not directly traded on markets. Outside of carbon credits, there are no systems in place to buy and sell clean air or the capacity of a mangrove to provide buffers against flooding events. Additionally, beneficiaries of regulating and habitat services are generally the public society. Their value is often only noticed once the service is lost as their loss most often has long-term, negative impacts, even though their economic value often goes unnoticed in the short term. Cultural services usually have a mix of marketable and non-marketable benefits for both private and public beneficiaries, on a short and longer term.

Because many regulating and habitat services are not priced, but have a large value, it is crucial that we look beyond conventional market tools to show the importance of nature to our wellbeing. Additionally, the distinction between private and public ecosystem services helps to understand the difference in terms of who 'benefits' and who 'loses' from changes in land use, and thus changes in the availability of ecosystem services. Private land, mostly used for agriculture, primarily yields provisioning services, benefiting mainly private stakeholders. While natural areas offer a broader spectrum of ecosystem services, which provide essential benefits for public and private stakeholders. Part of the purpose of this project is to better account for these public and economically invisible ecosystem services and show their large economic importance through translating their value into a monetary unit.

General methodological considerations

- Disservices (i.e., ecosystem processes and dynamics which have a negative influence on human wellbeing), are not taken into account. An example of a disservice is the occurrence of new pests in crops after land use change.
- Negative off-site externalities of land management resulting from investment practices are also not taken into account. These are very prevalent in human-dominated ecosystems such as agricultural lands. An example is fertilizer run-off from a corn field which influences ecosystems downstream.
- Another difficulty is that there is currently limited scientific consensus on the exact links of these factors (disservices and management off-site externalities) and the condition of an ecosystem, nor on the impact on the monetary value of the affected ecosystem services.
- Because of limited resources and the short timeframe of the project, we assume linearity for the development of some ecosystems and their related ecosystem services over time.
- For case-specific assumptions, we refer to the appendix.

4. Investment cases

4.1 INVESTMENT CASE 1: EL ROBLE

Description

The first case we analysed was the investment in the 'El Roble' farm by SLM Silva Fund Europe. This farm is located in Murcia, Spain. The total surface of farm area is almost 300 hectares. Different crops are produced, such as olives and almonds. The dominant type of climate in this area is Meso-Mediterranean, with little rainfall throughout the year and a high torrential rate. The natural vegetation is characterized by Mediterranean wood- and shrubland (Expósito, n.d.). In the recent years, this region faced more frequent and more intense droughts. Due to climate change, this is expected to exacerbate further. Besides these droughts, intensive agricultural practices have degraded parts of the land and decreased biodiversity in the area. To increase resilience against droughts and promote biodiversity, the farm is transitioning to 100% organic and regenerative agriculture.

To analyse the (potential) effects of this transition on ecosystem services, we used two scenarios: conventional agriculture and organic agriculture. In appendix 1, a full list of assumptions for these scenarios can be found.

Conventional agriculture

The BAU scenario describes the situation prior to the investment. The farm consisted of conventional agriculture, producing rainfed almonds, olives, peaches, apricots, and wheat. All crops are assumed to provide mature yields, except for the rainfed almond trees (see appendix 1), which were planted in 2017. Besides crop production, the farm also consisted of (some partly) degraded natural areas. We assume that these degraded natural areas would not be restored in the BAU scenario and thus stay degraded, therefore delivering less ecosystem services compared to healthy ecosystems.

Organic agriculture

The investment scenario describes the transition from conventional to organic agriculture including a different combination of crops and the restoration of formerly degraded natural areas. The farm produces rainfed and irrigated almonds, rainfed and irrigated pistachios and olives. Besides the rainfed almond trees planted in 2017 (see conventional agriculture), new irrigated almond and both rainfed and irrigated pistachio crops are planted in the first year of the investment. These are assumed to start production after 4, 7 and 5 years, and reach maturity after 7, 11 and 9 years, respectively. The area that was used to grow stone fruits (peaches and apricots) is converted to both irrigated almond and irrigated pistachio trees, and to a natural area. The degraded natural areas will be restored and are assumed to gradually increase their provisioning of ecosystem services over time.

Olive crops and natural area at the El Roble farm.

Besides the natural areas, hedges and biodiversity hotspots bordering the plots will be created, specifically dedicated to increase biodiversity. For this exercise and for simplicity purposes, the natural areas are grouped together with the different degraded natural areas that are being restored, hence the same ESVD subset applies to the different natural areas.

Table 1 below provides an overview of the different land cover types per scenario in hectares. The investment aims to replace wheat and stone fruits in the BAU scenario by several other crops while it aims to restore the 40.42 ha of degraded area and the additional creation of 2 ha of natural areas.

Table 1: Overview of different land cover types in both scenarios.

Land cover	#ha in conventional agriculture	#ha in organic agriculture
Rainfed almonds	72.1	72.1
Irrigated almonds	-	27
Olives	23.5	23.5
Rainfed pistachios	-	66.3
Irrigated pistachios	-	30
Wheat	78.8	-
Peaches	17.25	-
Apricots	29.25	-
Natural area	34.72	34.72
Degraded natural area	40.42	-
Natural area to be restored	-	42.42
Total	296.04	296.04

Ecosystem services

Both agricultural and natural ecosystems deliver ecosystem services, albeit in various forms and quantities. The ecosystem services included in the analysis are described in appendix 1. It is likely that more ecosystem services such as several habitat services are provided. However, due to a lack of data, these are not included in the analysis. This means that the outcomes are most likely an underestimation of the 'true' value (see the results section for more information).

In addition to the ESVD, we also used other relevant and available literature for data from the specific area. These data help to provide more accurate estimates of the ecosystem services that are provided, since biodiversity and ecosystem services are location-specific. Concerning the ESVD, we used values from the "Mediterranean wood- & shrubland" ecosystem, since this most closely resembles the natural ecosystem in the investment case. We refer to appendix 1 for a more elaborate description of the quantification and monetization of the ecosystem services. All ESVD values are in 2020 US dollars. We therefore corrected values obtained from outside the ESVD to 2020 US dollars.

Results

This section describes the results of the analysis. Firstly, the TEV and NPV are presented. Lastly, the effect of non-uniform discount rates on the NPV is discussed.

The Total Economic Value of the investment

Table 2 provides an overview of the TEV of both scenarios. In this case, the TEV reflects the flow of ecosystems to be in a static state at "full potential". This means that all the planted crops have reached maturity, and the natural areas in the scenario with organic agriculture are fully restored.

The TEV of the farm (full potential) with conventional agriculture is around $1.7 million per year ($5,720 per ha/yr), whereas the TEV with organic agriculture is around $2.9 million per year ($9,800 per ha/yr). This shows that the TEV of the farm increases by approximately $1,210,000 (70% increase) due to the transition to organic agriculture and the restoration of natural areas. There is an increase in value in the investment scenario for all four different ecosystem service categories. The difference in total provisioning services is approximately $800,000 (62%). Of these provisioning services, pistachios account for a large share of the total increase as they are a valuable crop. Regulating services increase by $390,000 (98%), habitat service increases by $160 (100%) and cultural services increase by $20,000 (370%). Interestingly the regulating, habitat and cultural services, which often are not reflected in market prices, show the largest relative increase. Table 2 clearly shows that the increase in their value is the result of the restoration of the natural areas. The results therefore indicate that the investment has a positive effect on nature and the corresponding ecosystem services, leading to an increase of both private and societal value.

There are also a few provisioning ecosystem services that decrease as compared to BAU scenario. This follows logically from the fact that peaches, apricots (stone fruits) and wheat are replaced in the investment scenario which brings their value to ‘0’ in the investment case. Additionally, there are some ecosystem services which are most likely provided, but for which there was no data available (see table 2). Therefore, the relatively low value for habitat services in table 2 is most likely an underestimation.

Table 2: Total Economic Value (TEV) of the farm (296.04 ha) in both scenarios, assuming all crops have reached mature yields. As explained before, the value of air quality regulation is not included in the calculation of the TEV. The ecosystem services for which no (relevant) data is available, but are likely to be provided are indicated by a grey colour.

Ecosystem service	Land use	Conventional agriculture (full potential)	Organic agriculture (full potential)	Difference
Provisioning	**Total provisioning services**	**$ 1,294,133**	**$ 2,095,202**	**$ 801,069**
Crop production	Rainfed almonds	$ 299,904	$ 299,904	$ -
	Irrigated almonds	$ -	$ 195,318	$ 195,318
	Olives	$ 229,499	$ 229,499	$ -
	Rainfed pistachios	$ -	$ 719,421	$ 719,421
	Irrigated pistachios	$ -	$ 651,060	$ 651,060
	Peaches	$ 159,721	$ -	-$ 159,721
	Apricots	$ 541,663	$ -	-$ 541,663
	Wheat	$ 63,346	$ -	-$ 63,346
Water	Natural area	$ -	$ -	$ -
Genetic resources	Natural area	$ -	$ -	$ -
Medicinal resources	Natural area	$ -	$ -	$ -
Ornamental resources	Natural area	$ -	$ -	$ -
Regulating	**Total regulating services**	**$ 394,234**	**$ 781,966**	**$ 387,732**
Air quality regulation	Natural area	$ 65,936	$ 131,220	$ 65,284
Carbon sequestration	Natural area	$ 98,839	$ 196,700	$ 97,861
	All crops	$ 258,783	$ 299,380	$ 40,597
Moderation of extreme events	Natural area	$ -	$ -	$ -
Regulation of water flows	Natural area	$ -	$ -	$ -
Waste treatment	Natural area	$ -	$ -	$ -
Erosion prevention	Natural area	$ 624	$ 1,241	$ 617
Maintenance of soil fertility	All crops	$ -	$ 28,245	$ 28,245
Biological control	Natural area	$ -	$ 12,370	$ 12,370
Pollination (for almonds)	Natural area	$ 35,988	$ 71,977	$ 35,989
	Natural area	$ -	$ 172,053	$ 172,053
Habitat	**Total habitat services**	**$ 159**	**$ 322**	**$ 163**
Existence, bequest values	Natural area	$ 159	$ 322	$ 163
Maintenance of genetic diversity	Natural area	$ -	$ -	$ -
Maintenance of life cycles	Natural area	$ -	$ -	$ -
Cultural	**Total cultural services**	**$ 5,367**	**$ 25,483**	**$ 20,116**
Aesthetic information	Natural area	$ -	$ -	$ -
Opportunities for recreation and tourism	Natural area	$ 5,367	$ 10,681	$ 5,314
Education/science	Whole farm	$ -	$ 14,802	$ 14,802
Inspiration for culture, art and design	Natural area	$ -	$ -	$ -
Spiritual experience	Natural area	$ -	$ -	$ -
Information for cognitive development	Natural area	$ -	$ -	$ -
	Total whole farm	**$ 1,693,893**	**$ 2,902,973**	**$ 1,209,080**

