D9.3 Report on ecosystem services evidence generation and uptake within the Demonstration Projects

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1. Introduction

1.1 Introduction to SELINA

The SELINA project aims to provide the evidence base and guidance necessary to integrate ecosystem services (ES), biodiversity (BD) and ecosystem condition (EC) into both public and private decision-making. This integration can occur through a variety of approaches (collectively termed throughout this report as ecosystem assessment (EA) approaches), each adapted to contextual needs. To consolidate and unify such approaches, SELINA has developed a Framework for Integrated Ecosystem Assessment (FIEA). The development of the FIEA has been informed by a range of resources and frameworks[1], thereby streamlining insights from multiple sources across different sectors into one holistic, flexible framework to support ecosystem assessments.

Within SELINA a series of Demonstration Projects (DPs, more information provided in section 1.3) have been designed and implemented. DPs have taken place across a range of sectors and decision-making contexts, with SELINA partners coordinating with private sector entities to gather insights on how EA approaches in decision-making are conducted. Typically, the private sector conducts EA approaches for various applications, each incentivized by contrasting demands to the public sector (often due to lack of regulatory drivers). Through providing insights as to how private sector entities are approaching and assessing their interactions with ecosystems, and how outputs from these approaches can be applied and used to support private sector decision-making, SELINA aims to enhance the uptake of EA approaches.

1.2 Purpose of this document

Implementing EA approaches within private sector decision-making faces many challenges, many of which are well documented.[2] Chief among these is the lack of standardized financial market values for the majority of nature's contributions. Because ecosystem services generally have the characteristics of public goods, a disconnect emerges: the negative externalities of industrial activity are socialized and borne by the public, while the financial gains remain with the individual entity. Despite this, over 50% of global GDP is moderately or highly dependent on the natural world.[3]

The private sector's historical blindness to EC, BD and ES is rapidly being replaced by an array of approaches to understand impacts and dependencies on nature. In turn, this helps

[1] Including, inter alia, the MAES framework, Capitals Protocol, IPBES 5-step valuation Framework, UN SEEA, CICES

[2] See, for example, zu Ermgassen et al., (2025) The current state, opportunities and challenges for upscaling private investment in biodiversity in Europe

[3] PWC (2023) Managing nature risks: From understanding to action

view nature not as an externality, but as a fundamental stock of capital that provides a flow of essential services. This is exemplified by the range of regulations and policies[4] which are forcing capital markets to confront nature risk (loss of nature and biodiversity) as financial risk.

Through the SELINA project, partners have collaborated with diverse private entities to operationalize the EA approach, demonstrating how assessing ESs can lead to positive outcomes. This document serves as a practical roadmap, documenting the real-world implementation of these approaches, identifying the structural and technical barriers encountered, and uncovering approaches to overcome these hurdles. Ultimately, this document is aimed at two main audiences:

- Academia**:** It provides evidence-based insights into effective communication and engagement strategies. Specifically, it explores how researchers can better align ES science with corporate logic to facilitate the integration of the EA approach into business processes.
- Private Sector: It serves as a source of strategic inspiration. By demonstrating how private sector entities are currently implementing the EA approach, the document provides inspiration to entities wishing to understand their impacts, dependencies, risks and opportunities in greater detail.

1.3 Introduction to Demonstration Projects

Within SELINA Work Package 9 (WP9), Demonstration Projects (DPs) were designed to reflect real-world innovative examples of how knowledge on biodiversity, ecosystems and ecosystem services can inform and support evidence-based decision-making processes in the private sector. These DPs relied upon an exchange between the SELINA consortium partners and a private sector entity (business partner) to deliver the projects.

[4] Including, inter alia, EU biodiversity strategy for 2030 and linked EU Nature Restoration Law, TNFD, EU Corporate Sustainability Reporting Directive (CSRD)

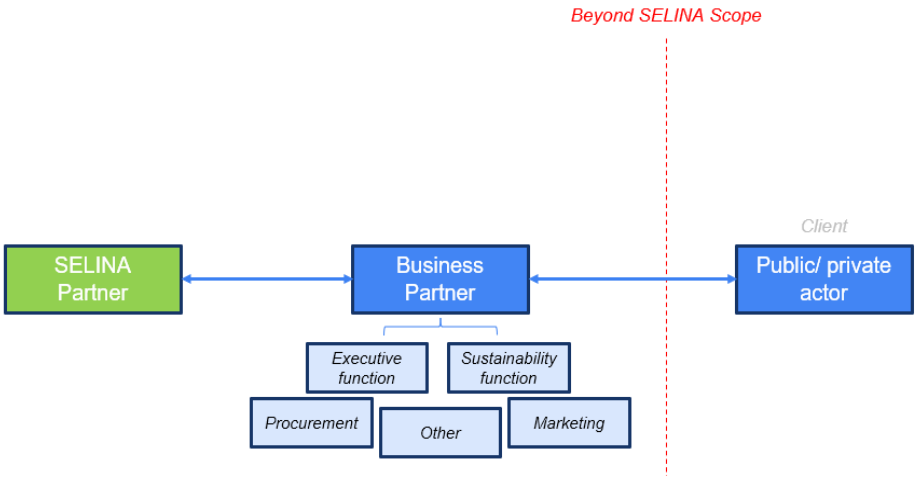


Figure 1. DP interaction with private sector

As shown in Figure 1 above, it is important to outline the limits of the scope of this document. Many of the DPs were developed or aligned with external drivers (policy, incentives) that are beyond the influence and scope of SELINA. As such, discussions on these drivers are not captured in the following sections. A detailed overview of the content of DPs is provided in section 3 and in the Annex of this document.

This report focuses directly on the engagement between SELINA partners and the business partners of each individual DP to unpack how the EA approach was implemented with each business partner. In doing so, it explores the specific operational mechanics, internal communication hurdles, and institutional frictions that define the science-business interface. By evaluating these collaborative journeys, the report examines how private-sector language, commercial timelines, and organizational cultures influence the long-term uptake of EA approaches.

Many of these DPs were formulated, designed, and implemented within the active timeline of the SELINA project. Given this, insights regarding the ultimate, long-term environmental impacts and tangible downstream organizational transformations are naturally outside the current reporting scope. The final outcomes and learnings of the DPs will be featured in Compendium of Guidance (CoG - final output of SELINA) to provide best practices of EA uptake.

This report synthesizes the immediate experiences across the DPs to identify common denominators of success and recurring systemic bottlenecks. In doing so, it establishes a scalable blueprint and a series of practical recommendations for how European businesses can navigate data scarcity, build cross-sectoral trust, and embed natural capital considerations directly into the core of corporate decision-making.

2. Approach

2.1 Process

i. Conceptualisation

Within SELINA, the EA approach centers around the Framework of Integrated Ecosystem Assessment (FIEA- developed as part of the SELINA project). The framework offers a systematic approach designed to plan, implement, and evaluate the ecological, economic, and social dimensions of ecosystems to directly support informed decision-making in both the public and private sectors. Each of the DPs used FIEA templates to formulate various aspects of their respective EA approach, including: the purpose, methods and indicators, data analysis, communication and application of the results. Developed as a universal framework spanning public, private, and academic contexts, the FIEA's architecture was actively informed by various frameworks, including the Capitals Protocol. Because of this shared lineage, deep conceptual synergies and direct structural alignments exist. While the FIEA provides the granular, scientifically rigorous methodology required to evaluate ecosystem extent, condition, and service flows, corporate stakeholders often require a streamlined framing to navigate this technical depth.

To bridge this gap, DPs were provided with a "zoomed-out" view of the FIEA by organizing its criteria around three familiar private-sector pillars derived from the ACT-D[5] framework and the Capitals Protocol[6]: Assemble, Assess and Act. Through this approach, additional institutional and decision-making dynamics within private entities were captured, tracking how EAs can gain internal traction, integrate with corporate culture, and ultimately inform strategy. Figure 2 below captures the alignment between the Capitals Protocol and FIEA, in addition to the decision-making dynamics which were captured as part of this report.

[5] Developed through the *High-Level Business Actions on Nature* initiative, ACT-D sets the strategic direction for a business's nature journey. ACT-D focuses on helping align the process and terminology used for evaluating, managing, and disclosing nature-related impacts and dependencies. While developed with a focus on nature, the set of actions prescribed in ACT-D are equally applicable to other aspects (people, society). The actions fall under the categories of **A**ssess, **C**ommit, **T**ransform, and **D**isclose.

[6] While ACT-D defines *what* to do, the Capitals Protocol provides the *how*. It focuses on the "Assess" stage of ACT-D, helping businesses evaluate trade-offs between natural, social, human, and produced capitals through three stages: Assemble (Framing), Assess (Valuation), and Act (Application).

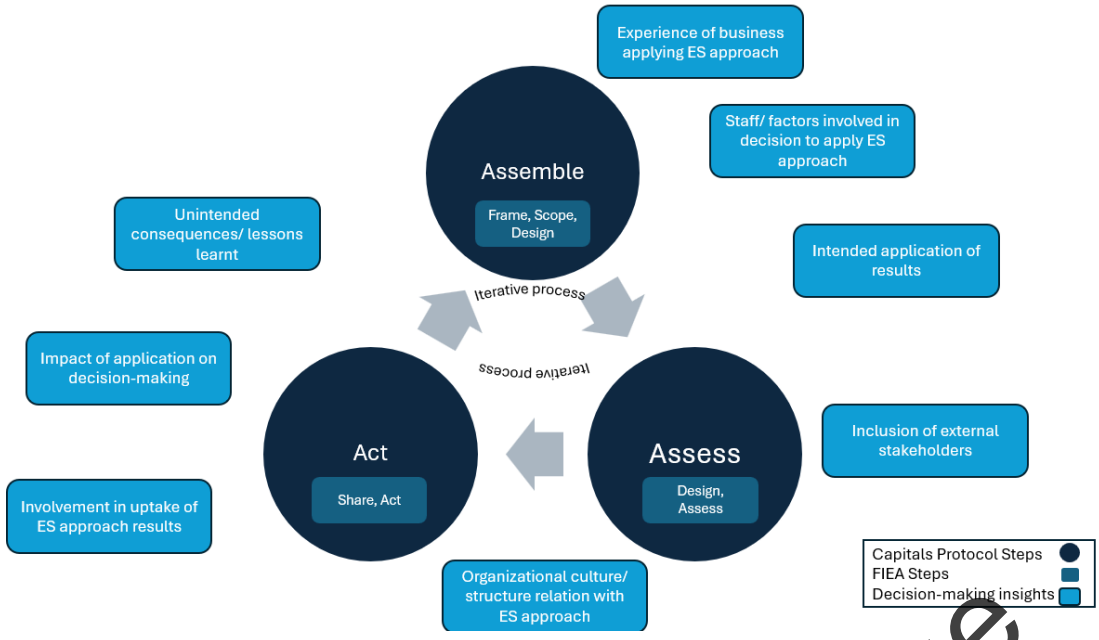


Figure 2. Alignment between FIEA and Capitals Protocol structure

Accordingly, both the data collected from DPs and the analytical findings presented in Chapter 3 of this report are synthesized across these three main stages:

- **Assemble:** Conceptualizing the assessment by identifying organizational objectives, baseline parameters, and internal resource requirements.
- **Assess:** Measuring and valuing the significance, worth, and materiality of the business's impacts and dependencies on various forms of capital.
- **Act:** Translating assessment findings into actionable business intelligence, embedding natural capital considerations into corporate governance, strategy, and daily operations.

Through collecting information on these aspects, this report aims to provide insights into not only how the private sector are implementing the EA approach, but how this is embedded within organizational culture and processes.

It should be noted, aspects relating to 'act' were largely not covered in this report, predominantly due to the timelines of the DPs within SELINA. Many of these DPs were formulated and designed within SELINA, therefore the EA approach they are advocating has only recently been implemented. Given this, insights into tangible impacts from implementing the EA approach, both on the organization, and on the environment, are not within the scope of this report. Impacts from the DPs will be reported on in SELINA deliverable D9.4 on scalable solutions, which is due in June 2027.

ii. Engagement

DPs were provided with a series of templates to capture key aspects during the implementation of their projects. First, the FIEA was provided for DPs to capture all steps of the framework. DPs had the opportunity here to test and provide comments to refine the final version of FIEA - embedding private sector considerations in this process. Secondly, a supporting template was provided [See Annex] to record key elements of the EA approaches implemented. The template was designed to capture management considerations when applying an EA approach, rather than the detailed, technical content of implementing the EA approach itself. The template focused on four main themes: 1) the context the DP was developed in, 2) engagement activities that were undertaken, 3) decisions that were made and 4) relevant process considerations. With these themes, the template was designed to capture insights into the interactions between the scientific partner and the private, ultimately with the aim to provide shared learnings on how EA approaches can be integrated into private sector decision-making process (explored in section 4 of this report).

2.2 Overview of Demonstration Projects

Within the SELINA project, eight private-sector DPs (DPs 8–15)[7] were developed, complementing the seven public-sector DPs created in a separate Work Package. These projects represent a diverse range of sectors and geographic locations across the EU. Table 1 below outlines the SELINA partners responsible for these DPs and provides key project details. The subsequent section explores the application of the EA approach for each of these initiatives.

7 https://project-selina.eu/dps

Code		Country	Lead Organisation	Title
DP08	Private/ public	Bulgaria	NIGGG-BAS	Integration of **Urban Heat Islands** and Ecosystem Services in urban and **spatial planning** (provide better tools for more informed decisions)
DP09	Private/ public	Norway	Asplan Viak	Integration of public-private ES knowledge (MAES) on **nature-based solutions** in **urban planning** & design using 'digital twins'
DP10	Private/ public	Malta	EcoINN	Integration of biodiversity and Ecosystem Services to develop **nature-based tourism** approaches and a tool that supports these approaches
DP11	Private	Finland	SYKE	Increase understanding of the impacts and dependencies of tourism on marine ecosystems and enhance **regenerative tourism approaches**
DP12	Private	Global	NINA	Assess impacts and dependencies on Ecosystem Services of **investment** bank portfolio to **screen for nature risk** and prioritize investments in companies
DP13	Private	Italy	SEACoop	Increasing synergies between **farming** activities and Ecosystem Services provided by **agroecosystems** to **foster biodiversity-based agricultural practices**
DP14	Private	Europe	EY Denkstatt	Developing a **standardized ecosystem services valuation approach** to support corporate transition planning and strategic decision-making
DP15	Private	The Netherlands	Grant Thornton	**Valuing Nature in construction**: A Tool to integrate Biodiversity Drivers and Ecosystem Services

Urban Planning & Constructon | Tourism | Corporate Strategy & Finance | Agriculture

Table 1. Overview of Private Sector DPs

3. Private sector application of the Ecosystem Assessment approach - WP9 Demonstration Projects

This section outlines the activities, methods, and materials employed across the individual DPs to support private sector implementation of the EA approach, and synthesizes the key lessons learned through their application. Each DP chapter presents practical experiences and insights generated through targeted interventions, illustrating how EA approaches can be operationalised in diverse business contexts. The individual DP narratives are structured according to the sectoral clusters introduced in Section 2: Urban Planning & Construction, Tourism, Corporate Strategy & Finance, and Agriculture. This clustering reflects the distinct challenges and opportunities within individual sectors while enabling cross-sectoral analysis of approaches, outcomes, and transferable good practices.

This chapter focuses on the decision-making processes behind the individual private sector applications, showing how EA considerations were used in practice at a high level. It highlights how assessment results informed planning and investment decisions, as well as key challenges and enabling factors following the steps of the Assemble, Assess and Act stages.