Figure 7 shows the distribution of the TEV among the four ecosystem services categories of both scenarios. In the organic agriculture scenario, regulating, habitat and cultural ecosystems services account for a larger share of the TEV as compared to conventional agriculture. This again highlights the relatively large increase in regulating, habitat and cultural ecosystem services due to the restoration of natural areas and biodiversity.

The increase in benefits from regulating, habitat and cultural ecosystem services is relevant because these services are often considered to be public goods, underpinning the health of the landscape, influencing surrounding communities and broader society. As shown, regulating services see the largest relative increase. Additionally, these benefits are often invisible economically because their value is not traded on markets. However, these increases in value have an actual positive effect on a diverse array of stakeholders and are of very real value.

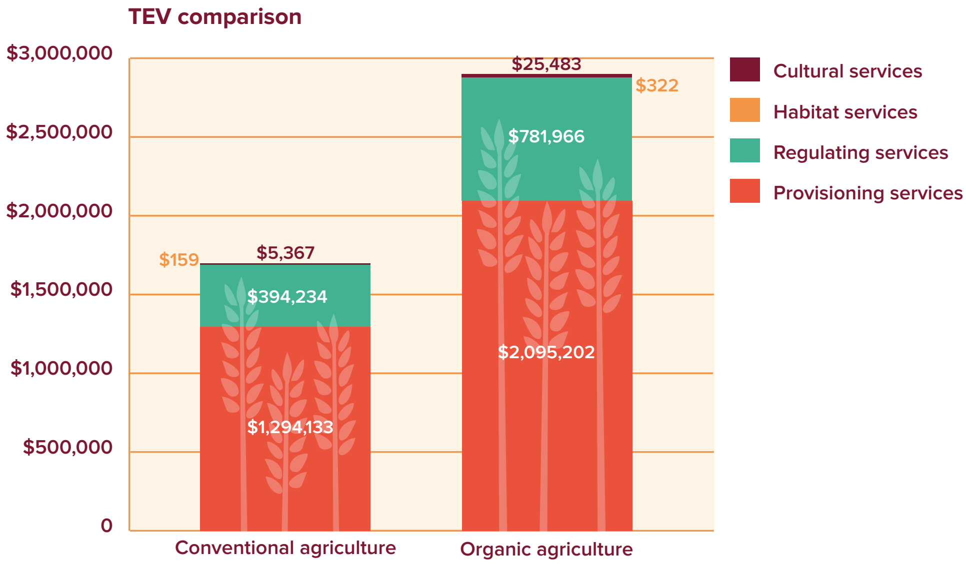

Figure 7: Comparison between the Total Economic Value of the farm (296.04 ha), when all crops have reached mature yields, of both scenarios, split out in the four types of ecosystem services categories.

Net Present Value

The NPV takes the factor of time into account. For this investment project we used a time horizon of 20 years, which is larger than the projected timeframe of the financial investment (10 years) in (the transition of) the farm. The time horizon of 20 years was used to better account for the time horizon of nature restoration (Poorter et al., 2021). Appendix 1 includes a table with an overview of the discounted values of each of the ecosystem services that make up the NPV, both after 10 and 20 years.

After 10 years, the total NPV in the BAU scenario is approximately $12.1 million while this is $9.5 million in the investment scenario. Interestingly, it shows that the NPV of the organic agriculture scenario therefore is approximately $2.6 million lower after the investment, when taking the 10-year time horizon into account. This observation follows from a lower value of provisioning services ($3.8 million). This is caused by the time needed for the crops in the investment scenario to reach mature yields. However, when a longer time horizon is used, the results change. The regulating, habitat and cultural services increase substantially which is the result of the restoration of and the increase in natural areas on the farm.

Although the investment timeline of this project is 10 years, it is important to note that the growing orchards which will stand for 20-25 years will increase the value of the land. When the land is sold, the valuation at exit will include both the value of the land and the future expected cash flows from the orchards. This capital appreciation is not included in this analysis, since this analysis solely focused on the transition to organic agriculture and the effect on corresponding ecosystem services.

Figure 8 shows the NPV over 20 years with a discount rate of 5%. The line graph highlights some very interesting observations. It shows that the NPV of conventional agriculture is higher than the NPV of organic agriculture for several years, creating an initial deficit. This deficit follows from the observation that restoration of natural areas and therefore the provisioning of ecosystem services takes longer than 10 years to reach full capacity. Nature needs time to regenerate, grow and recover. Additionally, the crops need time to reach maturity. Therefore, longer financial time horizons are needed to buffer and compensate for this natural growth. The deficit decreases over time because the crops need time to reach maturity. The graph shows that after 18 years, NPV of organic agriculture surpasses the BAU scenario of conventional agriculture, making the investment beneficial in terms of ecosystem services. This initial deficit as a result of the investment is often referred to as the “valley of death” and implicates the need for a system shift, as nature works on different time scales than financial investments do (see chapter 5).

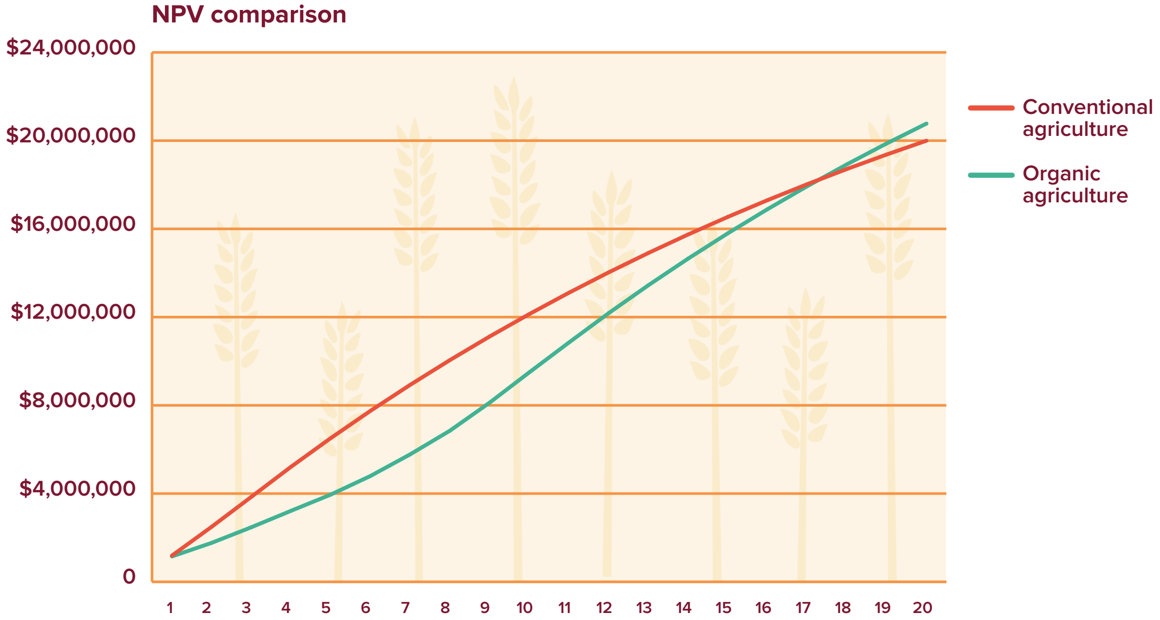

Figure 8: Net Present Value comparison of the farm (296.04 ha) of both scenarios, using a time horizon of 20 years and a discount rate of 5%.

Discount rates

One could argue that using a 5% (or any positive) discount rate for ecosystem services provided by natural areas is not correct. By using a positive discount rate, you place a lower value on future costs and benefits compared to present costs and benefits. This assumption is specifically difficult to hold with regard to benefits provided by nature. Investing in nature increases its value over time, so discounting these benefits directly might not make sense. As stated by Costanza et al (2021), goods and services created from different forms of capital (human, social, built, and natural) require different discount rates. We therefore also analysed the NPV using different discount rates, as is shown in figure 9.

Scenario 1: Using a 5% discount rate for the crops and a 0% discount rate for the natural areas in both scenarios.

As can be seen in the two columns in the middle in figure 9, adjusting the discount rate for natural areas does not lead to a substantial change in the NPV for conventional agriculture, which increases with approximately $1,060,000 (±5%). The NPV for organic agriculture however shows a larger increase, increasing with approximately $3,290,000 (±16%) as compared to the situation with a uniform 5% discount rate.

Scenario 2: Using a 5% discount rate for the BAU scenario and a 0% discount rate for the organic agriculture scenario.