To support the high-level insights provided in this chapter, two annexes have been added to this report. Annex A presents the reporting templates used to collect data from the individual Demonstration, including the supporting template to apply the ecosystem services (ES) approach in practice that was developed specifically for reporting purposes of

this deliverable as well as the Framework for Integrated Ecosystem Assessment (FIEA). In addition, Annex B compiles the FIEA applications by each Demonstration Project in the form of factsheets providing more background data on the methodologies and data used.

3.1 Spatial Planning and Construction

DP08 Bulgaria: Integration of Urban Heat Islands and Ecosystem Services in Urban and Spatial Planning

Additional material can be found on the SELINA website here

European cities are increasingly exposed to the impacts of climate change, including rising temperatures, more frequent heat waves, and greater variability in rainfall, which together intensify Urban Heat Island (UHI) effects and pluvial flood risk. As a result, local climate regulation—particularly the regulation of temperature and humidity provided by urban vegetation—has become a critical dependency for maintaining habitable urban conditions during heat waves. This is also the case in Sofia, Bulgaria, where increasing temperature anomalies since 2007 have led to more frequent heat waves, accompanied by rainfall variability that heightens pluvial flood risk. Although, within the framework of MAES Bulgaria (2017)[8], the concept of Local Climate Zones, as an indicator of ES condition, have been developed, ecosystem services remain weakly integrated into spatial planning legislation and methodological frameworks, limiting the uptake of science-based ecosystem services evidence in urban decision-making.

Demonstration Project 08 (DP08) is led by the National Institute of Geophysics, Geodesy and Geography at the Bulgarian Academy of Sciences (NIGGG-BAS) in collaboration with Aerographica Geospatial, a private company providing consultancy services in cartographic, geographical, and geospatial information systems. The project was implemented as a public–private hybrid case, combining scientific research with applied urban and spatial planning. An important starting point for DP08 was the development of the Local Climate Adaptation Plan adopted by Sofia Municipality, which created a concrete policy and planning framework for addressing urban heat islands and climate risks.

The project aimed to demonstrate how urban ecosystem mapping can support urban planning, particularly for private-sector actors involved in spatial analysis and design. By developing improved analytical tools, it sought to integrate urban heat island (UHI)

[8] European Commission. (2017). Mapping and assessment of ecosystems and their services (MAES) in Bulgaria: Outcomes of the MetEcosMap project (2015–2017).

dynamics and ecosystem services more effectively into planning processes and to support the assessment of UHI-related risks and potential impacts.

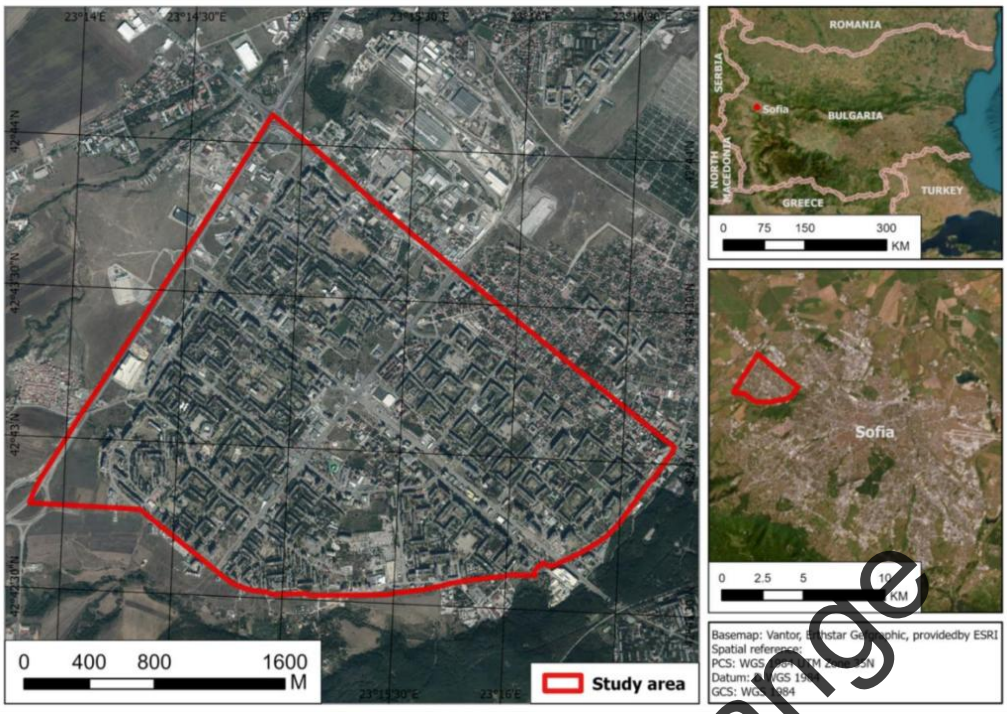


Figure 3. Case study area of Lyulin district in Sofia (Dimitrov et al. 2024)[9].

Assemble

At the beginning of the project, DP08 focused on defining the decision context, identifying key stakeholders, and framing the scope for integrating ecosystem services into urban planning. Key stakeholders included the Sofia Municipality, Burgas Municipality, Sofiaplan (municipal enterprise developing Sofia's urban development plans), spatial and urban planners, and private companies working with geospatial data. Engagement built on existing collaboration between municipalities and private partners, and was further supported through the Bulgarian Community of Practice (CoP) established under the SELINA project.

Several challenges were identified at this stage. Ecosystem services were not embedded in urban planning legislation or methodological guidelines, and the national framework for mapping and assessing ecosystems and their services was still under development. This limited the formal uptake of ecosystem services evidence in planning processes and delayed practical implementation. At the same time, the ongoing preparation of local climate adaptation strategies created an important opportunity to introduce ecosystem services considerations.

[9] Dimitrov et al (2024). A Methodological Framework for High-Resolution Surface Urban Heat Island Mapping: Integration of UAS Remote Sensing, GIS, and the Local Climate Zoning Concept.

In this context, a key enabling factor was the possibility to develop practical, decision-support products, such as an innovative analytical tool to inform urban and spatial planning and support mitigation of urban heat islands, as well as the potential to deliver this information to decision-makers through a GIS-based application, thereby increasing the expertise and impact of the private-sector partner.

The project also benefited from previous experience in applying the EA approach. NIGGG-BAS and Aerographica Geospatial had already collaborated with Sofia Municipality on related initiatives, with Aerographica Geospatial's team combining a strong scientific background with a private-sector, application-oriented mindset.

Assess

Research on the urban space and urban morphology requires detailed and precise geospatial information. The digital twin of the Lyulin district in Sofia is used as a geospatial basis for the analysis of the envisaged climatic events. The digital twin is generated from digital 3D photogrammetry (based on unmanned aerial systems, UAS), thermal photogrammetry, laser scanning, GIS-based modelling, and statistical analyses. The digital twin of the Lyulin district is publicly available (Sofia Municipality, 2024[10]). Additionally, the study includes Local Climate Zones data and climate projection datasets.

Figure 4. Local Climate Zones (LCZs) (50 x 50 m), Sofia City, Lyulin residential complex (Dimitrov et al. 2024)

Urban ecosystems in Sofia's Lyulin district were mapped to assess their extent and condition, with indicators such as thermal load, land-use-land-cover characteristics, and urban heat island magnitude. Ecosystem service assessment focused on regulation of temperature and humidity, including ventilation and transpiration (CICES 2.2.6.2). Spatial

[10] Sofia Municipality. (2024). Local plan for climate change adaptation.

mapping outputs highlighted areas with high UHI intensity and revealed how urban morphology and land-cover configuration influence local climate regulation.

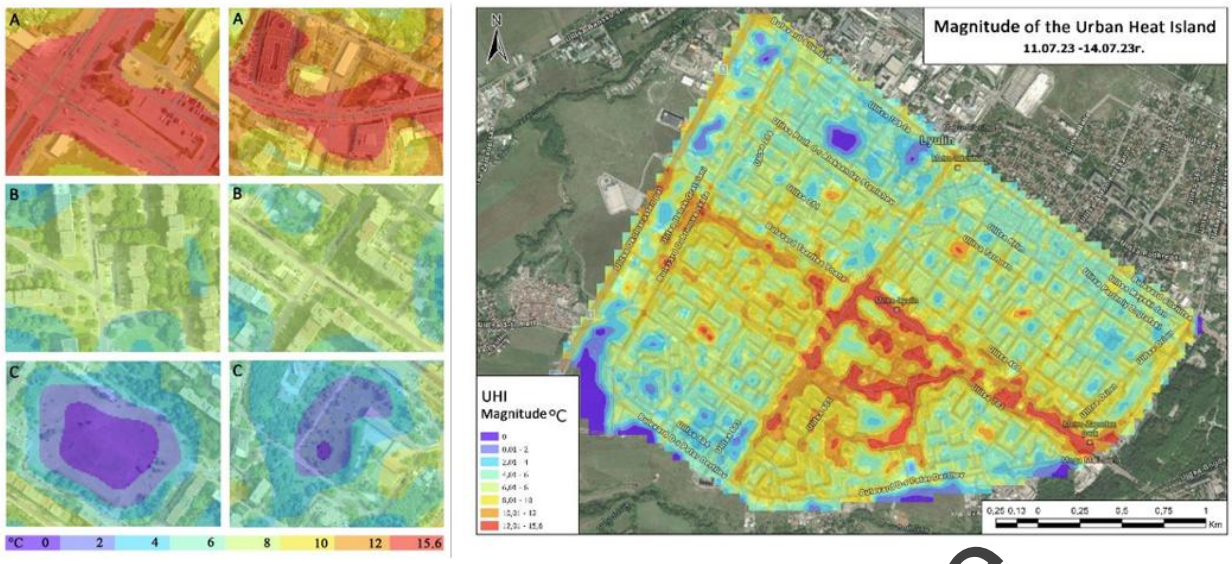


Figure 5. UHI magnitude – indicator for urban ecosystem condition within the boundaries of the Lyulin district, for the period 11–14 July 2023 (taken from Dimitrov et al. 2024)

Challenges primarily stemmed from the ongoing development of methods to fully integrate UAV-derived indices into ecosystem services assessment. Addressing these challenges required a closely coordinated workflow between the UAV-based remote sensing team and the ecosystem services research team, with joint planning of data collection, indicator selection, and analytical procedures. Collaboration focused on harmonising terminology, aligning approaches to local climate regulation assessment, and jointly interpreting results to ensure consistency between biophysical measurements and ecosystem services assessment.

Further challenges were related to the general lack of understanding of the applicability of ES as well as differing working approaches: while the research partners prioritised methodological robustness—such as ecosystem condition and pressure indicators—the business partner was primarily focused on generating geospatial data of UHI effect, whereas the Sofia Municipality needs are closely linked to urban planning. Bridging this gap in perspective required continuous dialogue to align scientific concepts with practical planning needs.

Act

As a result, the Aerographica Geospatial have identified key vulnerable areas of the Lyulin district:

- Central and densely built-up areas, especially along main boulevards, are most exposed to heat stress.
- Low-lying and highly sealed areas face an increased flood risk during intense rainfall.
- Soil moisture deficits will be more common in summer, stressing urban vegetation and increasing risk of fire outbreaks.
- Strong wind events, especially in spring and winter, pose risks to infrastructure and public safety.

Based on the assessment results, the Aerographica Geospatial designed a holistic, long-term adaptation strategy, structured around five strategic goals:

1. **Climate-sensitive land use and planning:** Integrate climate data into urban planning, prioritise compact development, and use scientific evidence for decision-making.
2. **Resilient infrastructure and built environment:** Retrofit and design buildings and infrastructure to withstand heat, flooding, and storms and promote energy efficiency.
3. **Enhanced green infrastructure:** Expand and connect green spaces, increase tree cover, and use nature-based solutions to mitigate UHI and manage water.
4. **Public health, safety and disaster preparedness**: Strengthen early warning systems, emergency response, and community resilience to climate-related hazards.
5. **Community engagement and education:** Raise awareness, provide training, and ensure inclusive participation in adaptation planning, with special attention to vulnerable groups.

To implement the resulting strategy, Aerographica Geospatial proposed a portfolio of short-term and long-term nature-based solutions. Short-term measures included pocket parks, mobile forests, green parking solutions, and temporary cooling corridors, while long-term measures focused on urban parks, green roofs and walls, permeable paving rain gardens, and floodplain restoration. These outcomes demonstrate how ecosystem services evidence can be translated into concrete planning and design measures relevant for both public authorities and private-sector actors involved in urban development

The results of DP08 directly informed the development of the Local Climate Adaptation Plan through a Digital twin for Sofia's Lyulin district.

The results of DP08 were actively disseminated and shared. Outputs were published on the Sofia Municipality website, presented in town hall meetings, and communicated through local media. The methodology and tools were also applied in educational and capacity-building activities, including workshops and international student challenges focused on urban heat islands and nature-based solutions.

Beyond Sofia, the analytical tool developed under DP08 was implemented in the Climate Atlas of Burgas Municipality as part of the Regions4Climate project, demonstrating transferability and upscaling potential.

Figure 6. Left: Student Competition (Source: T4EU). Right: Public introduction of the Local Climate Adaptation Plan through a Digital Twin (Source: Sofia Municipality)

Lessons learned

DP08 demonstrates that EA approaches can significantly enhance urban planning when supported by high-resolution scientific data and close collaboration between researchers, municipalities, and private-sector actors. A key lesson is that translating ecosystem services into decision-making tools **requires methodological innovation combined with practical usability** for planners and businesses working with spatial data.

The project highlights that **legislative and methodological gaps remain a major barrier to wider uptake,** particularly where ecosystem services are not formally embedded in planning guidelines. At the same time, ongoing climate adaptation efforts create important entry points for integrating ecosystem services evidence.

Finally, DP08 shows that **place-specific characteristics matter greatl**y in ecosystem services assessment. Approaches need to be **adapted to local conditions**, but once developed, they can be transferred and scaled to other cities facing similar challenges. Treating ecosystem services integration as an iterative, **collaborative process between science and practice** proved to be a key enabler of impact.

DP09 Norway: Integration of public-private ecosystem services knowledge in urban planning & design using Digital Twins

Additional material can be found on the SELINA website here

Urban development projects increasingly face the challenge of balancing regulatory compliance, sustainability ambitions, and societal expectations for green (vegetation) and blue (water management) urban environments. In Norway, some municipalities require developers to calculate and meet minimum Blue-Green Factor (BGF) thresholds. At the same time, there is a growing public demand for urban development that supports nature, recreation, local climate regulation and overall quality of life.

Despite this, existing planning processes often lack efficient, transparent, and early-stage tools that translate ecosystem-related considerations into practical decision-making for developers. DP09 responds to this gap by exploring how digital twins can be used in large-scale urban developments to automate and integrate BGF calculations, enabling iterative testing throughout the planning process. By providing a simple, accessible digital tool and dashboard, the project allows project managers to track performance related to ecosystem-relevant measures, increasing awareness of ecosystem services and their role in development outcomes. Making such calculations faster and more affordable also lowers barriers for wider uptake, supporting both private developers and municipalities in applying similar requirements more consistently. While the BGF does not directly measure ecosystem services, it provides a useful minimum benchmark for the inclusion of blue and green structures in development projects.

DP09 was implemented in Norway as a public-private hybrid case led by Asplan Viak, a planning and engineering consultancy, in collaboration with the Norwegian Institute for Nature Research (NINA), and Hav Eiendom, a publicly owned property development company operating under the Port of Oslo and the municipality of Oslo. Hav Eiendom has a public mandate to create sustainable waterfront development that generates value for the city, the port, and society. DP09 focused on one of Hav Eiendom's largest development projects, Grønlikaia, which includes approximately 1,500 homes and 3,000 workplaces on Oslo's waterfront.

Figure 7. The Grønlikaia development project in Oslo, Norway

DP09 aimed to support private-sector decision-making by developing a digital, automated approach for calculating BGF using digital twins, thereby enabling earlier, faster, and more iterative integration of ecosystem-related considerations into urban development planning.

Assemble

At the start of the project, DP09 focused on defining the decision context for private developers operating under municipal BGF requirements and high sustainability ambitions. Hav Eiendom is a small organisation in terms of staff capacity but manages large and complex development projects. While the company had not previously applied a formal EA approach, it had already been using ecosystem-related language and concepts through sustainability frameworks such as Doughnut Economics[11], centered on well-being within social and planetary boundaries. HAV Eiendom adapted this method in their report called DEiG, 'Doughnut Economics in Grønlikaia'. The DEiG working group consisted of representatives including a property developer, architect, environmental psychologist, sociologist, marine scientist, energy consultant, water and wastewater engineer, biologist, landscape architect, sustainability-oriented industry associations, a real estate association, and a user coordinator.

Other key stakeholders involved from the outset included Hav Eiendom's executive team, sustainability staff, landscape architects, municipal authorities, and external advisors. Engagement was driven by the need to ensure ownership of the process at senior decision-making level, while also involving those directly responsible for calculating and implementing BGF measures.

Public participation processes further shaped the context, resulting in ten recommendations for the Grønlikai project, notably *"Nature in the city"* and *"Recreation and physical activity in*

[11] https://doughnuteconomics.org/about-doughnut-economics

the city," both of which stressed publicly accessible nature, coastline, and opportunities for recreation on land and water, reinforcing the project's emphasis on blue-green solutions.

BGF is measured in terms of vegetation, terrain and water surface observable extents and types, qualities and conditions. Specifically, the factor is composed of 10 measures: Ground vegetation, green terrain, green roofs, green walls, rainbeds, water management, water surface and wetlands, terrain depression, partially open surface, closed surface, existing trees and new trees. Each BGF measure provides a bundle of ecosystem services, allowing ecosystem services to be considered indirectly through physical planning measures. Planting new trees might be done to increase evapotranspiration as a climate change mitigation effort, but also provides ecosystem services such as air quality improvement, temperature control, biodiversity & habitat, recreational values and aesthetics. This is not an ecosystem approach, but an index approach proxying ecosystem services. BGF compliance is not merely a technical calculation, but a way of designing to provide for ecosystem services such as local climate regulation, stormwater management, biodiversity support, and recreation, without having to model ES explicitly (excessively costly at a project scale).

The Assemble stage therefore identified a clear opportunity: to move BGF calculations from a late-stage compliance exercise to an early-stage, design tool throughout the planning process.

Assess

The Assess stage focused on importing the digital twin model into Asplan Viak's Geographic Information System (GIS), harvesting foundational data and setting up data flows to accommodate rapid BGF calculations.

Spatial data were collected and structured within a digital collaboration platform that integrates all thematic assessments relevant to the project. Automated BGF calculations were performed repeatedly across different scenarios, enabling rapid testing of design alternatives. Despite not required by legislation, Asplan Viak decided to run BGF calculations early on, using aerial photos and lidar-data. This allowed planners and developers to assess how changes in green and blue measures affected overall BGF performance in real time. An interactive map was created to allow users to test how modifications in BGF measures would affect the overall BGF result for each scenario.

A key challenge during this stage was the lack of clear guidance on how aquatic and marine environments should be included in BGF calculations. Since the Grønlikaia project aims to strengthen benthic ecosystems, uncertainty around whether and how such measures are rewarded in existing BGF frameworks required the exploration of multiple calculation scenarios, including inclusion, exclusion, and alternative weighting of marine areas.

A more technical challenge was to translate the BGF framework into tags for each measure. This allowed architects and landscape architects to tag each surface in their drawings with a corresponding measure so that calculation of BGF could be performed directly on the data they delivered.

A further challenge identified was the risk of late-stage non-compliance with minimum BGF requirements. Failure to meet BGF thresholds at advanced planning stages can require costly redesigns by architects and landscape architects, with implications for timelines and project feasibility. DP09 addressed this challenge by enabling BGF calculations to be carried out early and iteratively through the use of digital twins, allowing project teams to adjust designs in real time and reduce the risk of non-compliance emerging late in the development process.

When calculating BGF at an early stage the full extent and attributes of measures are not known in all areas. For example, a building will have a green roof, but the depth of the soil or whether the entire roof will be covered is not yet known. This information is required to fit into the BGF framework. To overcome this Asplan Viak added generic average measures for the group of green roofs in the framework and a functionality to assign a percentage of the roof likely to be covered by green surface.

Act

One of the main outcomes of DP09 was the demonstration that digital twins enable much faster and earlier BGF calculations, allowing ecosystem-related considerations to shape design decisions before plans become fixed. As a result, Grønlikaia incorporated more blue and green measures to reach target BGF values, including a commitment by the owner to ensure at least 30% green structures across the entire development.

Starting with the aim to solve BGF calculations for the Grønlikaia project, the DP ended up becoming a full scale digital collaboration platform, setting the standard for future projects of both Hav Eiendom and Asplan Viak. It is now being used to collect relevant spatial data information from all thematic assessments in the project, engaging much broader within Hav Eiendom and the various contractors. The platform has since then been used by Asplan Viak in other Norwegian municipalities to calculate their versions of BGF and similar mandatory factors.

Results from DP09 were shared continuously throughout the planning process via the digital collaboration platform, ensuring transparency for C-suite and project management. The platform contains an interactive dashboard, showcasing BGF performance and how each measure (surface) impacts the overall factor. The dashboard can be used to evaluate changes in BGF measures by interactively changing them directly in the map and re-run calculations.

Figure 8. Interactive dashboard showcasing BGF performance on the digital collaboration platform

Final BGF results were submitted to the municipality for approval, forming part of the formal planning documentation.

Finally, Asplan Viak, Hav Eivendom and NINA have created a storymap to showcase the Grønlikaia project and introduce the digital collaboration tool. The storymap was created to inspire both developers and municipal authorities to use this technology in their future projects. All GIS-tools to calculate BGF in Oslo are attached in the storymap for others to use or modify to their needs. The storymap can be viewed here.

Lessons learned

DP09 demonstrates the **importance of strong executive leadership and cross-functional engagement** when integrating ecosystem-related considerations into private-sector decision-making. Involvement from senior roles—including Hav Eiendom CEO, Sustainability Manager, Head of Zonal Planning, and Director of Communications—was critical in establishing ownership of the process and ensuring that ecosystem-related considerations were embedded beyond technical compliance. At the same time, the active involvement of architects and landscape architects supported adoption and continuous use of the approach throughout the planning process.

Organisational culture also emerged as a key enabler. Rather than aiming solely to meet minimum Blue-Green Factor (BGF) requirements, Hav Eiendom deliberately **pursued higher ambitions by grounding the project in the Doughnut Economics framework**. This encouraged the project team to view BGF not only as a regulatory threshold, but as a tool to support broader ecological and social sustainability objectives, reinforcing the relevance of ecosystem services in local urban development.

From a methodological perspective, DP09 showed the **value of developing generic and reusable models for BGF calculations**. By designing digital solutions capable of handling different municipal criteria and thresholds, the project increased applicability across

projects and municipalities, supporting scalability and reuse. This flexibility also strengthened the role of scientific evidence in supporting consistent, transparent decision-making under varying regulatory contexts.

DP15 Netherlands: Measuring and valuing biodiversity and ecosystem services within construction projects

Additional material can be found on the SELINA website here

The construction and real-estate sector play a significant role in biodiversity loss through land-use change, habitat fragmentation and soil sealing. At the same time, construction projects are increasingly exposed to nature-related risks, including flooding, heat stress, increasing regulation, and reputational scrutiny. While many companies recognise the importance of biodiversity and nature-inclusive design, they often lack decision-relevant evidence that demonstrate how nature-positive measures contribute to long-term value creation, risk reduction, and societal benefits. As a result, biodiversity is frequently framed as a cost or compliance obligation rather than as an asset.

DP15 is led by Grant Thornton (GT) in collaboration with Heijmans, a large Dutch construction and real-estate company operating across infrastructure, construction, real estate, and technology. As a leading European construction service provider, Heijmans sought to align their strategy with the Corporate Sustainability Reporting Directive (CSRD) and the Taskforce on Nature-related Financial Disclosure (TNFD) through four drivers: space for nature, species richness, environmental conditions, and nature as a resource. The construction company already had an advanced internal understanding of biodiversity, supported by an in-house biodiversity team and multiple pilot projects on nature-inclusive development. However, this expertise had largely focused on the mapping of ecosystem types and habitat, rather than the quantification of ecosystem services to improve the business case for nature-positive measures.

The primary objective was therefore to develop a practical, scientifically credible ES valuation tool that could demonstrate the tangible monetary value of nature-positive measures in infrastructure and real-estate projects. The project focused on building a business case for nature, showing how ecosystem services contribute to corporate goals. Furthermore, the assessment should be designed not merely to track compliance, but to inspire action beyond traditional "mitigation" activities and 'business as usual' scenarios, and help Heijmans go beyond regulatory requirements and peers.

A central design requirement was that the outcomes of the tool should be generally usable by non-technical decision-makers such as project managers, procurement staff, and

directors. These stakeholders should also be enabled to provide input through standardized questionnaires. In practice, the main stakeholder applying the tool for analysis will be the Sustainability team within Heijmans.

Assemble

The decision to apply ES as a strategic guidance was taken internally by the Executive Team and Sustainability function, with leadership from the Biodiversity Advisor and the Director of Real Estate Development. As the formal partnership between GT and Heijmans launched in early 2025, the project progressed rapidly through a streamlined engagement process. GT received input within Heijmans from ecologists, site managers, and procurement leads, ensuring the tool was grounded in practical, on-site realities without undertaking a lengthy external stakeholder engagement process. As the project needed to deliver immediate corporate value, GT held a series of initial engagement consultations with the Head of Real Estate & Biodiversity and the Biodiversity Advisor. By engaging leadership from both the Real Estate and Infrastructure divisions, GT ensured the final output was not just a technical asset, but a strategic instrument aligned with Heijmans' overarching commercial and environmental goals. As a result, GT and Heijmans' leadership decided to focus on early-stage project design and scenario comparison, where decisions about land use and design have the greatest influence on long-term impacts and costs. Instead of asking how projects affect nature, the assessment focused on how nature-inclusive design influences business outcomes, such as flood resilience, urban heat mitigation, human well-being, and real-estate value.

Assess

To balance precision with practicality, GT decided to implement a dual-tiered approach that consists of "Benefit Transfer" (tier 1), and "Condition-Adjusted Valuation" (tier 2). Benefit Transfer is employed to estimate the economic value of an ecosystem at policy site (the place you want to assess) by using valuation estimates from relevant study sites where primary evaluation has already been carried, which allows to leverage policy-ready values that would otherwise need more time consuming, expensive, or data-intensive valuation methods. The next tier, "Condition-Adjusted Valuation" consists in adjusting the valuation to observed ecosystem/site characteristics instead of treating them as context-free; in other words, it adds a precision layer to the previous tier that improves the accuracy of the valuation results to reflect the site-specific realities. Another tier was proposed as further work but not integrated (see Table 2).

Tier 1 “Benefit Transfer”	Using "Benefit Transfer" methods, applying generalized Dutch valuation coefficients from sources such as the TEEB Stad Tool and CBS to project sites based on land-use types.
Tier 2 “Condition-Adjusted Valuation”	Incorporates a performance weighting scale. This allows for a more nuanced valuation by adjusting the "standard" value based on the quality or condition of the land type. This was used for adjusting ecological integrity of different ecosystem types when using the STAD tool and assessing healthcare benefits (e.g.high-quality mixed forest is weighted significantly higher for ecological integrity than arable land, meaning ecosystem service values reflected are higher).
Tier 3 “Site-specific Modeling”	For high-priority projects, the tool can integrate direct biophysical data. This was not included in the project, but is suggested as further work to consider for more accurate results.

Table 2. The dual-tiered approach applied by GT

Indicators were chosen that reflected both the biophysical capacity of the ecosystem and its socio-economic impact. Carbon sequestration, air pollution removal, pollination, green living environment - using national statistical data and valuations from literature and publicly available tools such as TEEB Stad tool, CBS, and the ESVD. Furthermore, scenario development was a key aspect of the tool and allowed Heijmans to ascertain the benefits of implementing different combinations of measures or land-use change options.

To map ecosystem types, GT used data on land use type and ecosystem extent provided by Heijmans. The company also provided spatial data (GIS files) from which GT extracted the land cover in hectares for each ecosystem/ habitat type. Habitat location and connectivity were excluded from the assessment.

To assess and evaluate ecosystem services, GT integrated specific biophysical and monetary data across four core service categories into the tool:

- **Carbon Sequestration:** Calculated via sequestration rates ($tC/ha/year$) specific to Dutch landscapes (orchards, mixed forests)
- **Air Filtration:** Modeled as a health-cost saving. GT quantified pollutant removed by vegetation to calculate “avoided mortality and healthcare costs
- **Pollination Service:** Measured via a suitability index (floral resources and nesting distance) rather than just land area
- **Real Estate Appreciation:** Measured by the “Green Living Environment” through the amenity value - quantifying how proximity to nature directly boosts property premiums

Furthermore, standard economic adjustments were applied:

- **Inflation Normalization:** All historical data points were adjusted using the CBS Consumer Price Index
- **Discounting:** Applied discount rates to all 20-30 year future projections to reflect the Present Value (PV) of future nature benefits

At this stage, GT and Heijmans collaborated to generate robust valuations of the ecosystem services generated through land use change in their infrastructure and real estate projects, the focus of the collaboration. The Excel-based valuation tool GT developed quantifies the monetary value of ecosystem services by comparing a Business-as-usual scenario of construction with a Nature-positive scenario of construction which generally involves the increase of forested/greener surface. Helping make these values visible in monetary terms, allows to make the business case for nature providing an entry point to support buy-in of the incorporation of greener measures into projects' design and overall company's strategic decisions. The visualization of this impact in monetary terms also supports the company's reporting and disclosure as well as a narrative that can speak to investors, and provides the company a competitive advantage in tender processes.

While land-use and habitat data were generally available for project sites, many ecosystem services—especially cultural services and small-scale biodiversity measures such as bat boxes or ecological corridors—proved difficult to quantify reliably using existing datasets and benefit-transfer coefficients, which are typically calibrated for larger spatial scales. This made it challenging to generate credible monetary values for infrastructure projects, where ecological interventions are often spatially limited and baseline conditions already degraded. A further challenge was balancing scientific robustness with practicality: more detailed ecosystem condition assessments and site-specific modelling were recognised as scientifically desirable but would have made the tool too complex and resource-intensive for its intended users. As a result, the assessment relied on adjusted, literature-based proxies and scenario analysis, which were fit for decision support but required careful communication of assumptions and limitations to avoid over-interpretation of results.

Act

The project delivered a practical, excel-based tool designed for both technical and non-technical personnel. Tailored to the Dutch national context using localized data and literature, the tool enables Heijmans to model scenarios for infrastructure and real estate projects. It provides decision-makers and shareholders with evidence-based justifications for nature-inclusive investments supporting both corporate sustainability and societal well-being. The outcomes provide a consistent evidence base that can be interpreted according to different needs/ audiences: they support Project Managers in evaluating design alternatives and their long-term financial and ecological trade-offs; inform shareholders' understanding of ROI and natural capital appreciation; and provide substantiation of wider

societal value in public and private tendering processes, contributing to a stronger competitive position.