Some agricultural lands under conventional management were not in a good state and are likely to have a degrading effect on the landscape. The transition to organic agriculture is therefore likely to have a positive effect on the landscape (De Groot et al., 2022). We therefore decided to also analyse the organic agriculture scenario using a 0% discount rate while keeping the BAU scenario at 5% (visualised in the 2 bars on the right side of figure 9). This resulted in a large increase of the NPV of organic agriculture, increasing from approximately $20,770,000 to $36,540,000 (±75%). Comparing this to the NPV of conventional agriculture ($20,000,000), we can see that organic agriculture has a significantly higher NPV.

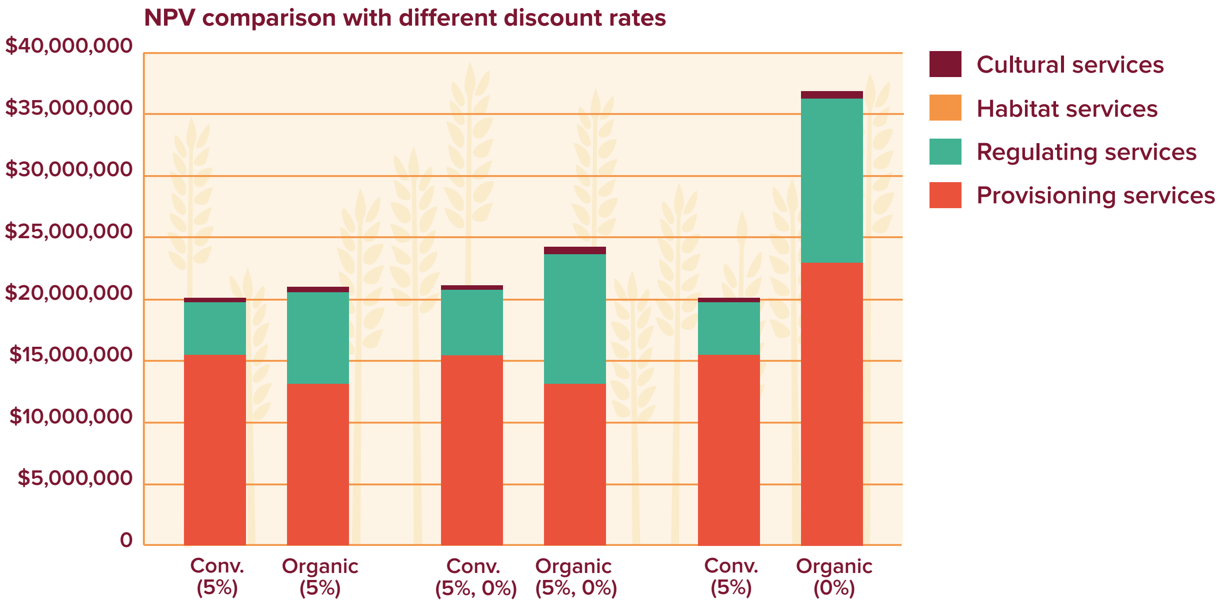

Figure 9: Net Present Value comparison of both scenarios after 20 years, split out in the four types of ecosystem services categories, using different discount rates. Conv. represents the BAU-scenario including conventional agriculture, whereas organic represent the investment scenario including organic agriculture. The (5%, 0%) means that a 5% discount rate is used for the crops and a 0% discount rate is used for the natural areas.

Conclusion and discussion

The investment of SLM aims to transform an agricultural area by transitioning from conventional to organic agriculture and thereby including additional natural landscape elements via multi-functional land use. Placing a monetary value on the ecosystem services provided by more sustainable, multi-functional land use provides essential insights into the so-called 'true returns' of landscape restoration, thereby obtaining insights into the 'invisible' value of nature. The results indicate that the investment has a positive effect on a wide range of ecosystem services and the health of the ecosystems in place. Due to the restoration of natural areas, the provision of regulating, habitat and cultural ecosystem services increases and general societal welfare is projected to increase, thereby showing the positive impact of this investment on nature, public welfare, as well as private benefits.

Accounting for nature's time horizon

After analysing the results, there are several other important things to mention. First and foremost, investing in nature takes time. We have seen that, when nature has time to grow and the crops have reached mature yields, the TEV of the ecosystem services provided by the farm is almost double the value of the current conventional agriculture scenario. This significantly increases both public and private benefits. However, we have seen that nature's regeneration and growth takes time as does the growth of newly introduced crops. The initial discrepancy in the NPV projection is often referred to as the 'valley of death', as after the initial investments the income from the farm displays a drop in productivity. In this case, after the 10 year time horizon of the investment, the NPV of organic agriculture is still lower than the NPV of conventional agriculture. However, after 18 years, the NPV of organic agriculture surpasses the NPV of conventional agriculture. This shows that when developing nature positive investments, longer time horizons are needed. Nature restoration can take several decades, as does her capacity to provide ecosystem services at maximum levels.

Non-market values

As the results have shown, regulating, habitat and cultural services see the largest percentual increase as a result of the investment. These services relate mainly to non-market values. Our current economic system still focuses largely on marketed goods and services, thereby neglecting the non-marketable values that nature provides. Even though these services are at the foundation of healthy ecosystems on which the economy and societies depend, including both public as private stakeholders.

Discounting the future

The results also indicate that current discounting practices, only limitedly or not at all, account for ecological dynamics. By placing investing in nature in the current economic system of depreciating value over time, our economic practices do not match ecological reality. In order to reach the goal that nature-positive investments effectively “halt and reverse biodiversity loss” we need to align discount rates with actual ecological value development within the land-use.

Final conclusion investment case

In conclusion, the transition from conventional to organic agriculture pays off in the long term. It is beneficial by providing a larger distribution of ecosystem services, including the more public, non-market type of ecosystem services compared to conventional agriculture. These services become visible and could therefore also be internalized. However, the effects of the transition and these benefits only become positive and fully visible after roughly 20 years. It is therefore important to use longer time horizons and adjusted discount rates to see the full potential of the ecosystem services that are to be provided reflected in economic value.

4.2 INVESTMENT CASE 2: REFORESTERRA

Description

The investment of the Amazon Biodiversity Fund (ABF) is in the ReforesTerra project. This project aims to recover low-intensity and degraded pasturelands in the Baixo Rio Jamari watershed in the State of Rondônia, Brazil, in the Southern Amazon region. The project zone is under tropical, humid and hot climate throughout the year, with precipitation ranging from 2,100 to 2,600 mm annually and an average temperature of 25°C (tropical monsoon climate). In the affected watershed, only 40.5% of the native forest cover is left. The project aims to reforest 2,000 hectares of deforested land converted to pastureland more than 10 years ago, where grazing activities have led to soil degradation. Through the reforestation of the degraded lands, the project aims to protect water resources, plant dozens of native tree species and improve connectivity for wildlife. Additionally, the project expects to benefit 600 landholders in the first instance through capacitation and Payment for Ecosystem Services schemes, as well as employing 37 local people full-time and 12 other professionals in the region part-time (Reforest'Action, 2022).

To analyse the (potential) effects of the project on ecosystem services, we used two scenarios: the BAU scenario describing the current degraded pasturelands, and the investment scenario describing the reforestation process and the end point of a standing forest. In appendix 2, a full list of assumptions for these scenarios can be found.


Seedlings of native Southern Amazonian tree species

Degraded pasturelands

This scenario describes the current situation without the project. In the absence of the project activities, the project area (2,000 hectares) would continue to be managed as degraded pasturelands. These pasturelands are being used for cattle to produce meat and milk. Spontaneous natural regeneration of trees would be prevented in degraded pasturelands due to competition with invasive fodder grasses, trampling and herbivory from cattle, frequent fire events and eventual mowing of shrubs and trees by landholders. Over time, such activities would deplete the native seed bank of the area, and the thick layer of invasive grasses and litter would prevent native seed rain to establish in the area (Reforest'Action, 2022).

Reforestation

This scenario describes the reforestation project by recovering 2,000 ha of degraded pasturelands into new areas of rainforest. Reforestation will be carried out in degraded pasturelands composed of invasive fodder grasses and, to a minor extent, in agricultural lands where tillage practices are in use. A result-based Payment for Environmental Services (PES) fund will be implemented to benefit landholders that maintain reforested areas in their landholdings (Reforest'Action, 2022).

Ecosystem services

This section describes the ecosystem services that are included in the analysis. For the investment scenario, we used ESVD values from the "tropical rainforests" ecosystem, largely with data from Brazil and South-America. For some services, we used the average of all tropical rainforest data in the ESVD if there was no data available from Brazil or South-America.

For the degraded pasturelands scenario, there was not enough relevant ESVD data on degraded pastures as an ecosystem, neither for Brazil specifically, or South-America and the world generally. Hence, so we used data from a combination of ecosystems, namely from "tropical grasslands" and from "pastures". Since there was not sufficient data from South-America alone, we also included a data subset from Africa and Asia. A few ecosystem services were not available in this dataset (medicinal resources, air quality regulation, erosion prevention, maintenance of genetic diversity, inspiration for culture, art and design, and information for cognitive development), so we used global data of "rangelands, natural grasslands and savannas" for these services. All ESVD values are in 2020 US Dollars. We therefore corrected all external monetary values to 2020 US Dollars.

Table 3 presents an overview of the ecosystem services and their monetary values that were included in the analysis of the investment.

Table 3: Overview of the ecosystem services included in the analysis. A grey cell means that there is either no data for this ecosystem service or the ecosystem service is not provided by the ecosystem.

	Degraded pasturelands (value per ha/y)	Tropical rainforest (value per ha/y)
Provisioning services		
Food	$ 228.8	$ 158
Water	$ 44.67	$ 99.30
Raw materials	-	$ 734
Medicinal resources	$ 0.02	$ 558
Genetic resources	-	$ 508
Ornamental resources	-	$ 0.30
Regulating services		
Air quality regulation	$ 0.62	$ 14.80
Carbon sequestration	-	$ 1,069
Regulation of water flows	$ 0.39	$ 10.70
Erosion prevention	$ 5.20	$ 35
Pollination	-	$ 238
Habitat services		
Existence, bequest values	$ 0.01	$ 198
Maintenance of genetic diversity	-	$ 6.80
Maintenance of life cycles	-	$ 18.90
Cultural services		
Opportunities for recreation and tourism	$ 37.96	$ 155

There was no data available about the ecosystem service food in the BAU scenario. We therefore used average cattle productivity data for Rondonia (Arantes et al., 2018) and combined this with the average 2020 price of beef found by Nogueira (2022).

De Oliveira et al. (2022) researched the effect of degradation of Brazilian pastures on their ability to store carbon. They found that degraded pastures may actually not sequester carbon at all. We therefore decided to use a value of $0 for carbon sequestration for degraded pasturelands instead of a higher value obtained from the ESVD.

There are some ecosystem services that we excluded in the analysis based on expert judgement. These are biological control, maintenance of soil fertility, moderation of extreme events, inspiration for culture, art and design, and information for cognitive development. The values we extracted from the ESVD for these ecosystem services did not provide a realistic picture of the actual situation. However these services are very likely to be provided to a higher extent by tropical forests than by degraded pasturelands. Excluding these values leads to an underestimation of the full value of the tropical forests as the provisioning capability of these services is very likely to increase due to the investment.

The newly planted tropical forest is assumed to grow at a rate of 5% per year, reaching a full grown state after 20 years. This means that after 10 years (time horizon of the Amazon Biodiversity Fund), the forest has grown to 50% of its full grown state. We made the assumption that the provision of ecosystem services will be identical to the growth of the forest. This means that the provisioning of ecosystem services will also be at 50% of its full capacity after 10 years. The time horizon of the full project is 30 years. We therefore decided to analyse the results after 10 years and after 30 years.

Results

Total Economic Value

Table 4 shows the TEV of both scenarios. The TEV before the investment, approximately $635,300 ($318 per ha/yr), increases to $8.25 million ($4,125 per ha/yr) (1200% increase).

The total value of provisioning services increases as compared to the baseline scenario (from $545,000 to $4,115,000). Even though the main use of the land in the BAU scenario was focused on maximizing the economic value of its outputs (the provisioning services). Despite this focus on outputs, the reforestation results in an increase in the total value of provisioning services, because tropical rainforests provide a wide range of various provisioning services. It is important to be aware that the TEV (and NPV) reflects the potential use of the ecosystem services. That does not automatically mean that these services are actually utilized, which certainly does not have to be a "bad" thing. Ecosystem services are interconnected and a change in one can affect other services.

The total value of regulating services exhibits a very large increase from $12,400 to $3,826,000. The largest share of this increase is caused by the increase in carbon sequestration values ($3,230,000). Tropical rainforests have a much higher capacity to store carbon during their growth as compared to degraded pasturelands.

Carbon sequestration is (currently) one of the few regulating ecosystem services that can be marketed, by means of carbon credits. In this reforestation project smallholder farmers whose land is being used for reforestation are paid by revenues obtained from selling carbon credits. As shown in table 4, most of the other regulating services also increase, showing that reforestation of degraded pasturelands leads to a significant increase in regulating ecosystem services.

Habitat services also demonstrate a large increase in value, increasing from $22,600 to $447,400. This is mainly caused by the increase in existence, bequest values. Tropical rainforests are very unique, hosting a large share of the world's biodiversity and therefore the value people derive from knowing tropical rainforests exist, now and in the future, is large. This ecosystem service is closely related to the increase in the value of opportunities for recreation and tourism. Due to the richness of tropical rainforests with regard to biodiversity, tourism is an important ecosystem service. This is reflected in the increase in cultural services from $76,000 to $310,000. The same results as in investment case 1 are observed, hence also here, the TEV shows that the investment has a positive effect on the provisioning of ecosystem services and therefore on benefits nature and both beneficiaries in the private and public domains. Not only is the TEV much larger in the reforestation scenario compared to the degraded pastureland scenario, but more importantly a broader range of services is provided and thereby benefitting a much wider array of stakeholders. The table shows the total value and the distribution of different ecosystems services provided by the different scenarios. The largest increase in total value comes from regulating services, which points towards the urgent need to properly account for these services in our economic system.

Table 4: Total Economic Value (TEV) of the land (2000 ha) in both scenarios, assuming the forest has reached its full grown state. The ecosystem services for which no (relevant) data is available, but are likely to be provided are indicated by a grey colour.

Ecosystem service	Degraded pasturelands	Rainforest	Difference
Provisioning	**$ 546,980**	**$ 4,115,200**	**$ 3,568,220**
Food	$ 457,600	$ 316,000	-$ 141,600
Water	$ 89,340	$ 198,600	$ 109,260
Raw materials	$ -	$ 1,468,000	$ 1,468,000
Medicinal resources	$ 40	$ 1,116,000	$ 1,115,960
Genetic resources	$ -	$ 1,016,000	$ 1,016,000
Ornamental resources	$ -	$ 600	$ 600
Regulating	**$ 12,420**	**$ 3,825,691**	**$ 3,813,271**
Air quality regulation	$ 1,240	$ 29,600	$ 28,360
Carbon sequestration	$ -	$ 3,228,691	$ 3,228,691
Moderation of extreme events	$ -	$ -	$ -
Regulation of water flows	$ 780	$ 21,400	$ 20,620
Waste treatment	$ -	$ -	$ -
Erosion prevention	$ 10,400	$ 70,000	$ 59,600
Maintenance of soil fertility	$ -	$ -	$ -
Pollination	$ -	$ 476,000	$ 476,000
Biological control	$ -	$ -	$ -
Habitat	**$ 22,600**	**$ 447,400**	**$ 424,800**
Existence, bequest values	$ 22,600	$ 396,000	$ 373,400
Maintenance of genetic diversity	$ -	$ 13,600	$ 13,600
Maintenance of life cycles	$ -	$ 37,800	$ 37,800
Cultural	**$ 75,920**	**$ 310,000**	**$ 234,080**
Aesthetic information	$ -	$ -	$ -
Opportunities for recreation and tourism	$ 75,920	$ 310,000	$ 234,080
Inspiration for culture, art and design	$ -	$ -	$ -
Spiritual experience	$ -	$ -	$ -
Information for cognitive development	$ -	$ -	$ -
Total	**$ 635,320**	**$ 8,250,891**	**$ 7,615,571**

Figure 10 shows the distribution of the TEV among the four types of ecosystem services categories of both scenarios. It shows that in the BAU scenario, degraded pasturelands, most of the TEV comes from provisioning services. In the reforestation scenario, the provisioning services demonstrate a significant increase, while on top of that regulating, habitat and cultural ecosystem services account for a larger share of the TEV as compared to the BAU scenario. The share of regulating ecosystem services even increases from around 2% to 46%.

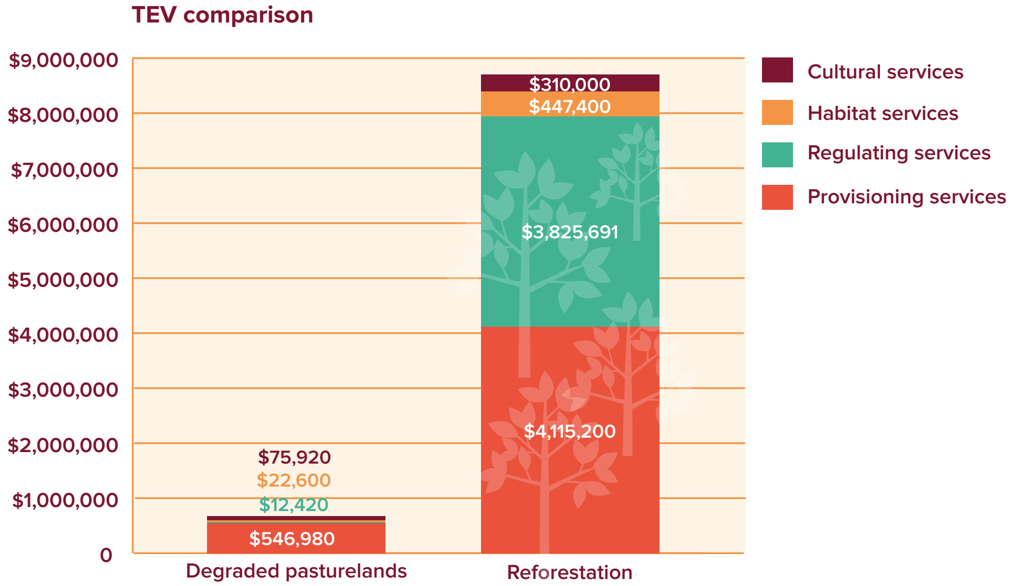

Figure 10: Comparison of the Total Economic Value of the land (2,000 ha) assuming the forest has reached its full-grown state, of both scenarios, split out in the four categories of ecosystem services.

Net Present Value

For this project, two time horizons were used. Firstly, a time horizon of 10 years was used, which is the projected time of the Amazon Biodiversity Fund investment. Secondly, a time horizon of 30 years was also used, which is the lifetime of the project, to account for the time horizon and dynamics of restoration, as it takes at least 20 years for a tropical forest to regrow (Poorter et al., 2021). Appendix 2 includes a table with an overview of the discounted values of each of the ecosystem services that make up the NPV, both after 10 and 30 years.