Overall, the tool demonstrates that natural capital is a sound investment by quantifying ecological and economic value. Key applications include:

- **Strategic Planning:** Integrating nature-inclusive measures during early design phases to maximize ecosystem services.
- **Competitive Advantage:** providing evidence of societal impact to strengthen bids during public and private tender processes.
- **Economic Analysis**: Using Cost-Benefit Analysis to compare "Business as Usual" against biodiversity-positive scenarios, determining the monetary impact for investors
- **Impact Measurement:** Tracking net changes in ecosystem services to validate project interventions and enhance brand reputation

The EA approach allows Heijmans to develop an evidence-based narrative that is grounded in quantitative valuations, helping translate environmental benefits into financial terms that are meaningful for decision-makers. By enabling cost-benefit analyses and demonstrating a clear return on investment for nature-based solutions, the approach provides a concrete framework for integrating environmental considerations directly into project design and procurement processes. Quantifying the "higher total value" of nature-inclusive solutions also allows Heijmans to distinguish its bids from competitors, while supporting more informed site selection and strengthening the company's reputation and image as a leader in biodiversity-focused construction.

Lessons learned

A key lesson from DP15 is that for an ecosystem services tool to be used routinely across a large organisation, **practicality and usability of results must take precedence over maximum scientific complexity**. Adopting a tiered approach delivers evidence base outcomes relevant to different audiences (i.e. project managers, shareholders, procurement team), while accepting certain assumptions and grouping ecosystems into broader categories made it scalable across Heijmans' project portfolio.

The project also showed that in urban development contexts, the **quality and amenity value of nature often outweighs the sheer land area**, as small parcels typical of infrastructure and real-estate projects generate limited production values but deliver substantial benefits through cultural ecosystem services such as health, aesthetics, and urban cooling. Finally, while traditional ecosystem accounting is well suited to valuing large areas, it has clear limitations in capturing the value of **micro-interventions** or non-spatially explicit biodiversity positive measures (e.g. bat boxes, insects' hotels, ponds, etc.), which are

common in urban construction and require alternative or complementary valuation approaches. Currently GT continues to work to address the incorporation of these into the tool.

3.2 Coastal and Marine

DP10 Malta: Integration of biodiversity and ecosystem services to support nature-based tourism in Malta

Additional material can be found on the SELINA website here.

Malta is experiencing increasing pressure on its natural ecosystems due to rapid urban development and a steadily growing tourism sector. Nature-based tourism (NBT) activities – swimming, hiking, birdwatching, and scuba diving- are concentrated in specific locations across the Maltese Islands, often overlapping with environmentally sensitive areas, including protected coastal and terrestrial ecosystems. While tourism represents one of Malta's most significant economic sectors, and businesses rely on the good conditions of natural sites, unregulated visitation patterns pose risks to the long-term health and sustainability of nature-based attractions.

DP10 focuses on developing a prototype digital platform that integrates near-real time environmental data with tourism activity in Malta. The project is facilitated by Ecostack Innovations, an environmental consultancy, which initiated the project after identifying the need for a tool to better understand tourism pressures on Malta's ecosystems. By understanding peak periods, popular destinations, and emerging preferences, businesses can strategically time and target their marketing efforts. Seasonal and site-specific data also empower service providers to adapt their offerings in line with visitor demand and environmental conditions.

The project was implemented as a hybrid public-private sector case, involving close collaboration with public authorities – primarily the Environment and Resources Authority (ERA) and the Malta Tourism Authority (MTA) – as well as engagement with local businesses, tourists, local residents, researchers, and technical partners, including the European Space Agency (ESA).

Assemble

The project aims to explore synergies between ecosystem assessment, tourism management, and stakeholder needs by co-developing a platform that provides transparent, spatially explicit information on ecosystem condition and nature-based tourism activity across the Maltese Islands. The platform is intended to support multiple user groups, including tourists, residents, public authorities, researchers, and local businesses.

At the start of the project, a comprehensive stakeholder analysis was conducted, identifying the following main stakeholder groups: Tourism and residents, government authorities (ERA

and MTA), business sector, academia and technical partners. Based on that, potential use cases were selected:

- **Tourists and residents** can observe NBT sites popularity over time, as well as access crowdsourced information about the site and its conditions to make a decision regarding desire to visit.
- **The Environment and Resources Authority (ERA)** is interested in evaluating the state of the environment across the Maltese Islands and to evaluate trends in time for regulation/enforcement purposes or to inform ecosystem restoration activities which have become a requirement under the EU Nature Restoration Law.
- **The Malta Tourism Authority (MTA)** can explore correlations between NBT site popularity and their environmental conditions, using these insights to inform and implement new policies in the tourism sector.
- **Local businesses**, particularly those offering nature-based activities, services, or experiences, can leverage the platform to identify NBT sites.
- **Researchers and practitioners** in the public and private sector will be able to use the application or export calculated indices for a specific timeframe to observe Maltese ecosystems and potentially incorporate that knowledge in other interdisciplinary topics.

Identified Stakeholders were categorised using a power–interest grid to support a targeted engagement strategy, with ERA and MTA identified as high-power, high-interest actors to be managed closely.

Manage closely (High power – high interest)	Environment and Resources Authority (ERA), Malta Tourism Authority (MTA)
Keep Informed (low power – high interest)	Local businesses, researchers, Open University of Cyprus (OUC), tourists and residents
Keep Satisfied (high power – low interest)	European Space Agency (ESA)
Monitor (low power -low Interest)	No stakeholders have been identified in this category

Table 3. Power grid to identify engagement strategy

Engagement focused on understanding stakeholder needs, expectations, and potential platform use cases. Methods included Maptionnaire surveys with tourists and residents—combining qualitative input with spatial data through interactive mapping—structured one-to-one interviews with ERA and MTA, consultation of academic expertise, and email-based outreach to local businesses. Business engagement followed a two-phase approach. First, a structured online survey targeting over 200 businesses active in sectors such as agrotourism, guided walks, outdoor recreation, rentals and tours, and hotels was

conducted, with 22 businesses completing the questionnaire. Building on these insights, which confirmed a strong interest in nature-based tourism, a second phase of targeted email outreach focused specifically on the platform's relevance to business needs, aiming to validate use cases, assess potential uptake, and identify businesses interested in future collaboration. During the second phase, two businesses responded.

Assess

The assessment design combined multiple data sources and methodologies to capture both environmental conditions and visitation patterns across the Maltese archipelago.

Ecosystem type and extent are assessed using satellite imagery from the Copernicus Sentinel programme, with validation through UAV-based ground-truthing at selected representative sites. Five main recreation-relevant ecosystem categories were delineated: coastal areas, marine habitats, agricultural land, urban green spaces, and terrestrial ecosystems.

Ecosystem condition is assessed through a suite of satellite-derived indicators, including vegetation indices (e.g. NDVI), tree canopy cover, land surface temperature, air quality variables, and species distribution models derived from crowdsourced biodiversity data sourced from the iNaturalist platform. These indicators are calculated consistently across the archipelago to enable spatial comparison and temporal analysis.

Ecosystem services related to nature-based tourism are assessed using a combination of public participation GIS (PPGIS) surveys and social media analyses. Data from Maptionnaire surveys with residents and tourists, alongside georeferenced content from platforms such as Flickr, iNaturalist, and Twitter (X), are used as proxies for visitation patterns, recreational use, and landscape appreciation. Indicators capture visitation hotspots, activity types, seasonal patterns, frequency of visits, accessibility, and user perceptions of site quality.

During the Assess stage, external stakeholders continued to contribute to indicator selection, method refinement, and use case validation. Public authorities provided input through semi-structured interviews to ensure relevance for policy and regulatory applications. Local businesses participated in a second phase of engagement, validating hypothetical use cases related to marketing, service adaptation, and business development.

A key challenge identified related to stakeholder engagement, particularly with local businesses operating in the NBT sector. Despite broad outreach efforts, including surveys distributed to over 200 businesses, response rates were relatively low, limiting the depth and representativeness of private-sector input at this early stage. This reflected both the time constraints faced by small and medium-sized enterprises and the difficulty of engaging businesses around a platform concept that was still under development and not yet

operational. As a result, the initial engagement primarily supported scoping and awareness-raising, rather than sustained co-design. This challenge highlighted the potential need for alternative and more sustained engagement formats—such as interactive workshops or facilitated sessions—to enable deeper exploration of private-sector use cases and to collect more detailed feedback from a wider range of businesses.

In addition, while no institutional barriers obstructed the development of the platform, differing—and potentially conflicting—use cases between public authorities and local businesses were already evident during the Assemble stage. Public authorities, particularly the ERA, expressed interest in using the platform to monitor tourism impacts on ecosystem condition, evaluate historical and near-real-time environmental trends, and inform environmental regulation and policy. In contrast, local NBT businesses were primarily interested in accessing visitor trend data to promote services and identify new opportunities in under-served areas. This creates a tension whereby increased visibility of previously remote or lightly visited sites could stimulate new business activity while simultaneously increasing pressure on ecosystems with historically low visitation. At the same time, the platform could also support public authorities in identifying overexploited hotspots requiring protection or restoration, potentially improving ecosystem condition in highly visited areas. These contrasting but interlinked objectives underscored the need to design the platform in a way that transparently supports both protection and sustainable use, while acknowledging that balancing public and private interests would remain an ongoing challenge throughout the project.

Act

The immediate outcome of the project is the development of a prototype platform, expected to reach a beta version by later this year (2026). The platform will integrate geospatial layers on ecosystem types, extent, condition, and nature-based tourism activity through a user-friendly interface.

While the platform has not yet been launched, envisioned applications include monitoring visitation pressure on ecosystem condition, informing tourism zoning and policy adjustments, supporting business intelligence for NBT operators, and enabling researchers to explore linkages between tourism and ecosystem change. The platform is also designed to support adaptive management approaches, allowing users to observe trends over time and respond to emerging pressures with data-driven interventions.

Planned next steps include piloting the platform with stakeholders, collecting user feedback, refining functionality, and establishing a strategy for long-term maintenance and updates. Monitoring and evaluation of platform use, user engagement, and environmental relevance are foreseen as part of an iterative improvement process.

Lessons learned

DP10 highlights the i**mportance of early and structured stakeholder engagement** when applying EA approaches in a complex, multi-actor context such as nature-based tourism. The project demonstrated that while public authorities showed strong interest and capacity to engage with ecosystem-related evidence, sustained engagement with local businesses proved more challenging, particularly at early stages when tools and benefits were still conceptual. This underlined the need for tailored, low-burden engagement formats and more interactive approaches, such as workshops or facilitated sessions, to support meaningful private-sector participation.

The DP also revealed that **differing use cases between public authorities and businesses need to be acknowledged from the outset**. Public actors primarily sought ecosystem condition monitoring and policy support, while businesses focused on market intelligence and service development. Rather than acting as a barrier, these **contrasting perspectives highlighted the potential for complementary outcomes** if ecosystem-related information is presented transparently and spatially, allowing both protection and sustainable use objectives to be addressed in parallel and therefore transforming potential conflicts into synergies.

Finally, DP10 shows the **value of integrating multiple data streams**—including Earth Observation, crowdsourced ecological data, and participatory mapping—into a single, accessible platform. Even before full implementation, the co-development process itself helped clarify data needs, use cases, and governance considerations, providing a transferable model for other regions facing similar pressures from high-density, seasonal tourism.

DP11 Finland: Integration of marine biodiversity, condition and ecosystem services for regenerative tourism

Additional material can be found on the SELINA website here.

The Baltic Sea is in poor ecological condition due to cumulative pressures such as nutrient loading, wastewater discharges, and maritime activities, which degrade marine ecosystems and the services they provide. These impacts directly affect tourism activities that depend on clean water and healthy seascapes, such as swimming, boating and aesthetic outdoor experiences. Yet, small actions by individual businesses alone are insufficient to address such systemic challenges. This highlights the need for more coordinated, science-based interventions to guide tourism businesses in managing their ecosystem dependency and impacts sustainably.

Figure 9: Satellite image displaying the cyanobacteria bloom in the Gulf of Finland [satellite image]. Original data: © ESA Copernicus Sentinel-3 Data, SYKE (2019). Retrieved from: https://yle.fi.

The challenges facing the Baltic Sea underline the need to better recognise and manage the impacts of tourism activities on marine ecosystems and the services they provide. In response, the Finnish Environment Institute (Syke) collaborated with Visit Finland, the official national tourism board of Finland.

Originally, SYKE followed a local, bottom-up ambition: Supporting small tourism businesses operating in the Helsinki archipelago to integrate marine ecosystem knowledge into their activities. However, while local operators show interest in topics around ecosystem preservation, many are small or micro-enterprises with limited capacity to engage in development processes or struggling with the difficult economic situation. As a result, DP11 evolved strategically into a national-level intervention through collaboration with Visit Finland to revise the Sustainable Travel Finland (STF) programme[12] but kept the focus on marine ecosystems.

This shift transformed DP11 from a localized pilot into a mechanism capable of influencing tourism businesses across Finland, including those with indirect impacts on marine ecosystems, while also highlighting the challenges of engaging small and medium-sized enterprises with limited capacity to apply the EA approaches in practice.

[12] Visit Finland (2026) Travel Sustainably in Finland. Available at: https://www.visitfinland.com/en/practical-tips/sustainability/

Assemble

Early engagement with tourism businesses in the Helsinki archipelago highlighted that while awareness of marine ecosystems was relatively high, businesses lacked practical guidance on how to manage their dependency on the ecosystems in a way that preserves - or rather improves - their condition while allowing continued use. Limited time and resources constrained the ability of many smaller businesses to participate in the bottom-up development processes. In addition, addressing marine ecosystem degradation requires attention to major pressure drivers and long-term cumulative impacts, rather than isolated actions.

This prompted SYKE to seek collaboration with Visit Finland to identify the STF programme as a key leverage point. In doing so, the project created the opportunity to address marine ecosystem degradation focusing on major pressure drivers and long-term cumulative impacts. The STF programme was already widely adopted by tourism businesses and offered strong incentives through certification, visibility, and market positioning. Yet it lacked explicit, science-based guidance related to marine ecosystems and ecosystem services. The Assemble stage therefore concluded with a deliberate strategic decision to integrate scientifically grounded marine ecosystem criteria into the STF programme. Through this approach, DP11 positioned ecosystem services evidence not as additional information for businesses to absorb, but as a structural element shaping private-sector decision-making on a larger scale.

Assess

In the Assess step, SYKE focused on translating existing scientific knowledge on marine ecosystems into decision-relevant guidance that could be embedded within the STF programme. Rather than conducting new ecosystem assessments, the project built on extensive research previously or simultaneously (e.g. in SELINA WP3) carried out by SYKE on Baltic Sea ecosystem types, ecosystem condition, pressures and ecosystem services. Those studies provided a robust basis for identifying which aspects of tourism activity are most relevant from an ecosystem perspective.

In addition to systematically reviewing existing criteria and indicators of the STF programme, SYKE worked on the design of further direct or indirect impacts on marine ecosystems, making the dependency of tourism activities more visible and quantifiable. This also included indicators relevant for businesses located inland, whose activities may nonetheless contribute to cumulative pressures on the Baltic Sea through waste upstream, procurement choices, or supply chains. To further refine those indicators and to obtain a wider, scientifically sound view, SYKE organized a workshop, collaborating with senior-level researchers and experts of marine, freshwater and terrestrial biodiversity. Additionally, Syke

supervised a group of students at a University of Applied Sciences to assess the STF criteria from a service design point of view, meaning how impactful, transparent and equal the STF programme is.