The first and most important thing to note is that the NPV of reforestation is much higher than the NPV of degraded pasturelands (around $46.1 million as compared to $5.1 million) for a 10 year time horizon. It is apparent that the value of food decreases after a change from pastureland to forests. However, the total value of provisioning services is still positive, due to the increase in value of most of the other provisioning services. The total of regulating and habitat services demonstrates a dazzling increase in value. The value of the regulating services increases by approximately $36.4 million (±38,000%), a large share of which can be attributed to carbon sequestration. The value of habitat services increases by approximately $700,000 (±400%).

The value of cultural services increases as compared to the BAU scenario. This increase is $24,100 (±4%) for the 10 years time horizon and if a 30 year time horizon is used, the increase accounts for $1,450,000 (±125%). It is important to bare in mind that the values in the reforestation scenario are most likely an underestimation, because there is no data available for other ecosystem services that are most likely to be in place.

As shown in figure 11, there is a large difference between the NPV of both scenarios if the time horizon is increased to 30 years. The NPV of the BAU scenario increases to $10.1 million (100% increase), whereas the NPV of reforestation increases to $104.8 million (130% increase). This can be contributed to the fact that after 10 years, the forest is still growing and thereby is not able to deliver ecosystem services at full capacity. After 20 years the forest is assumed to have reached its full grown state, meaning that it delivers ecosystem services to its full potential. This also explains the relatively large NPV growth in the first decades, whereafter, the growth stagnates, but still increases.

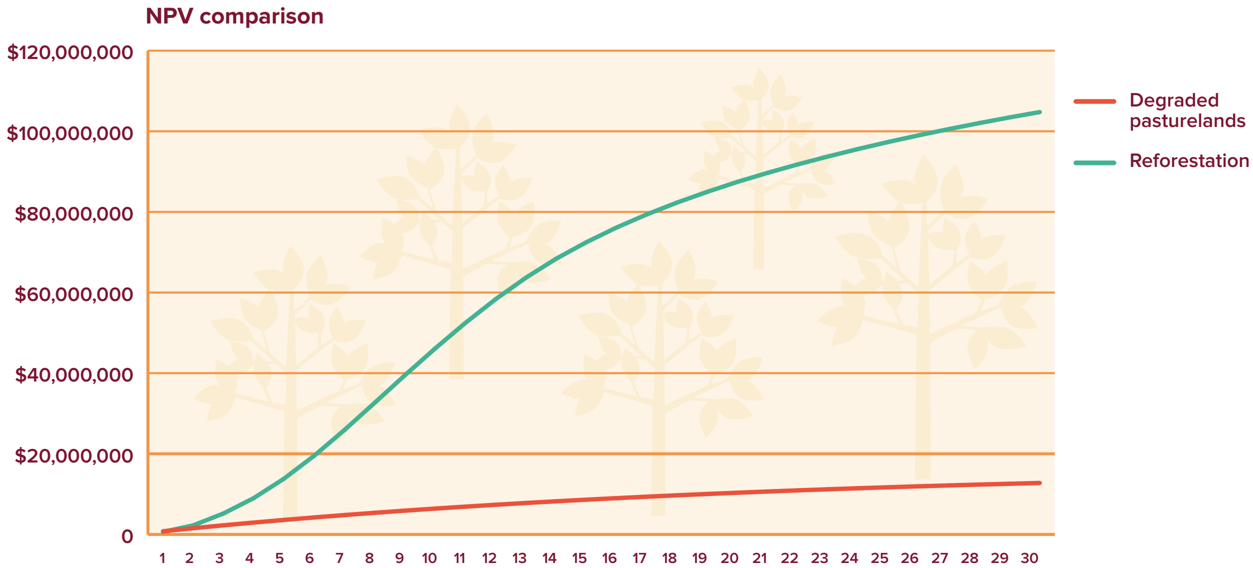

Figure 11: Net Present Value comparison of the land (2,000 ha) of both scenarios, using a time horizon of 30 years and a discount rate of 5%.

Discount rates

The values for the NPV above are calculated using a 5% discount rate. Because the BAU scenario assumes a continuation of degradation and because the benefits of the forest are likely to increase in the future, we decided to analyse the results using a different discounting scenario, namely a 5% discount rate for degraded pasturelands (no change) and 0% for the reforestation scenario.

Using a time horizon of 10 years, the NPV of the reforestation scenario increases from $46.1 million to $64.6 million (40% increase). Using a time horizon of 30 years, the increase is larger; from $104.8 million to $209 million (99% increase). Using these non-uniform discount rates even further emphasizes the large potential positive effect of the investment on the value of nature and biodiversity. Additionally, it highlights the delicate aspect of deciding on a discount rate (see discussion in chapter 5).

Conclusion and discussion

The investment of ABF aims to recover low-intensity and degraded pasturelands by means of reforestation, aiming to protect water resources, plant native tree species and improve connectivity for wildlife. Placing an economic value on the ecosystem services of both ecosystems provides essential insights into the so-called 'true returns' of landscape restoration, thereby obtaining insights into the 'invisible' value of nature. The results clearly indicate that the investment has a positive effect on the provision of ecosystem services by the affected ecosystem: all four categories of ecosystem services increase.

Non-market values & time horizons

An additional observation is that, just like the results of the first case, the largest percentual increase as a result of the investment mainly relates to non-market benefits. This again underscores the difficulty in building the business case for nature conservation and/or restoration efforts. Since our current economic system still focuses largely on marketed goods and services, thereby neglecting the non-marketable values that nature provides. Although there is no initial investment gap in this investment case, the NPV still highlights the importance of taking a longer time horizon to account for ecological dynamics.

Stakeholders - Local communities

One of the impacts the project aims to achieve, is to improve livelihood of local smallholder farmers by involving them in the project. These farmers receive a compensation in return for local stewardship of the reforestation. This compensation is generated by means of carbon credits. The effects of this compensation are not included in this analysis, since this analysis focused on the impact of the ecosystem services at the project location. Including these effects would provide an even more complete understanding of the effects of the project.

Final conclusion investment case

Reforesting degraded pasturelands offers significant benefits in both the short and long term. In this case, the trade-offs are notably positive, with the value of each ecosystem service category on the rise, positively affecting almost all stakeholders. However, it is crucial to keep in mind that this project has addressed the challenge of compensating farmers for any potential loss in food production by utilizing carbon credits. Such Payment for Ecosystem Services (PES) mechanisms play a pivotal role in underpinning the financial viability of nature restoration initiatives.

We must also acknowledge that in some other scenarios, there is a need to make trade-offs between certain ecosystem services to ensure the production of others, such as food and water. However, this investment case makes it abundantly clear that a sole focus on these provisioning services carries a substantial risk of devaluing the land to a point where the financial sustainability of these services becomes indefensible. It serves as a compelling demonstration of the need to maintain a healthy balance among the ecosystem services in play. An insight that closely aligns with the growing call for a just transition.

5. Conclusions and recommendations

In the world of investments, conventional wisdom often pits profit against principles. However, in recent years, there has been much focus and attention on the impacts of financial institutions on nature. New laws, regulations and frameworks are under development to assess these impacts, aiming to halt and reverse biodiversity loss and land degradation. Additionally, there is increased recognition by financial institutions that they are dependent on the services nature provides and are at risk when these services decline.

In this project, we assessed the impact of land cover changes on ecosystem services and their monetary value in two investment cases of the ASN Biodiversity Fund by applying the ESVD and other sources of monetary valuation. The aim was to obtain a more in-depth insight in local and on-the-ground impacts of the investments in nature, how these impacts influence an investment case from an ecological perspective and what concrete steps need to be taken in the pursuit of more sustainable financial decision-making. Based on the results of the two cases, we highlight five pivotal insights:

REDEFINING ECONOMIC VALUE: MAKING THE BUSINESS CASE FOR NATURE:

1. **Ecosystem services valuation provides a clear language for due diligence efforts and pinpoints the way in needed stakeholder engagement.**
2. **Ecosystem services valuation is key to determine most effective mitigation strategies.**

THE SUSTAINABLE INVESTMENT CASE – THREE KEY RECOMMENDATIONS:

1. **We need to recognize the value of regulating ecosystem services.**
2. **We need to align our time horizons with nature.**
3. **We need to reconsider our discount rates based on land use.**

REDEFINING ECONOMIC VALUE: MAKING THE BUSINESS CASE FOR NATURE

Ecosystem services hold the key to transcending the profit-versus-principles dilemma. By conveying their information in a universal (monetary) language, we gain the ability to estimate the order of magnitude and direction of the impacts of the investment on nature and society. By expanding our impact assessments to encompass all ecosystem services beyond the few conventional marketable ecosystem services like carbon sequestration or water provisioning, we highlight the implicit and hidden value of nature for societies, economies and financial institutions.

Including the ‘hidden’ economic and financial value of nature, allows to create a solid business case for nature. This *Make Nature Count 2.0* report provides clear evidence of the transformative power of the ecosystem perspective in developing this business case. In both investment cases, which focused on nature restoration, the outcomes were astonishing. The Total Economic Value (TEV) of ecosystem services provided as an outcome of the investments surged by 70% in the first investment and by 1200% in the second one. These numbers would have looked starkly different using conventional practices of focusing on only one or two marketable ecosystem services. This revelation underscores that beneath the surface of direct financial returns, there is a hidden world of actual value that is not yet considered in conventional financial decision-making. Including all ecosystem services is crucial in ‘Making the business case for nature’, as pointed out in the TNFD’s recommendation framework “How to get started, 7 key steps to consider”.