A key challenge during this stage was avoiding the risk of low-impact and purely symbolic/ communicative sustainability measures. The solution to overcome this was to rely on scientific evidence gained from past studies and scientific collaboration with senior level researchers and experts of marine, freshwater and terrestrial ecosystems. Past SYKE studies showed that marine ecosystem degradation is driven by major, cumulative pressure drivers such as eutrophication, harmful substances, biodiversity loss, and marine litter. The solution for this was to assess the existing STF indicator list from the point of view of impacts on marine ecosystems and even more importantly, create a new indicator which has potential to make a substantial impact on the condition of marine ecosystems, independent of the location of the tourism business. Finland's marine areas and archipelagos offer an important asset for nature-based tourism, but the poor condition of marine ecosystems restricts the potential. This dependency of marine or coastal nature-based tourism on marine ecosystems and ecosystem services is a motivator to concretely act.

Act

The selection, refinement and design of criteria considered material for impactful interventions of tourism businesses was guided by scientific evidence. The detailed list of measures needed to fulfill a composite indicator is not publicly available, but SYKE's researchers were given access to it for the assessment work. The performance of tourism companies' in carrying out the composite indicators based on more detailed measures required in the STF programme have been published on the Visit Finland Website[13] in June 2026. The measures of composite indicators to the development of which Syke contributed with scientific evidence are shown in Table 4 below. The new composite indicators are the last three highlighted with a blue background. The first two of them comprise the previously existing measures which were identified to also have an impact on the Baltic Sea. The third one is completely new. The STF_IDs can be similar in different rows meaning that those composite indicators belong to the same topic.

[13] Visit Finland (2026) State of Sustainable Tourism. Available at: https://www.visitfinland.fi/globalassets/visitfinland.fi/vf-julkaisut/2026/state-of-sustainable-tourism-2025_annual-report_visit-finland.pdf

STF_ID	STF Indicators
D.7.1	Percentage of tourism companies actively supporting the protection, conservation and management of local biodiversity
D.7.1	Average number of actions promoting biodiversity
D.7.1.2	Share of companies in the STF programme that operate in national parks and other nature conservation areas managed by Metsähallitus and have a sustainable tourism agreement with Metsähallitus
D.7.1.4	Share of protected and designated areas of the country's total land area
D.7.1.1	Share of companies offering food services that take into account the climate and environmental impacts of food and/or utilize local food production
D.7.1.1	Average amount of measures to promote sustainable food choices in food service companies
D.7.2	Share of STF companies that take into account the state of the Baltic Sea in their operations
D.7.2	Average amount of measures taken by companies to address the state of the Baltic Sea
D.7.2.2	Number of STF companies that have signed the Baltic Sea Commitment

Table 4: Sustainable Travel Finland programme's composite indicators to the development of which SYKE contributed (shown in light blue) from the marine ecosystems perspective.

After the final approval of Visit Finland's STF management board, the prioritised indicators were operationalised through the updated STF programme, the completely new one requiring participating businesses to sign the Baltic Sea Commitment. The Commitment translates scientific knowledge about the ecosystem pressures into six concrete action areas, thereby linking marine ecosystem condition directly to business responsibility and practice. In the Commitment, the business should state which actions it will take towards promoting the situation of the Baltic Sea and local waterways. Below is an overview template of the topics which businesses should complete.

Commitment	Description	Actions (for business to complete)
1. Decreasing eutrophication	The aim of preventing eutrophication is to reduce the load of suspended solids and nutrients, such as phosphorus and nitrogen, entering inland waters and the Baltic Sea, and to enhance the circular economy of nutrients.	*Our actions in this theme are:…*
2. Reducing hazardous substances	The aim of reducing harmful substances is to decrease and prevent harmful substances, such as toxic chemicals, plastics, and oils, from entering water, soil, and air.	*Our actions in this theme are:…*
3. Increasing biodiversity	The aim of increasing biodiversity is to halt biodiversity loss and safeguard the diversity of species and habitats by combating invasive alien species and protecting and restoring natural environments.	*Our actions in this theme are:…*
4. Promoting sustainable use of the seas	The aim of promoting the sustainable use of the seas is to ensure environmental sustainability in maritime transport, recreational use, and other marine industries.	*Our actions in this theme are:…*
5. Preventing littering	The aim of preventing littering is to minimise the amount of waste generated by properly sorting waste and removing litter that has already ended up in the environment.	*Our actions in this theme are:…*
6. Increasing cooperation and inclusion	The aim of increasing cooperation and participation is to enhance water protection collaboration within and between organisations, increase knowledge of best practices, and integrate consideration of the Baltic Sea into the organisation's regular operations.	*Our actions in this theme are:…*

Table 5: Template of topics for businesses to complete as part of the Baltic Sea Commitment.

As of March 30th 2026, nine businesses have signed the Commitment as part of the STF programme.

Alongside the release of Baltic Sea-related criteria and indicators, Visit Finland designated 2026 as the thematic year of the Baltic Sea. The launch was led by SYKE researchers in collaboration with representatives of Business Helsinki and the Head of Sustainable Tourism at Visit Finland at the 2026 Helsinki Travel Fair in January. This represents a significant step in external communication, as the annual theme is prominently integrated into Visit Finland's marketing and communication activities.

Going forward, Visit Finland will manage and implement the new criteria within their STF programme, with SYKE as scientific partner stepping away. With the tourist businesses applying for the STF certification, they are required to take actions to meet the criteria and indicators set for improving the condition of the marine ecosystems, as well as reporting back to Visit Finland, who will monitor business activities. Furthermore, future collaboration is planned to continuously improve the programme, including the feasibility of existing criteria and indicators.

Lessons learned

DP11 highlighted the importance **of embedding EA approaches within existing programmes and governance structures** to ensure relevance and reach. Rather than operating as a standalone pilot, integrating ecosystem services and biodiversity evidence into the STF programme enabled the project to influence tourism businesses at scale, demonstrating that already existing sustainability frameworks can function as effective vehicles.

The project also demonstrated the value of **combining bottom-up and top-down perspectives**. While the initial bottom-up ambition to work directly with small tourism businesses in the Helsinki archipelago proved difficult to implement due to limited capacity and resources, it provided critical insights into the practical constraints faced by businesses. These insights informed the subsequent strategic pivot towards a top-down approach, which proved far more effective in achieving impact. At the same time, the experience underlined that designing EA approaches without understanding the operational realities of smaller enterprises risks producing solutions that are difficult to implement in practice.

Maintaining **strong scientific rigor** throughout the project was essential in avoiding low-impact or purely symbolic sustainability measures. By grounding decision-making in existing scientific evidence on major and cumulative ecosystem pressure drivers, DP11 was able to prioritise actions with genuine potential to marine ecosystem condition and reduce the risk of greenwashing. This scientific backbone helped ensure that biodiversity and ecosystem services considerations translated into meaningful and targeted interventions.

Finally, the project underscored the **importance of aligning ecosystem services knowledge with business incentives**. Translating scientific evidence into clear, actionable requirements linked to certification, visibility, and market positioning increased relevance for tourism businesses. Treating the Sustainable Travel Finland programme as an evolving system rather than a fixed framework further enabled continuous improvement, allowing ecosystem services and biodiversity considerations to be refined over time as knowledge, experience, and data accumulate.

3.3 Corporate Strategy & Finance

DP12 Norway: Nature Risk Screening Tools in Finance: A review of knowledge gaps in biodiversity metrics

Additional material can be found in the SELINA website here.

It is increasingly important for financial institutions to understand how their activities impact and depend on biodiversity and ecosystem services, as these relationships can pose material financial risks and influence long-term viability, resilience, and regulatory compliance. Regulatory frameworks such as the Corporate Sustainability Reporting Directive (CSRD), particularly the European Sustainability Reporting Standard E4 (ESRS E4), as well as voluntary initiatives such as the Taskforce on Nature-related Financial Disclosures (TNFD) and the Global Reporting Initiative (GRI), require financial actors to provide more transparent, science-based biodiversity reporting. At the same time, the biodiversity screening tools that these institutions rely on mostly focus on high-level portfolio screening. This creates uncertainty for private-sector actors attempting to integrate ecosystem services and biodiversity considerations into risk management, investment decisions, and regulatory reporting.

DP12 was led by the Norwegian Institute for Nature Research (NINA) as a scientific desk-based study. The overarching objective of this project was to evaluate whether current biodiversity risk screening tools used in the financial sector (such as ENCORE, IBAT,BFFI, GID, CNBS, MBFM) are fit for purpose in light of emerging regulatory and voluntary disclosure requirements. Specifically, the project assessed how well these tools align with biodiversity-related metrics under ESRS E4 and comparable indicators under TNFD and GRI, and whether they can support asset-level decision-making rather than only high-level portfolio screening.

NINA primarily engaged with large financial institutions, including banks, pension funds, and asset managers, alongside a small number of medium-sized financial actors and service providers, such as ESG analytics firms and consultancies. The researchers mainly communicated with sustainability, ESG, and risk managers, along with investment officers and data/analytics specialists. These larger organisations typically manage diversified portfolios and operate under EU sustainability reporting requirements, and therefore have limited but growing experience in integrating ecosystem services into their decision-making. Next to the financial institutions, experts from voluntary frameworks (TNFD), tool providers and NGOs also informed the study.

Assemble

At the start of the project, NINA focused on defining the decision context faced by financial institutions and identifying the scope and relevance of a scientific assessment. Financial

actors involved in the project operate in a rapidly evolving regulatory and market environment, characterised by increasing scrutiny of biodiversity-related risks and dependencies. While ecosystem services terminology is increasingly used in finance, practical application remains limited and is often driven by compliance requirements rather than strategic decision-making.

A key challenge identified for financial institutions was the widespread reliance on biodiversity risk screening tools that offer high-level insights but lack transparency, spatial resolution and consistency. Many of these actors have limited internal biodiversity expertise, which further reinforces dependence on external tools whose capabilities and limitations are not always well understood. This highlighted the need for neutral, scientific evaluation to clarify what such tools can and cannot support in private-sector decision-making. Given this context, a desk-research approach allowed NINA to focus on a systematic, comparable assessment of biodiversity risk screening tools already in use across the financial sector.

Assess

The research focused on a desktop analysis of biodiversity risk screening tools supplemented with semi-structured interviews with stakeholders from multistakeholder initiatives, platforms, coalitions, and financial institutions (e.g., banks or pension funds). NINA selected twelve tools that had been identified as highly relevant to the financial sector by Finance for Biodiversity (2024)[14] and subjected them to a structured desktop analysis. The assessment was grounded in publicly available documentation, tool descriptions, user manuals, scientific publications, online platforms that describe each biodiversity risk screening tool and supplementary information obtained through direct exchanges with tool providers.

Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE)
Integrated Biodiversity Assessment Tool (IBAT)
Biodiversity Risk Filter (WWF) - BRF
Biodiversity Impact Analysis powered by the Global Biodiversity Score (BIA-GBS)
Global Biodiversity Score for financial Institutions (GBSFI)
Corporate Biodiversity Footprint (CBF)
Biodiversity Footprint for Financial Institutions (BFFI)
Global Impact Database, Biodiversity Impact Data (GID)
MSCI Biodiversity Footprint Metrics (MBFM)
Biodiversity Impact Assessment Tool (BIAT)
Nature Risk Profile (NRP)
GIST Impact Climate, Nature and Biodiversity Suite (CNBS)

[14] Finance for Biodiversity Foundation (2025) Biodiversity measurement approaches. Available at: https://www.financeforbiodiversity.org/publications/biodiversity-measurement-approaches-guide-4th-edition/

Table 6. Nature Risk Screening Tools included in the assessment

A desktop analysis resulted in a traffic-light system that classified whether tools fully provided, partially provided, or did not provide metrics relevant for ESRS E4 and voluntary disclosure frameworks. This visualization helped translate complex methodological differences into decision-relevant insights for private-sector users.

Indicators were derived from biodiversity and ecosystem-related datapoints identified under ESRS E4, as compiled by Lammerant et al. (2024)[15], and cross-references with corresponding requirements under TNFD and GRI. This approach allowed the assessment to focus on regulatory relevance while also considering emerging best-practice guidance.

During the research process, NINA encountered several challenges. A key barrier was limited access to biodiversity screening tools, as many require paid subscriptions or provide only limited publicly available documentation. In addition, significant data gaps were identified, particularly the lack of location-specific, asset-level biodiversity data, which constrained deeper analysis. Methodological inconsistency across tools also posed challenges, as they rely on different metrics, proxies, and assumptions, complicating systematic comparison. Finally, capacity constraints were evident, with limited in-house expertise in biodiversity and ecosystem services assessments. Competing internal priorities further constrained uptake, as biodiversity was often secondary to climate or financial risk considerations.

Act

Results were synthesized by comparing each tool against the selected ESRS E4 and voluntary biodiversity indicators, using the traffic light system to classify their coverage and usefulness. The tools were then evaluated as fully providing, partially providing, or not providing relevant metrics (called datapoints in ESRS), highlighting strengths, weaknesses, and gaps in relation to asset-level risk management. This synthesis allowed NINA to identify patterns across tools, prioritize areas for improvement, and generate actionable insights for both financial institutions and policymakers.

[15] Lammerant et al. (2024). Biodiversity disclosure initiatives.

Table 1. Desktop assessment of nature risk screening tools against ESRS E4.	Nature risk screening tools											
ESRS E4, TNFD AND GRI BIODIVERSITY METRICS	BFFI	BIA-GBS	CBF	GBSFI	GID	ENCORE	IBAT	MBFM	BIAT	BRF	NRP	CNBS
Proximity to biodiversity-sensitive areas												
Number of sites owned, leased or managed in or near protected areas or key biodiversity areas that undertaking is negatively affecting (ESRS E4)												
Area of sites owned, leased or managed in or near protected areas or key biodiversity areas that undertaking is negatively affecting (ESRS E4)												
Drivers of biodiversity loss: land and sea use (change)												
Land-use based on Life Cycle Assessment ESRS E4												
Metrics considered relevant on land-use change, freshwater-use change and (or) sea-use change. ESRS E4												
Conversion over time of land cover ESRS E4												
changes over time in management of ecosystem ESRS E4												
changes in spatial configuration of landscape ESRS E4												
changes in ecosystem structural connectivity ESRS E4												
(changes in) functional connectivity ESRS E4												
Drivers of biodiversity loss: (over)exploitation												
Drivers of biodiversity loss: invasive alien species												
How pathways of introduction and spread of invasive alien species and risks posed by invasive alien species are managed ESRS E4												
Number of invasive alien species ESRS E4												
Area covered by invasive alien species ESRS E4												
State of biodiversity: ecosystem extent and condition												
metrics considered relevant (state of species) ESRS E4												
ecosystem area coverage ESRS E4												
quality of ecosystems relative to pre-determined reference state ESRS E4												
structural components of ecosystem condition ESRS E4												
State of biodiversity: species												
population size, range within specific ecosystems and extinction risk ESRS E4												
Information about species at global extinction risk ESRS E4												
changes in number of individuals of species within specific area ESRS E4												
threat status of species and how activities or pressures may affect threat status ESRS E4												
multiple species within ecosystem ESRS E4												

– tool does not provide the metric necessary for addressing ESRS E4, TNFD or GRI requirements; – tool only partly provides the metric necessary for addressing ESRS E4, TNFD or GRI requirements; – tool fully provides the metric necessary for addressing ESRS E4, TNFD or GRI requirements.

Figure 10. Desktop assessment of nature risk screening tools against ESRS E4

The analysis showed that current biodiversity risk screening tools are primarily suited for broad, portfolio-level assessments and are limited to support the detailed, location-specific evaluations required under ESRS E4 or voluntary frameworks such as TNFD. Most tools rely on proxies, sector averages, and modelled data, meaning they capture potential rather than actual biodiversity impacts. In addition, they often lack metrics for key pressure drivers such as land-use change, water use, and invasive species, and provide limited insight into ecosystem dependencies. Overall, the findings highlight a clear gap between the needs of financial institutions for decision-grade biodiversity assessments and the capabilities of existing tools.

On the other hand, the increasing alignment of regulatory and voluntary frameworks provides future opportunities, creating a common reference point for tool development and evaluation.

Those results were communicated to stakeholders, highlighting financial institutions' exposure to biodiversity risks and the limitations of tools for asset-level decision-making., The findings emphasized gaps in spatial resolution, transparency, and metric standardization, providing guidance for improving tool design and aligning outputs with

ESRS E4 and voluntary reporting requirements. The research paper was disseminated through the publication of peer-reviewed paper in the Journal of Forest Business Research[16]. Regarding scalability and future plans, NINA has begun collaborating with the Center for International Climate Research (CICERO) to develop a Screening Climate and Nature (SCAN) platform for the banking sector in Norway, focused on helping local banks better understand and manage climate and nature-related risks in their lending and investment decisions. This project aimed to develop practical guidance and a due diligence platform to help banks in Norway to assess whether projects could contribute to biodiversity loss, emissions, flooding risks, or harmful land-use changes[17].

Lessons learned

Based on these outcomes, NINA recommended enhancing biodiversity risk screening tools by **incorporating spatially explicit, asset-level data to improve accuracy and regulatory compliance.** In parallel, individual organisations should **adopt a modular approach**, combining high-level portfolio screening with site-specific assessments to better capture impacts and dependencies. Finally, NINA emphasizes the **need for standardized metrics**, **transparent methodologies, and stakeholder collaboration** to ensure tools are robust, comparable, and actionable for financial decision-making.

Overall, DP12 shows that desk-based scientific assessments can play a critical enabling role, even in the absence of direct business implementation. By clarifying evidence gaps, methodological constraints, and development needs, such studies create the conditions for more effective future application of EA approaches in private-sector decision-making.

[16] Chudy and Barton (2025). Biodiversity risk screening tools in finance fail to meet the need for local project risk screening.

[17] Refer to Sandanger and Syverhuset (2025). Banker kan spille en viktig rolle i å ivareta naturen. Available from : https://www.nina.no/About-NINA/News/article/banker-kan-spille-en-viktig-rolle-i-a-ivareta-naturen

DP14 Europe: Investing in Nature-Based Solutions to Support Corporate Transition Plans

Additional material can be found on the SELINA website here.

Many large companies invest in biodiversity protection and nature restoration, yet struggle to demonstrate the value of these actions in a way that meaningfully informs decision-making. Biodiversity initiatives are often treated as voluntary or reputational activities, disconnected from core business processes, due in part to limited data availability, low familiarity with ecosystem services concepts, and the difficulty of translating ecological outcomes into decision-relevant insights. However, EA approaches can provide a structured way to link changes in ecosystem condition to benefits for companies and society, helping organisations better understand, prioritise, and communicate the value created by nature-positive actions.

DP14, led by EY denkstatt—a sustainability consultancy within the Ernst & Young network—initially focused on water replenishment and corporate transition plans. It has since shifted to valuing ecosystem services to highlight restoration benefits for various stakeholders, reflecting a move from EU-mandated reporting to voluntary, business-driven resilience actions. EY denkstatt is developing a standardized method for global ES valuation that EY experts can use across different corporate settings. The approach focuses on building auditable methodologies and templates that link ecosystem type, condition, service flows, stakeholders, and value, while remaining practical under typical business constraints. It is designed for large corporations and multinationals that must align with multiple corporate reporting requirements, assess portfolios of sites across geographies, and conduct desktop-based pre-feasibility assessments. The method explicitly accounts for common challenges faced by companies, including low familiarity with ES concepts, limited data availability, and reliance on externally implemented restoration or protection projects supported mainly by third-party species surveys.

The method is specifically developed with auditability in mind. It is underpinned by ISO 14007 and 14008 standards and documented according to the requirements of the international sustainability audit standard ISAE 3000.

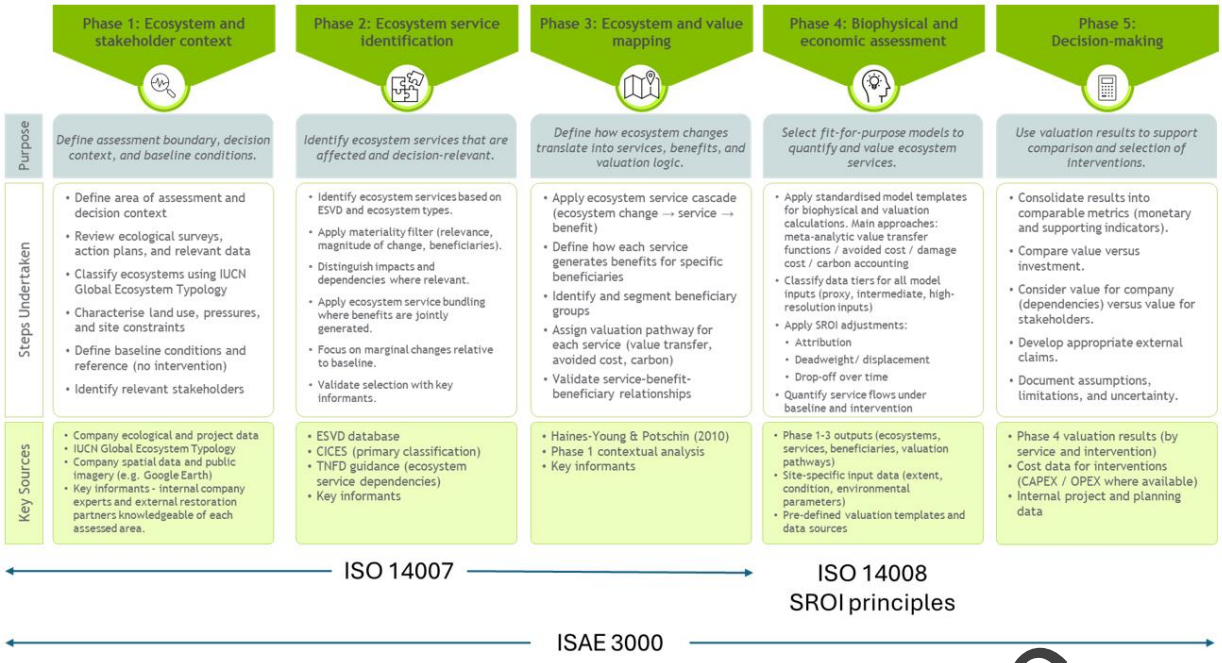


Figure 11. Summary of EY denkstatt approach

In addition to client-facing needs, the development of this approach responds to internal challenges within EY itself. Many EY client executives and project staff are not familiar with ecosystem services science, creating a need for clearly standardised methods, templates, and client-facing "go-to-market" materials that can be applied consistently across teams and regions.

Assemble

A stakeholder analysis is the core of the standardized ES valuation method and was applied at the beginning of a project. Stakeholders are considered not only as audiences for the project results, but also as "key informants", potential data providers, and essential partners for validation and ground-truthing, particularly in contexts where site visits and primary measurement campaigns are not feasible. Stakeholders are identified jointly with the client representatives - typically sustainability managers - and include both internal actors such as executive management, operations, supply chain, and marketing teams, as well as external actors including conservation partners, technical providers, land stewards, government authorities, and other beneficiaries. To ensure consistency across projects and clients, a common stakeholder typology has been developed and applied, explicitly linked to valuation methods, reflecting the principle that ecosystem service value is ultimately experienced by people. The standardized approach builds on prior experience from earlier engagements, including a previous project with Coca-Cola. Stakeholder identification was conducted iteratively:

1. The process began by compiling a comprehensive list of ecosystem services for each ecosystem type within the areas assessed. For each area, IUCN-GET ecosystem types were established using the online IUCN-GET map viewer.[18]
2. Potential ecosystem services are identified using the ESVD database for each IUCN GET ecosystem type.
3. For each ecosystem service combination, desk research and available client documentation were used to evaluate whether proximate stakeholders were likely to benefit. Considerations included public access, accessibility, evidence of use (e.g. online reviews indicating recreational activity), and the presence of nearby economic activities or infrastructure, such as residential areas exposed to flooding. Google Earth was used for initial spatial screening.
4. Findings were subsequently validated through interviews with client staff working in the assessed areas to elicit additional contextual information.

Each step was documented, establishing an audit trail for the assessment. A key challenge EY encounters during early project stages, is the lack of availability of data crucial for assessment. As a result, the standardized method was deliberately developed to function under data-scarce conditions, while guiding clients through the core steps of an ecosystem service assessment. A data tier concept was introduced – each data inputs is mapped to a "tier" representing quality of the data input. This explicit documentation allows auditors to assess whether the conclusions drawn from the assessment and any public claims are supported by the underlying data.

Data Tier	What this evidence represents	Typical data used
Tier 1: Site-specific evidence	Site-specific data collected within the assessment area, based on direct observation or measurement.	• Field survey data (habitat, species, condition) • Site-specific monitoring data • Project documentation (management plans, technical reports) • Data elicited from key informants
Tier 2: Locally relevant evidence	Data representing conditions and relationships relevant to the local context, derived from spatial datasets, statistics, or established regional information.	• Regional or national spatial datasets • Public statistics and monitoring data (national, regional) • Region-specific empirical relationships or coefficients • Modelled relationships that account for local context (e.g. meta-analytic value transfer functions)
Tier 3: Non-local proxy data	Data originating from other geographical or contextual settings, applied where local or site-relevant data are not available.	• Unit values or coefficients from studies conducted in other regions • Results from global or non-local datasets and databases • Generic values not calibrated to the assessment area (e.g. social cost of carbon)

Figure 12.Data tiers as adopted by DP14

[18] See: https://global-ecosystems.org/analyse

Emphasis was placed on maintaining clear linkages between ecosystem type, changes in ecosystem condition, resulting changes in service flows, stakeholder circumstances, and value. In practice, this requires that each ecosystem service model includes at least one variable reflecting changes in ecosystem condition driven by the intervention. It also requires combining site data, locally relevant datasets, and external reference values in a consistent manner. Engagement with implementation partners is important to identify data that may exist but is not systematically captured or shared.

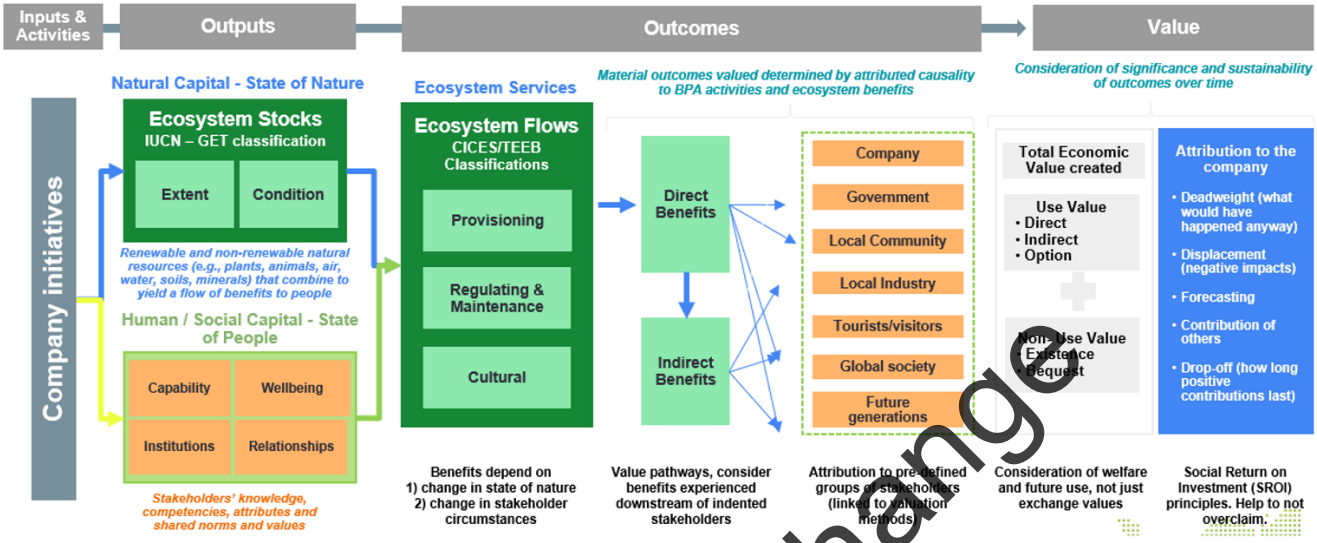


Figure 13. High-level scope of EY denkstatt approach, illustrating components of the assessment and pre-defined beneficiary groups.

Assess

Following establishment of the project context in the Assemble stage, the evaluation of changes in ecosystem extent and condition, changes in benefits to stakeholders over time, and their attribution to the company's interventions takes place.

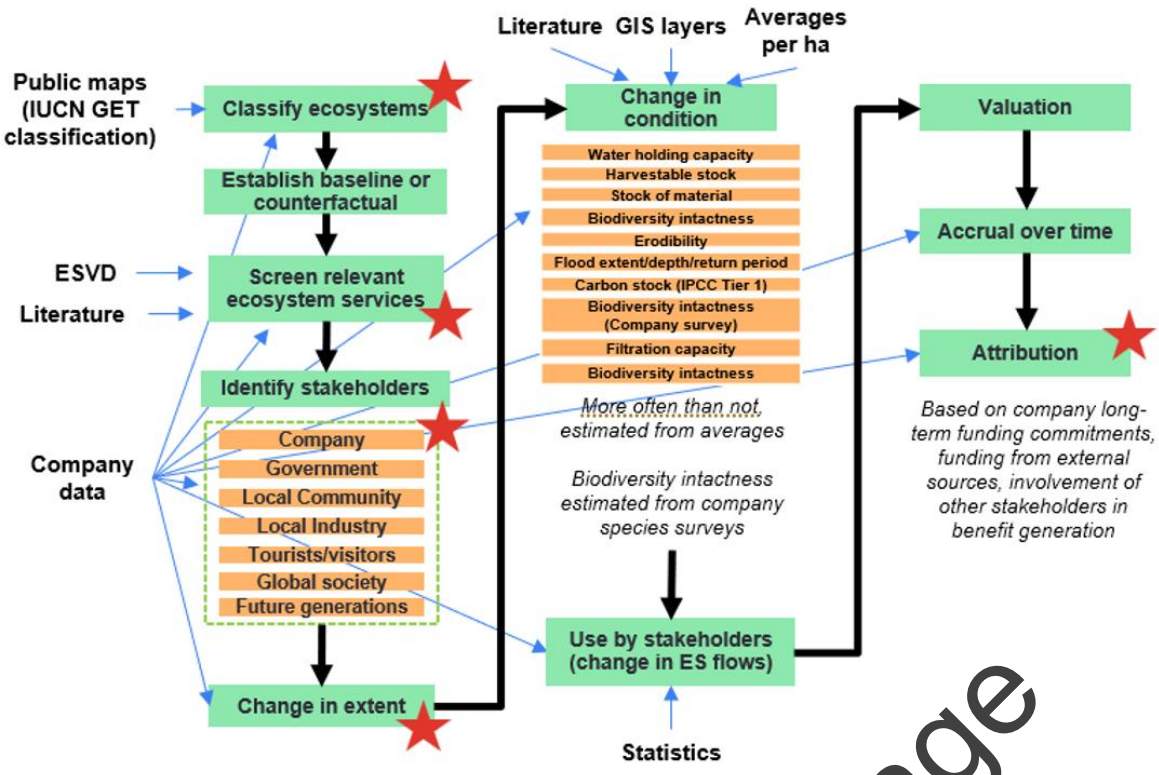
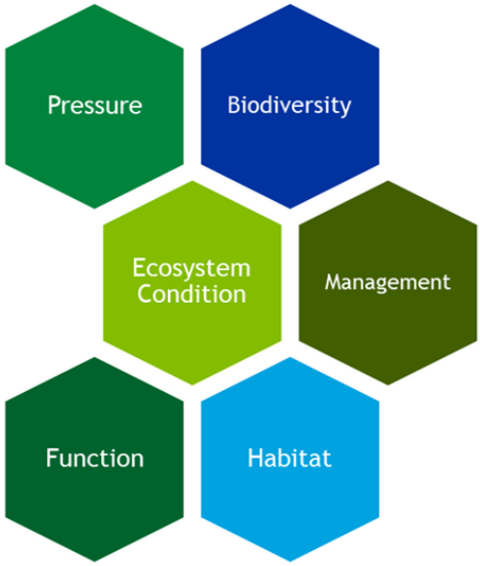


Figure 14. Step by step Assemble and Assess stages, showing also pre-defined stakeholder groups (applicable to typical client engagements) and selected condition indicators (applicable to modeling templates developed by EY denkstatt)

EY's experience with clients (including Coca-Cola) shows that companies typically have reasonably good information on ecosystem extent, derived from site surveys and project documentation, and in some cases also on ecosystem type. In contrast, information on ecosystem condition is usually less systematic. While ecological and species surveys are frequently commissioned, these tend to focus on species presence or status and do not provide a consistent basis for assessing ecosystem condition across sites.