Our insights point towards two important conclusions and three key recommendations to create the business case for nature:

Conclusions

1. Due diligence and stakeholder engagement
Understanding the changes in the values of all relevant and different ecosystem services offers more than just financial insights. It unveils the multifaceted impact on the environment, society, and finance because it reveals stakeholders and their position in relation to nature. For instance, while food provisioning services decreased in the second investment case, resulting in a direct loss of approximately $140,000 in provisioning services per year for the private investor, the shift in land use towards forest restoration yielded an order of magnitude higher, approximately $3,800,000 per year in regulating services such as carbon sequestration, pollination and air quality regulation. Although some of these benefits are not as tangible as market-tradable provisioning services are, they bear a very real value over time, impacting a diverse array of public stakeholders who are dependent on and influenced by changes in these services on a broader landscape level. For due diligence and stakeholder engagement this is important information as the ecosystem services perspective provides an overview of stakeholders that could, or should, be involved in the business case.

2. Effective mitigation measures
Understanding the benefits and losses of the affected ecosystem services also provides guidance in crafting truly effective nature positive investments. Additionally, understanding the impact via ecosystem services benefits and losses also provides entry points in finding the most suitable mitigation strategy from the mitigation hierarchy ladder. In the first investment case, we showed the changes in ecosystem services of moving towards an organic farming system. Showing the value of the restored natural areas fits with 'restore' in the mitigation hierarchy while different crop systems avoid and minimize the negative impact on the environment. Therefore, this ecosystem services approach can place specific management decisions or regulations into perspective of the mitigation hierarchy and can identify opportunities that fit best within the specific investment cases.

The sustainable investment case – Three key recommendations

1. Recognizing the value of regulating services
Our findings show that recognizing and valuing regulating ecosystem services is not only a matter of common sense but also a critical component of responsible financial impact assessments. As the case of the restoration of degraded pasturelands in the Southern Amazon region revealed, these services play a pivotal role in maintaining the overall health and resilience of ecosystems. Unlike some other services, which may have more localized impacts, regulating services have far-reaching effects at a broader landscape level. Although they are critical for humans and nature alike, they are often not considered as they do not fit the traditional market logic and investment analyses, because they are public goods and unpriced.

In relation to target 15 of the GBF with the aim to halt and reverse biodiversity loss, the urgency to acknowledge the importance of regulating services cannot be overstated. By including these services in our assessments and integrating their value, we not only make more informed decisions, but we also contribute a common-sense approach that is both ecologically sound and financially prudent.

2. Shifting towards longer time horizons
To truly integrate nature into financial decision-making, it is also crucial to adjust to the time horizons of ecological processes. Nature restoration and its full capacity to provide ecosystem services can take decades, making longer horizons more realistic and necessary. Both investment cases show that nature needs time to grow and become a healthy fully functioning ecosystem delivering its ecosystems. In both cases, however, due to the time factor, the initial value of ecosystem services is lower, the so-called "Valley of death". During a certain time period, the delivery of ecosystem services is lower while the investment funds have been spent and demand a return. This valley of death poses a challenge, as traditional financial mechanisms often rely on shorter timeframes. These shorter timeframes demonstrate unrealistic perspectives on the (social) profitability and development of capital, and often open the door for destructive management decisions and their corresponding alterations of the land before an ecosystem has reached its full potential to deliver ecosystem services.

On the other side, extending time-horizons requires careful risk assessments for investors and solid adaptation in the decision-making processes of financial institutions. These adjusted timeframes ideally require an ecosystem-specific perspective to match the needs of various (blended) financing mechanisms. Blended finance mechanisms can help in generating private finance for nature positive projects that require larger time horizons. By blending public and private finance, risks for private investors can be reduced and stakeholders can be represented in the correct manner within the financing scheme.

3. Reconsidering discount rates

The results of this report also highlight the inadequacy of the current economic systems in accounting for the value of nature. Conventional discounting practices usually depreciate ecological dynamics, wrongly implying that nature's value diminishes over time. While it is common practice to depreciate regular investments over time, restoring nature builds value over time, increasing ecosystem resilience and benefiting biodiversity. The investment case in Brazil highlights that reforestation and regrowth of forests takes time. By depreciating these forests, this ecological dynamic is not accounted for. To accurately reflect nature's value and to incentivize nature positive investments, we need to reconsider and move beyond existing discounting practices. As we have demonstrated in the first case in Spain, adjusting discount rates can better align natural capital development with financing schemes and is essential in the pursuit of nature positive investment cases. Showing this increased value of nature by using 0% discount rates or even negative rates, changes the view of an investment. It is an essential step toward recognizing the true worth of our natural world.

LIMITATIONS

Additional to the newly generated insights, there are several limitations related to different aspects of this project.

- **One of the main obstacles concerning ecosystem services analyses, is data availability.** This is also something experienced during this project. To do justice to the location- and case-specific characteristics of an ecosystem service analysis, it is important to have accurate and fitting data. Using local data is always preferred as compared to proxies. However, this is of course very time and resource consuming. In the second case, the reforestation of degraded pasturelands in Brazil, there was little data on the degraded pasturelands in the ESVD. We therefore had to use average global data on pasturelands and use a certain percentage of the total value of these ecosystem services to account for degradation. Some of these values did not fit well with the actual situation on the ground. Several values for habitat and cultural services were significantly lower for tropical forests as compared to degraded pasturelands, which in reality does not seem likely. These services are very likely to be provided to a higher extent by tropical forests than by degraded pasturelands. This is one example of the difficulties we faced during this project. Initiatives like the ESVD are crucial in the process of improving research on monetization of ecosystem services. If more data on more ecosystems becomes available, more accurate analyses can be performed.

- **The TEV is likely to be an underestimation.** Not all ecosystem services used had data availability. Additionally, due to time and data limitations, it was not possible to account for additional drivers than land cover change which could affect the monetary value of ecosystem services. For example, it was not possible to account for all changes in ecosystem condition as the result of an investment to provide ecosystem services, although we made efforts with applying restoration rates. Therefore, the TEV is likely to be underestimated.

- **Trade-offs between ecosystem services and between different land covers could not be accounted for.** It was not possible to account for the dynamic and complex interactions between ecosystem services in the computations. For example, changes in timber extraction have an effect on the capacity of a forest to provide other services such as erosion prevention or the removal of air pollutants. Because these interactions are highly dynamic and complex and because the links between these services and their monetary values is not yet clearly modelled by science, these dynamics could not be taken into account.

- **Exclusion of the costs of restoration.** The costs of restoration and conservation are an important barrier to implementation of restoration and conversation policies. It is generally assumed that restoration pays, e.g. the United Nations Environmental Program (UNEP) mentions that every dollar invested in restoration creates up to 30 euros in economic benefits (UNEP, 2021). It is still important to account for the costs of restoration as the distribution of who pays for and who receives the benefits of restoration are not equal.
- **Monetary valuation tells only part of the story.** Monetary or economic valuation of ecosystem services tells only part of the story of the importance of nature. It aims to place nature on the balance sheets and creates consensus of the very important contributions of nature to our wellbeing. However, it is important to note that nature has non-instrumental and intrinsic values and that economic valuation as has been conducted in this report should be seen as an additional piece of information in decision making, not a replacement of non-monetary ways to show the value of biodiversity and nature.

CONCLUDING REMARKS

If there is one clear insight from this project and from nature at large, it is that we must reason and think from the perspective of nature to effectively align financial decision-making and our economies with environmental sustainability, not the other way around. It is impossible to put a square peg in a circular hole just as it is impossible to place our economic systems outside of nature. Our economies, as are pegs, are malleable. So instead of altering nature to fit the needs of our economies, we need to alter our economies, the pegs, to fit the circular hole of environmental sustainability.

In collaboration with ASN Bank, the Foundation for Sustainable Development embarked on an explorative journey, setting clear examples of how the integration of monetary valuation of ecosystem services into financial impact assessments unveils nature's hidden values, which, in turn, yield new business opportunities. We are very pleased with the cooperation and the outcomes of this project. Yet, the journey has only just begun. As we look into the coming year and beyond, there are crucial follow-up steps to further integrate the valuation of ecosystem services at the heart of financial decision-making:

1. Building the business case for nature

It is crucial to learn and adapt. Our focus will expand towards generating more case studies and examples, exemplifying how ecosystem services valuation can seamlessly integrate into investment portfolios' impact assessments. Understanding the impact on an ecosystem and subsequently knowing the stakeholders unlocks new business opportunities.

2. Development of new data and functionalities for location-specific ecosystem services valuation

To more accurately estimate the value of location-specific ecosystem services, we will expand the ESVD with new monetary valuation data. This expansion aims to increase data density and capture the values of ecosystem services across diverse locations, ecosystems, and services.

3. Creating pathways for financial institutions

We are determined to form collaborations that craft pathways and contribute to frameworks and guidelines to make the integration of monetary ecosystem services assessments into financial decision-making an accessible and effective endeavour. The ESVD currently functions as a backbone for many of these tools that will be instrumental for financial institutions looking to reduce their impact and make nature-positive investments.

While writing this report, the world is facing extreme political unrest and even outright wars, alongside the growing interconnected biodiversity and climate crisis we are in. We are at several turning points in history. Therefore, we urge and encourage other financial institutions and businesses to seize this pivotal moment in time. We have to critically assess practices, evaluate dependencies and scrutinize impacts on nature and biodiversity. It is our unwavering belief that we can no longer be distracted from this mission. Secure and functional societies are the bedrock of economies, and healthy, resilient ecosystems are the bedrock of societies.