At the same time, relevant knowledge on ecosystem condition often exists in practice but is not formally captured. It is typically held by internal experts with site-specific experience or by external implementation and restoration partners. This results in a situation where condition-related information is available, but fragmented, qualitative, and not directly comparable across assessment areas. To address this, the approach applies a standardised condition rubric in later stages of the assessment, allowing both formal data and expert knowledge to be integrated in a consistent and transparent manner.



Category	Score	Description
Ecosystem Function & Resilience	1	Coastal protection/productivity/recruitment functions largely lost; very low resilience to disturbance.
	2	Functions impaired and unstable; slow/limited recovery after stress events.
	3	Core functions present but weakened; moderate recovery capacity.
	4	Strong functional performance; good resilience to episodic stress.
	5	Fully functioning, highly resilient system; rapid recovery from disturbance.
Habitat Integrity, Structure & Extent	1	Severe structural damage or habitat loss; coral rubble/mangrove dieback/seagrass loss widespread; physical recovery unlikely.
	2	Significant degradation or thinning; fragmented/patchy extent; reduced structural complexity.
	3	Habitat present but visibly degraded; partial loss of structure/cover; recovery possible if pressures reduced.
	4	Habitat mostly intact with minor damage; structural complexity largely maintained; good regeneration potential.
	5	Structurally intact, continuous habitat; near-natural condition; high ecological integrity.
Pressure & Threat Intensity	1	Chronic pollution/dredging/overfishing; poor water quality persistent.
	2	High pressures with limited mitigation; water quality frequently compromised.
	3	Moderate pressures; water quality generally acceptable but episodically degraded.
	4	Low pressure; good to very good water quality.
	5	Minimal human pressure; excellent water quality consistently.
Biodiversity Value & Species Condition	1	Very low diversity; depleted fish/invertebrate populations; nursery/breeding functions lost.
	2	Reduced diversity and abundance; key functional groups missing/rare; simplified food webs.
	3	Typical assemblages present; some declines evident; partial nursery function.
	4	High biodiversity and abundance; healthy trophic structure; important nursery areas intact.
	5	Exceptional biodiversity value; strong threatened/commercially important species; critical regional nursery function.
Protection, Management & Enforcement Effectiveness	1	Protection nominal only; no effective compliance or monitoring.
	2	Limited enforcement capacity; management plans poorly implemented.
	3	Some enforcement and monitoring; partial compliance.
	4	Active marine/coastal management; good compliance and enforcement.
	5	Best-practice management and governance; high compliance and adaptive management.

Figure 15. DP14 ecosystem condition rubric – example for coastal ecosystems

Data is collected via existing company documentation, occasionally by EY via simple GIS analysis work, and is validated with company experts and knowledgeable stakeholders / key informants. Building on EY's experience in assessments with clients such as Coca-Cola, standardized modelling templates are developed, allowing subsequent audit. These templates implement biophysical quantification of ecosystem service flows due to company interventions and their subsequent valuation. Each quantification approach includes at least one biophysical variable that is influenced by client interventions typically linked to land use types e.g. change in average carbon stocks of different components of the ecosystem carbon balance, assessed versus counterfactual depending on the specific client intervention (the counterfactual is defined in the Assemble stage, as explained previously). The ecosystem services in scope and families of valuation approaches are outlined in the Figure 16 below.

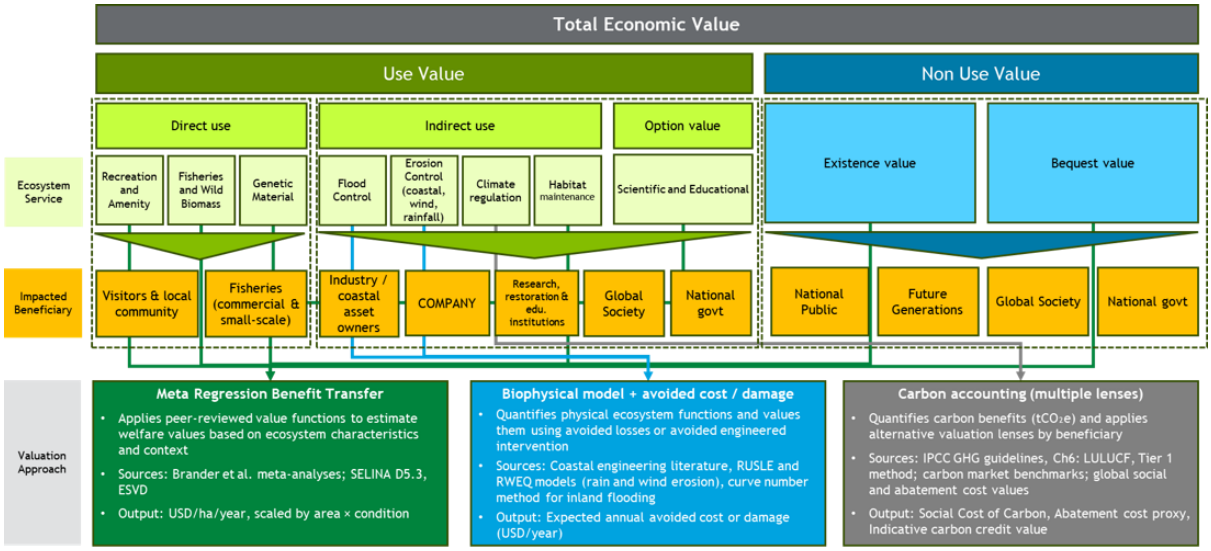


Figure 16. Summary of DP14 modelling approach incl. main sources, linking benefits to value

Once company data is uncovered to complement broader literature and publicly available sources, relevant stocks (i.e. ecosystem extent, condition) and flows (i.e. ecosystem services) are identified and verified with stakeholders (internally and externally).

The assessment above yields annual results (in ecosystem service flow units of EUR/year). A subsequent step accrues benefits over time using simple accrual curves – for benefits such as carbon, accrual is based on known relationships such as vegetation growth curves. For other benefits, simple linear extrapolation is assumed unless client-specific data indicates otherwise (such as investment plans). In addition, attribution to the client's activities is performed following Social Value International's Social Return on Investment (SROI) principles. In brief, this considers:

1. What part of the change in value to stakeholders is attributable to the client. This considers the contributions of other actors (both financial and in-kind), including co-financing partners, public authorities, or other stakeholders involved in generating the benefits.
2. How long the client's contribution can reasonably be expected to influence outcomes (drop-off), reflecting that benefits may not persist indefinitely without continued intervention or support, penalizing one-off investments and rewarding long-term commitments.
3. Deadweight, i.e. the extent to which the observed changes would have occurred in the absence of the intervention.

Each element is evidenced by client documentation (e.g. investment plans, maintenance contracts, implementation partner memorandums) and is recorded as part of the assessment's audit trail.

Act

The final stage organises results to aid comparison, interpretation, and decision-making. It assigns ecosystem service values to specific stakeholder groups, including the company when relevant, enabling decisions based on risk, reputation, and beneficiary-specific value rather than just overall totals. This approach identifies who benefits from ecosystem changes.

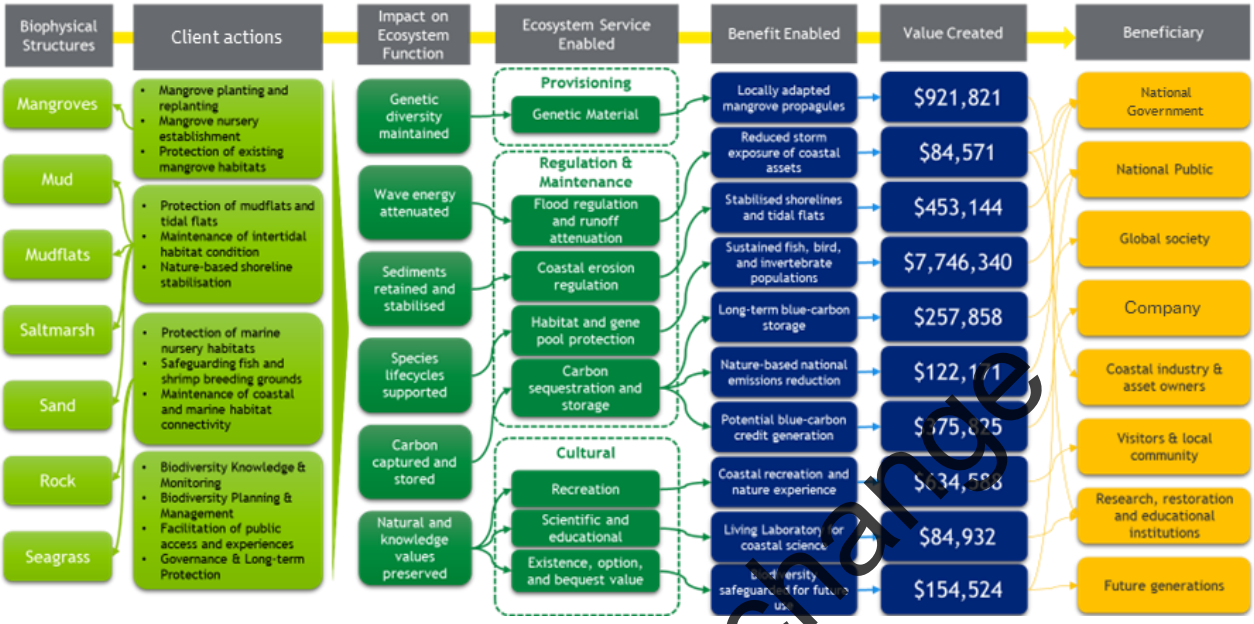


Figure 17. Value of client actions, linked to change in ecosystem function and benefits for specific stakeholders. Example presentation for a coastal ecosystem site. Adapted from Potschin and Haines-Young (2016). Defining and measuring ecosystem services.

In addition to stakeholder-level results, values are also consolidated across assessment areas. This enables comparison between sites both in terms of total value generated and on a per hectare basis. The latter is particularly relevant in identifying smaller or less prominent sites that generate relatively high value.

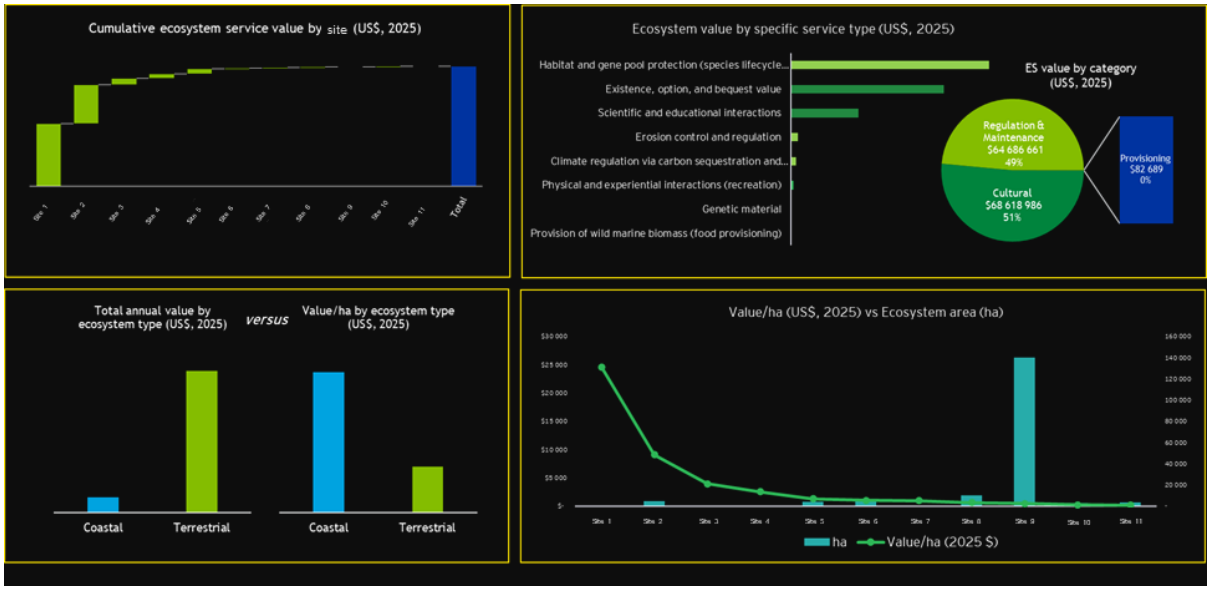


Figure 18. example consolidated results dashboard with value stacking across sites (top-left), value by type of ecosystem service (top-right), value by type of ecosystem (bottom-left), and total value versus value per hectare for each site (bottom-right).

This structure allows results to be used across different decision contexts. In practice, this includes comparing intervention options, identifying priority areas for action, and supporting the development of claims related to ecosystem restoration and impact. The explicit linkage between ecosystem services, beneficiaries, and value ensures that results can be interpreted consistently and transparently in each case.

EY denkstatt's specific focus on auditability following the internationally recognized standard ISAE 3000 aims to also ensure that any conclusions drawn and public claims made are supported by the underlying data and calculations – not only in terms of correctness of the calculations themselves, but also suitability of the methods chosen, and detail in the underlying data (based on the tiered data classification approach elaborated in the Assemble stage).

Lessons learned

DP14 consolidates several years of EY denkstatt client experience into a structured and repeatable process. Key to this is **basing the approach on established standards** (ISO 14007, ISO 14008, SROI) and the **development of templates following best-practice assurance requirements.** This allows for **3rd party verification of results** (following ISAE 3000) – seen as a way to add credence to results while also ensuring that conclusions drawn and public claims follow from the underlying data and models.

A key insight is that **data availability should not be treated as a barrier to proceeding with the assessmen**t. Focusing on gathering “perfect” data can delay or prevent analysis, while in practice many relevant data gaps - particularly for ecosystem condition can be addressed through proxies, standardised parameters, and structured approaches such as condition scoring rubrics. These allow both available data and tacit knowledge held by site experts and implementation partners to be incorporated in a consistent way.