As Winston Churchill famously quoted, "Never let a good crisis go to waste." This is our call to action: Please join our mission to contribute to solving the biodiversity crisis and feel free to reach out if you want to explore collaborative opportunities, are in dire need of some presentations on this topic or have any other questions.

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Appendix 1 – El Roble

Assumptions

General assumptions

1. On the farm, there are both rainfed and irrigated almonds (and pistachios). This difference is neglected, so rainfed and irrigated crops are grouped together in the calculations. In reality, water is a key resource for the farm and yields are very likely to be different between irrigated and rainfed crops.
2. Newly planted trees are assumed to produce 5%, 50%, 80% and 90% (until maturity) of their mature yield in their first four years, respectively.
3. All different natural area classifications are grouped together as Mediterranean wood- & shrubland (for use if the ESVD).
4. Artificial ponds are not taken into account in the calculations.
5. Different, separate measures to improve populations of wild pollinators and other useful insects (insect hotels etc.), are not taken into account in the calculations.
6. We assume the provision of ecosystem services to be linearly.

Conventional agriculture

7. For the natural areas, we classify two types: fully functioning natural areas, and degraded natural areas.
8. We assume that the fully functioning natural areas are in a good state and provide all ecosystem services for that specific ecosystem.

Organic agriculture

9. For the natural areas, we classify two types: fully functioning natural areas, and degraded natural areas that are to be restored.
10. The natural areas to be restored areas and natural areas that are <1 or <2 years old are considered to be recently planted.
11. We assume that the natural areas to be restored will gradually increase their provisioning of ecosystem services over time, reaching the maximum in 10 years.

Quantification and monetization of ecosystem services

Provisioning services

Crop production

As mentioned above, the investment links to different types of crops, namely rainfed and irrigated almonds, olives, rainfed and irrigated pistachios, peaches, apricots and wheat. Silva Fund Europe provided us with yield and farm gate price data that we used in our calculations. For the years between the start of production and maturity, a yield of 5% in the first year of production, 50% in the second year, and 80% in the third year and 90% in the fourth year until maturity was anticipated.

Table 5: Overview of years to production and maturity for both almonds and pistachios.

Crop	Years to production	Years to maturity
Irrigated almonds	4	7
Rainfed almonds	5	8
Irrigated pistachios	5	9
Rainfed pistachios	7	11

For wheat, we used the average price of wheat in Spain for the period of 2017-2021, obtained from the FAO (FAO, n.d.). For wheat yield, we used the average of wheat yields in Spain for the period of 2010-2021, obtained from Our World In Data (OurWorldinData, n.d.).

Regulating services

Air quality regulation

In the ESVD, there was only one value/observation for this service. This value is very high, $1,701 per hectare per year. Due to the context of this case, namely that the investment area is relatively remote, with few beneficiaries who might benefit from improved air quality, the value is not included in the TEV and NPV calculations . Nevertheless, we have chosen to present the value associated with this ecosystem service to underscore its significance. It is imperative to note that, despite its presentation, this value remains excluded from the TEV and NPV calculation, as previously mentioned.

Carbon sequestration

In this case, there are different land covers that all sequester carbon, namely the natural areas/ecosystem, almond trees, olive trees, pistachio trees, wheat and stone fruits (peaches and apricots). These all differ in their ability to sequester carbon. Because of time and resource constraints, no distinction was made between sequestration rates for conventional and organic agriculture, thereby not taking the effect of agricultural practices on carbon sequestration into account.
For the natural areas/ecosystem we used the average found by Almagro et al. (2010) for abandoned shrubland (5.41) and forest (6.48), which is 5.8 tonnes of carbon per hectare per year (tC ha/y). Using the conversion factor of 3.67 (1 ton C = 3.67 tonnes of CO_2), this corresponds to a value of 21.2 tCO_2 ha/y.
In their research on almond plantations in Spain, De Groot et al (2022) used the value of 4.2 tC ha/y, derived from Almagro et al. (2010) for carbon sequestration of almonds under sustainable land management. This corresponds to a value of 15.41 tCO_2 ha/y.
Almagro et al. (2010) found that carbon sequestration in olive groves is 3.24 tC ha/y, which is 11.89 tCO_2 ha/y.
For pistachios we used the average of two research projects (1.87 and 1.99) (Rousta et al., 2013a; Rousta et al., 2013b) on carbon sequestration in pistachio trees in Iran. We assumed that carbon sequestration values are identical in our case. This results in a value of 1.93 tC ha/y, corresponding to a value of 7.08 tCO_2 ha/y.
For stone fruits, we used the value found by Montanaro et al (2021). They found that a conventional peach orchard sequesters carbon with a rate of 11.7 tCO_2 ha/y.
For wheat, we used the value for carbon sequestration in a semiarid region found by Civeira (2011). This leads to a value of 2.75 tCO_2 ha/y.

All crops that not yet reached maturity are assumed to sequester carbon equivalent to the percentage of mature yield that they produce.

There are different ways to determine the monetary value of carbon, such as the market price of carbon based on the EU Emissions Trading System (EU ETS), which is currently around €90 per tonne of CO_2. Another way of determining the carbon price, is by using the social cost of carbon (SCC). This price includes societal damages caused by greenhouse gas emissions. According to Wang et al (2019) the social cost of carbon is at least €50 per tCO_2, which is currently lower than the market price. With regard to this project, using the social cost of carbon seems like an appropriate value to use, since the partial aim of this project is to integrate non-market values into financial decision-making. But since this value is actually lower than the current market price for carbon, we decided to use the average 2022 value per tonne of CO_2, which is €88. This value, based on the EU ETS, is still very likely to be an underestimation, because the EU market price for carbon does not incorporate the welfare factors of the SSC, while it is already higher than the SSC.

Maintenance of soil fertility

This ecosystem service represents the difference in nutrient loss due to different land management and thus less need for fertilizer. In order to determine the value of this ecosystem service, we used fertilizer costs as a proxy. SLM Silva Fund Europe provided us with cost data for fertilizer use for a mature almond orchard, as well as a younger almond orchard. These values are €160 ha/y and €330 ha/y, respectively. We used these values to calculate the value of the ecosystem service soil fertility. Since we had no available data on fertilizer costs for the other crops, we used the fertilizer costs for almonds for these crops. If crops did not reach maturity yet, we used the value of €330/ha. De Groot et al (2022) assumed that sheep can reduce the need for fertilizer by approximately 50%, leading to a cost of €80 ha/y and €165 ha/y for the mature and young almond orchard, respectively. Because of the presence of sheep with organic agriculture, we decided to use these values for the fertilizer costs associated with soil fertility for organic agriculture. Thus, the benefits of this ecosystem services are delivered in the investment scenario, representing the reduction in costs.

Erosion prevention
This ecosystem service represents the avoided damage costs associated with the different land covers. The average monetary value for erosion prevention was extracted from the ESVD. It amounts to $16.09 per ha/y.

Pollination
Almonds, peaches and apricots are dependent on natural pollination. A higher proportion of natural area leads to higher pollination effectiveness (Klein et al., 2012; Saunders et al., 2013). To some extent the benefits of this service are already reflected (as Factor Income) in the total revenues of the almonds and peaches. To illustrate the value of pollination for the three different crops, we calculate the added value of pollination to almonds and assume the same proportion to be existing for peaches and apricots. Natural pollinators increase the almond crop yield by 8-27% (De Groot et al., 2022). In order to avoid double counting, we therefore reduce the total almond yield by a certain percentage in both scenarios and attribute this value to pollination. The total value of almond production therefore remains the same, but provides an illustration of the effect of pollination. Due to the presence of natural area in the first scenario, we use a 12% increase of almond production due to pollination. With organic agriculture, the amount of natural area is approximately doubled. We therefore use a 24% increase of almond production due to pollination.

Biological control
De Leijster (2020) calculated that conventional almond farmers spend €64 ha/yr on chemical pest control. Another study by Ramirez del Valle (2020) found that the number of pest-controlling insects increased on average by 30% resulting from sustainable land management. De Groot et al (2022) combined both studies to calculate the costs of pest-control measures per hectare per year under sustainable land management, which is €45 ha/yr (70% of €64 ha/yr). We decided to use this value of €45 ha/yr for pest-control costs for conventional agriculture, because this scenario more closely resembles a farm under sustainable land management due to the presence of natural areas on the farm, as compared to a conventional almond farm without natural areas.
For organic agriculture, we assume the pest control expenditures to be zero because of the aim of the investment to create hedges surrounding the productive plots. These hedges provide habitat for species beneficial for pest control. This assumption is in line with the assumption of De Groot et al (2022). Thus, the benefits of this ecosystem services are delivered in the investment scenario, representing the reduction in costs.

Habitat services

Existence, bequest values
Existence value involves the emotional gratification derived from the awareness of an entity's existence. This notion is related to intrinsic value, resonating with ethical and moral principles that govern our perceptions of worth. On the other hand, bequest value involves the worth attributed to safeguarding ecosystems for the benefit of future generations. It symbolizes a conscious dedication to ensure that the ecosystem remains intact. In this case, this service is assumed to be provided only by the natural areas on the farm.
The average monetary value for existence, bequest values was extracted from the ESVD. It amounts to $4.18 per ha/y.

Cultural services

Opportunities for recreation and tourism
The average monetary value for opportunities for recreation and tourism was extracted from the ESVD. It amounts to $138.47 per ha/y.

Education/science
The farm offers the opportunity for students/researchers to participate in research, education and training programs with regard to organic agriculture (in the South-East of Spain). For this ecosystem service, we used the monetary value used by De Groot et al (2022), which is €50 per ha/y.

Additional information

Table 6: Net Present Value (NPV) of the farm (296.04) in both scenarios, using a discount rate of 5% over 10 years. As explained before, the value of air quality regulation is not included in the calculation of the NPV.

	Land use	Conventional agriculture	Organic agriculture	Difference
Provisioning	**Total provisioning services**	**$ 9,310,988**	**$ 5,469,653**	**-$ 3,841,335**
Crop production	Rainfed almonds	$ 1,633,817	$ 1,411,024	-$ 222,793
	Irrigated almonds	$ -	$ 432,884	$ 432,884
	Olives	$ 1,772,128	$ 1,772,128	$ -
	Rainfed pistachios	$ -	$ 609,549	$ 609,549
	Irrigated pistachios	$ -	$ 542,684	$ 542,684
	Peaches	$ 1,233,325	$ 159,721	-$ 1,073,604
	Apricots	$ 4,182,580	$ 541,663	-$ 3,640,916
	Wheat	$ 489,139	$ -	-$ 489,139
Regulating	**Total regulating services**	**$ 2,784,423**	**$ 3,851,534**	**$ 1,067,110**
Air quality regulation	Natural area	$ 87,624	$ 740,169	$ 652,545
Carbon sequestration	Natural area	$ 763,212	$ 1,109,520	$ 346,308
	Rainfed almond	$ 827,519	$ 827,519	$ -
	Irrigated almond	$ -	$ 145,977	$ 145,977
	Olives	$ 259,531	$ 259,531	$ -
	Rainfed pistachios	$ -	$ 47,858	$ 47,858
	Irrigated pistachios	$ -	$ 54,393	$ 54,393
	Stone fruits	$ 505,291	$ -	-$ 505,291
	Wheat	$ 201,262	$ -	-$ 201,262
Erosion prevention	Natural area	$ 4,816	$ 7,001	$ 2,185
Maintenance of soil fertility	All crops	$ -	$ 366,038	$ 366,038
Biological control	Natural area	$ -	$ 86,371	$ 86,371
Pollination (for almonds)	Natural area	$ 222,793	$ 445,586	$ 222,793
	Natural area	$ -	$ 501,741	$ 501,741
Habitat	**Total habitat services**	**$ 1,232**	**$ 1,817**	**$ 586**
Existence, bequest values	Natural area	$ 1,232	$ 1,817	$ 586
Cultural	**Total cultural services**	**$ 41,445**	**$ 174,547**	**$ 133,103**
Opportunities for recreation and tourism	Natural area	$ 41,445	$ 60,250	$ 18,806
Education/science	Whole farm		$ 114,297	$ 114,297
	Total whole farm	**$ 12,138,088**	**$ 9,497,551**	**-$ 2,640,537**

Table 7: Net Present Value (NPV) of the farm (296.04) in both scenarios, using a discount rate of 5% over 20 years. As explained before, the value of air quality regulation is not included in the calculation of the NPV.

	Land use	Conventional agriculture	Organic agriculture	Difference
Provisioning	**Total provisioning services**	**$ 15,275,188**	**$ 12,918,901**	**-$ 2,356,288**
Crop production	Rainfed almonds	$ 2,884,900	$ 2,491,505	-$ 393,395
	Irrigated almonds	$ -	$ 1,136,568	$ 1,136,568
	Olives	$ 2,860,060	$ 2,860,060	$ -
	Rainfed pistachios	$ -	$ 3,977,885	$ 3,977,885
	Irrigated pistachios	$ -	$ 1,751,498	$ 1,751,498
	Peaches	$ 1,990,479	$ 159,721	-$ 1,830,758
	Apricots	$ 6,750,321	$ 541,663	-$ 6,208,658
	Wheat	$ 789,428	$ -	-$ 789,428
Regulating	**Total regulating services**	**$ 4,653,286**	**$ 7,556,300**	**$ 2,903,014**
Air quality regulation	Natural area	$ 821,715	$ 1,362,213	$ 540,499
Carbon sequestration	Natural area	$ 1,231,757	$ 2,041,970	$ 810,212
	Rainfed almond	$ 1,461,185	$ 1,461,185	$ -
	Irrigated almond	$ -	$ 383,272	$ 383,272
	Olives	$ 418,860	$ 418,860	$ -
	Rainfed pistachios	$ -	$ 312,316	$ 312,316
	Irrigated pistachios	$ -	$ 175,552	$ 175,552
	Stone fruits	$ 815,496	$ -	-$ 815,496
	Wheat	$ 324,819	$ -	-$ 324,819
Erosion prevention	Natural area	$ 7,772	$ 14,535	$ 6,762
Maintenance of soil fertility	All crops	$ -	$ 505,070	$ 505,070
Biological control	Natural area	$ -	$ 139,395	$ 139,395
Pollination (for almonds)	Natural area	$ 393,395	$ 786,791	$ 393,395
	Natural area	$ -	$ 1,317,356	$ 1,317,356
Habitat	**Total habitat services**	**$ 1,988**	**$ 3,344**	**$ 1,357**
Existence, bequest values	Natural area	$ 1,988	$ 3,344	$ 1,357
Cultural	**Total cultural services**	**$ 66,888**	**$ 295,351**	**$ 228,463**
Opportunities for recreation and tourism	Natural area	$ 66,888	$ 110,885	$ 43,997
Education/science	Whole farm		$ 184,466	$ 184,466
	Total whole farm	**$ 19,997,350**	**$ 20,773,895**	**$ 776,546**

Appendix 2 – ReforesTerra

Assumptions

General assumptions

1. We assume the provision of ecosystem services to be linearly.

Degraded pasturelands

2. Concerning the ESVD, pasturelands data was used. There was no data for this ecosystem from Brazil or the Amazon, so we used the average of global data. Since the pasturelands in our case are degraded, we used 25% of the total value of the ecosystem services.
3. We assume the degraded pastureland to remain in the same state during the project lifetime.

Reforestation

4. Concerning the ESVD, tropical rainforest data from Brazil was used. If data from Brazil was absent, we used the average of global data.
5. The forest is assumed to grow by 5% per year, reaching its full grown state after 20 years.
6. The degree to which all ecosystem services provided by the forest are provided is assumed to be identical to the growth of the forest, meaning that it is assumed to grow by 5% per year, reaching full capacity after 20 years.
7. The social impact (by means of improving livelihood of farmers) is not taken into account.

Additional information

Table 8: Net Present Value (NPV) of the land (2000 ha) in both scenarios after 10 years, using a discount rate of 5%.

Ecosystem service	Degraded pasturelands		Reforestation		Difference	
Provisioning	**$**	**4,223,635**	**$**	**8,101,550**	**$**	**3,877,915**
Food	$	3,533,466	$	622,106	-$	2,911,360
Water	$	689,860	$	390,982	-$	298,878
Raw materials	$	-	$	2,890,036	$	2,890,036
Medicinal resources	$	309	$	2,197,057	$	2,196,748
Genetic resources	$	-	$	2,000,188	$	2,000,188
Ornamental resources	$	-	$	1,181	$	1,181
Regulating	**$**	**95,904**	**$**	**36,528,969**	**$**	**36,433,066**
Air quality regulation	$	9,575	$	58,273	$	48,698
Carbon sequestration	$	-	$	35,353,662	$	35,353,662
Regulation of water flows	$	6,023	$	42,130	$	36,107
Erosion prevention	$	80,306	$	137,808	$	57,502
Pollination	$	-	$	937,096	$	937,096
Habitat	**$**	**174,511**	**$**	**880,792**	**$**	**706,280**
Existence, bequest values	$	174,511	$	779,601	$	605,090
Maintenance of genetic diversity	$	-	$	26,774	$	26,774
Maintenance of life cycles	$	-	$	74,416	$	74,416
Cultural	**$**	**586,234**	**$**	**610,294**	**$**	**24,060**
Opportunities for recreation and tourism	$	586,234	$	610,294	$	24,060
Total	**$**	**5,080,284**	**$**	**46,121,604**	**$**	**41,041,320**

Table 9: Net Present Value (NPV) of the land (2000 ha) in both scenarios after 30 years, using a discount rate of 5%.

Ecosystem service	Degraded pasturelands	Reforestation	Difference
Provisioning	**$ 8,408,423**	**$ 34,805,423**	**$ 26,397,000**
Food	$ 7,034,434	$ 2,672,656	-$ 4,361,778
Water	$ 1,373,375	$ 1,679,713	$ 306,339
Raw materials	$ -	$ 12,416,009	$ 12,416,009
Medicinal resources	$ 615	$ 9,438,873	$ 9,438,259
Genetic resources	$ -	$ 8,593,096	$ 8,593,096
Ornamental resources	$ -	$ 5,075	$ 5,075
Regulating	**$ 190,926**	**$ 63,555,911**	**$ 63,364,985**
Air quality regulation	$ 19,062	$ 250,350	$ 231,288
Carbon sequestration	$ -	$ 58,506,621	$ 58,506,621
Regulation of water flows	$ 11,991	$ 180,996	$ 169,006
Erosion prevention	$ 159,873	$ 592,044	$ 432,171
Pollination	$ -	$ 4,025,899	$ 4,025,899
Habitat	**$ 347,417**	**$ 3,784,007**	**$ 3,436,590**
Existence, bequest values	$ 347,417	$ 3,349,278	$ 3,001,860
Maintenance of genetic diversity	$ -	$ 115,026	$ 115,026
Maintenance of life cycles	$ -	$ 319,704	$ 319,704
Cultural	**$ 1,167,076**	**$ 2,621,909**	**$ 1,454,833**
Opportunities for recreation and tourism	$ 1,167,076	$ 2,621,909	$ 1,454,833
Total	**$ 10,113,843**	**$ 104,767,250**	**$ 94,653,407**