The approach combines site-specific inputs, locally relevant datasets, and non-local proxy data within a transparent framework, supported by the data tier concept. This enables the assessment to **establish clear linkages between site interventions, changes in ecosystem condition, resulting changes in service flows, and value for stakeholders, even under limited data availability**. At the same time, the explicit documentation of data sources allows users to understand the limitations of the results and identify where improved data would strengthen the analysis.

Another key lesson is the importance of **explicitly linking ecosystem service values to beneficiaries.** Presenting results by stakeholder group, including the company itself in the case of dependencies, provides a clearer basis for interpretation than aggregated values alone. This helps distinguish between different types of value, including use and non-use values, and avoids misinterpretation of valuation results as direct financial gains to the organisation. A focus on dependencies however illustrates that such value does exist and opens avenues for applying natural capital accounting beyond restoration projects and toward core operational assets.

3.4 Agriculture

DP13 Italy: Enhancing farm management through synergies with ecosystem services for biodiversity-based agriculture in Italy

Additional material can be found in the SELINA website here.

The Chierese–Carmagnolese Food District (CCFD) in Piedmont, Italy, faces increasing pressure from climate change, particularly prolonged droughts and increasing water stress that threaten agricultural productivity and the long-term viability of local farming systems. An important weather event triggering the need for climate adaptation strategy was a severe drought period between 2021 and 2023. Agricultural production in the district is highly dependent on soil fertility and water availability, both of which are strongly influenced by ecosystem condition and land-use patterns. In this context, traditional sector-based approaches to agricultural planning are insufficient to capture the multiple interactions between farming practices, natural ecosystems, and climate resilience. Integrating ecosystem services (ES) evidence into territorial planning therefore becomes essential to identify adaptation strategies that preserve agricultural production while enhancing ecosystem functionality and community resilience.

DP13 was implemented by SEAcoop, an environmental consultancy and technical cooperative, focusing on the Chierese–Carmagnolese Food District, covering 30 municipalities and 2,112 farms across approximately 654 km² in the Piedmont Region. The project was initiated in response to the Food District's need to define a climate change adaptation and sustainable water management strategy. The assessment conducted under DP13 directly responds to the Food District's strategic requirements and feeds into the development of a territorial Masterplan called SWITCH (ecosystem **S**ervices and **W**ater management for the **Integration** of **C**limate change adaptation and **H**abitat quality), designed to integrate ecosystem services and water management into climate adaptation planning. The project engages farms as the primary private-sector actors, while the Food District, municipalities, and farmers' associations act as coordinating and facilitating bodies.

Assemble

The project was strongly enabled by pre-existing governance structures established through the Food District. A comprehensive stakeholder analysis had already been conducted by SEAcoop during the creation of the Food District. This earlier work identified and formalized relationships between municipal administrations, farmers' associations (Coldiretti, Confagricoltura, CIA), individual farms, and technical and advisory bodies.

Engagement was operationalized through the Agro-Environment Table, a permanent coordination body of the Food District. This table functioned as the primary interface

between science and practice. SEAcoop used this forum to present the purpose of an ecosystem service assessment, align the assessment objectives with the Food District's planning needs, and collect feedback on priorities, feasibility, and policy relevance.

Farmers were not engaged directly but through farmer's associations, which acted as trusted intermediaries and already supported farms with CAP payments, compliance, and advisory services.

A main challenge encountered at this moment of the project was the limited familiarity of farmers with the Ecosystem Service approach as well as limited capacity for additional analytical work. The farmer's associations therefore played a crucial role in translating the project's objectives into language that resonated with the farmer's operational realities and interests. Ecosystem services were framed as concrete co-benefits—such as improved water availability during droughts, increased soil fertility, reduced vulnerability to extreme events, and greater access to agri-environmental payments—rather than as abstract environmental goals or additional obligations.

Assess

The assessment was deliberately designed as a multi-scale process, combining ecosystem services modelling at the Food District scale with Life Cycle Assessment (LCA) at farm level.

At the territorial scale, ecosystem types and extent were mapped using regional topographic data and land-use databases, including CAP declarations and regional forestry and ecological network datasets, validated through high-resolution satellite imagery. This provided a consistent spatial basis for analysing ecosystem service provision across the district.

Ecosystem condition was assessed indirectly, using proxies such as the distribution of organic farming parcels, protected areas, and soil organic carbon content. While direct field-based measurements were recognised as scientifically desirable, they were not economically or operationally feasible at the district scale. SEAcoop therefore explicitly limited the scope of ecosystem condition assessment and relied on proxies that were available, policy-relevant, and scientifically defensible for the purpose of spatial prioritisation. This choice was transparent and aligned with the assessment's objective of informing territorial planning rather than producing fine-scale ecological diagnostics.

Ecosystem services were quantified using established GIS-based models, including **InVEST** for carbon sequestration, habitat quality, pollination, seasonal water yield, and nutrient retention, and the **KIP-INCA** model for crop production. These models allowed SEAcoop to identify ecosystem service hotspots and cold spots across the district, providing spatially explicit evidence of where ecosystem functions were strong or deficient. The assessment

was carried out for two consecutive years (2023 and 2024), corresponding to the timeframe of the Food District Plan, and showed no significant changes in land-use patterns between the two years.

In parallel, Life Cycle Assessment was conducted at farm level on a voluntary basis, focusing on representative livestock systems (beef and dairy). This decision was taken because 95 per cent of the agricultural land in the reference area is linked to the milk and/or beef production sectors. The LCA was used to identify environmental hotspots within production processes and to analyse dependencies and impacts linked to specific farming practices. The results of the LCA were not merged with the ecosystem services assessment but were used complementarily, allowing SEAcoop to distinguish between pressures arising from farm operations and those linked to territorial land-use patterns.

Several challenges emerged during this stage. Farmers generally lacked time, resources, and management capacity to collect primary data required for detailed assessments. This constraint was structural and related to the size and organisation of farms. It was mitigated by relying on administrative datasets, selecting representative farms for primary data collection, and working through farmers' associations to validate assumptions. Another challenge was the need to demonstrate short-term relevance for farmers. While long-term benefits such as resilience and ecosystem stability were clear, SEAcoop addressed this by linking assessment results to optimisation of existing practices, prioritisation of interventions in high-impact areas, and improved access to future agri-environmental payments.

Science acted as a key enabler at this stage by translating complex interactions between agriculture, ecosystems, and climate into maps, indicators, and priority areas that could be directly used in planning and policy contexts. The integration of ecosystem services assessment with LCA strengthened the credibility and relevance of the results by linking territorial ecosystem functions with concrete production systems and economic realities. Where possible, the indicators considered in the LCA were qualitatively linked to the ecosystem services assessed. With particular reference to the objectives of the masterplan, the following examples are cited: freshwater eutrophication, which can be linked to the nutrient retention service; global warming, which can be linked to the carbon sequestration service; and water consumption, which can be linked to the water provision service.

In this way, given the type of farms examined, their representativeness at the territorial level in terms of supply chains, and the impact of these supply chains on land use, ecosystem conditions, the provision of ecosystem services and biodiversity, it was possible to fine-tune the development of the decision-support tool created for farms of the Food District.

Act

To ensure practical uptake, assessment results were translated into parcel-level guidance using a WEBGIS decision-support tool developed by SEAcoop. This tool overlays ecosystem service results with cadastral parcels and administrative boundaries, allowing farmers' associations to support farms in selecting and applying agri-environmental measures that align with CAP and Rural Development Plan schemes. This operationalisation ensured that ecosystem services considerations could be integrated into existing advisory workflows and subsidy applications without increasing administrative burdens for farmers. At the same time, the WEBGIS enables to identify the plan schemes that can maximise the increase in ecosystem services provision for each agricultural parcel in line with the objectives of the master plan.

The Food District played a central role in adopting and maintaining these results. Ecosystem services protection and enhancement were embedded in the updated Food District Plan for the 2026–2029 period, ensuring continuity beyond the SELINA project. Rather than requiring individual farms to act independently, implementation was coordinated at landscape scale through district-level planning and intermediary organisations, maximising cumulative and synergistic effects.

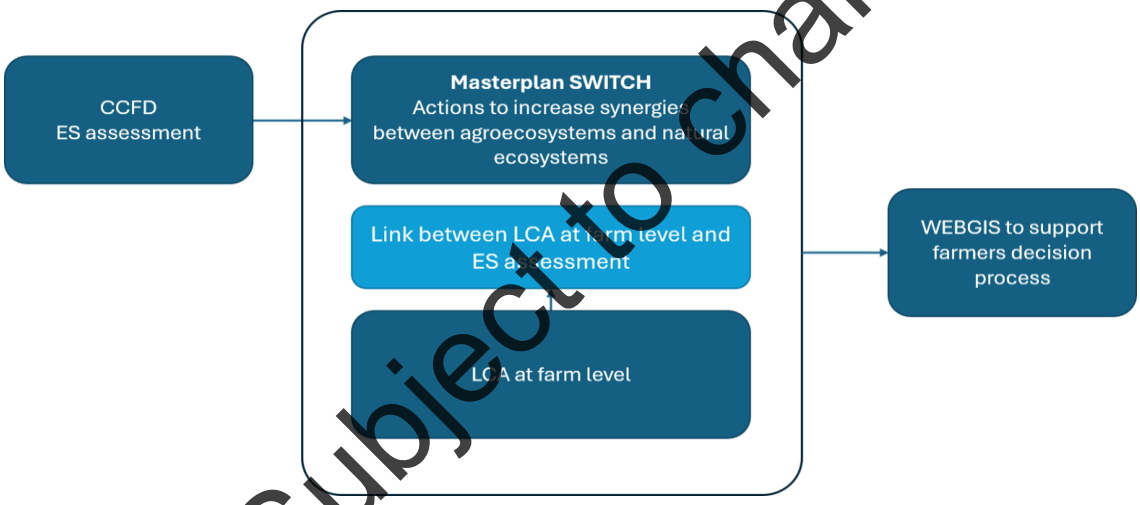


Figure 19. Conceptual diagram of the approach adopted in DP 13

Lessons learned

DP13 shows that EA approaches can be effective when **embedded within existing governance, policy, and funding frameworks** rather than introduced as standalone analytical exercises. The presence of a Food District with established coordination bodies and trusted intermediaries was essential in enabling uptake of scientific evidence. Farmers' associations played a critical role in bridging science and practice, reducing resistance, and ensuring that results were operationally meaningful.

A key lesson is that **ecosystem services evidence should be translated into operational units familiar to end users**, such as cadastral parcels and subsidy-relevant land units. This translation is essential to move from assessment to action. Framing ecosystem services in terms of risk reduction, efficiency gains, and optimisation of public support—rather than as additional environmental obligations—proved crucial for farmer engagement.

Finally, DP13 demonstrates the **value of combining ecosystem services assessment with complementary tools such as Life Cycle Assessment**. This integration provided a more complete understanding of impacts and dependencies, supported coordinated landscape-scale action, and reinforced the role of science as a foundation for territorially grounded climate adaptation strategies.

4. Supporting private sector implementation of the EA approach

The private sector is currently at a pivotal juncture: moving beyond the conceptual recognition of ecosystem services and nature toward their integration into core decision-making. However, this transition remains a complex and non-linear journey. While global benchmarks, including the Capitals Protocol and the Taskforce on Nature-related Financial Disclosures (TNFD), provide essential high-level guidance, their practical application frequently encounters significant operational, technical, and cultural hurdles. These barriers are often compounded by a lack of clear regulatory drivers[19], which can hinder a business's ability to view nature not only as an externality, but as a fundamental pillar of its own functioning and longevity.

Despite these challenges, private entities are increasingly acknowledging that financial performance and strategic resilience are inextricably linked to the health and stability of the ecosystems in which they operate. As biodiversity loss accelerates and planetary boundaries are breached, the risk profile for businesses, particularly those with extensive land-use footprints, resource dependencies, or global supply chains, is shifting. Conversely, significant opportunities are emerging for organizations that proactively assess and manage their interactions with the environment.

The SELINA Demonstration Projects provided key insights for observing how the private sector is engaging with the EA approach. This section of the report synthesizes the key findings across these engagements with DPs, moving beyond individual case studies to identify the cross-cutting learnings that can enhance private sector engagement moving forward. This synthesis aims to provide a roadmap for overcoming the systemic barriers to natural capital integration and unlocking the potential for businesses to act as stewards of the ecosystem services they depend upon.

4.1 Develop shared language

A fundamental barrier to the adoption of the EA approach is the language gap that is often encountered between academia conducting the EA approach, and the private sector user. Translating the technical language of ecosystem services for application in the private sector remains an underlying challenge. While researchers tend to focus on the biophysical intricacies of ecosystem functions, businesses operate with attention to risk, efficiency, and financial return. Therefore, translating technical ES terminology into a language that

[19] In instances of clear regulatory drivers, such as the EU CSRD, changes under the EU Omnibus packages have led to significant uncertainty amongst companies in regards to the timing and scope of the CSRD

resonates with private sector logic, and vice-versa, is not only a communication task, it is a strategic necessity for securing organizational buy-in.

To successfully integrate EA approaches into business decision-making requires a communication strategy to navigate the various departments within an organization. For scientists/technical teams, language should focus on impacts and dependencies. For ESG and sustainability teams, the language typically shifts to reporting metrics and disclosure standards (e.g., GRI, TNFD, CSRD-ESRS), focusing on how ES data fulfills transparency requirements. For the C-suite and investors, the language must be that of Return on Investment (ROI) and long-term value.[20] Here, the focus is often on how ecosystem resilience protects the company's license to operate and reduces the cost of capital by lowering risk profiles. This cross-functional alignment ensures that data derived from EA approach does not remain siloed and simply recorded within a sustainability report but instead informs Key Performance Indicators (KPIs) within organisations.[21]

Within SELINA, DP13 found that success depended on mapping ES functions directly to business-critical outcomes such as land productivity and crop resilience. This could then ultimately be linked to agri-environmental payments and compensation schemes to demonstrate to farmers the long-term benefits of their time and resources to collect primary data required for ES assessments. In DPs characterized by multiple stakeholders with diverse expertise, such as DP8, findings emphasized a critical need to co-develop the EA approach alongside end-users to ensure linguistic and conceptual coordination from the outset. In this instance, scientific partners encountered challenges in aligning the EA-related terminology used to describe the Urban Heat Island (UHI) effect and its mitigation with the existing language of municipal climate adaptation plans. Because these plans are often non-regulatory in nature, they frequently employ a patchwork of contrasting terms to describe climate impacts and the role of the EA approach.

While challenges in translating language are often framed as a lack of shared terminology, the experience of DP11 suggests that for Small and Medium-sized Enterprises (SMEs), it is equally a 'capacity gap.' In the Helsinki archipelago, small tourism operators expressed high interest in biodiversity themes but repeatedly cited a lack of time and personnel as the primary barrier to engaging with complex Ecosystem Services (ES) frameworks. This suggests that for an EA approach to be 'understood' by the private sector, it must be translated into operationally digestible actions. Rather than expecting small businesses to participate in lengthy discussions, the approach should focus on providing pre-vetted,

[20] Czebiniak and Choi (2025) A guidebook for businesses for nature. Guidebook. World Resources Institute (WRI)

[21] See, for example, A-Track (2025) What nature means for your business role: A primer on location-focused decision making.

actionable criteria that fit into their existing workflows without requiring extensive additional research capacity.

One of the most powerful methods to complement and bridge the language gap between scientific findings and corporate decision-making is the application of economic valuation. In the context of the EA approach, monetary valuation is best utilized to provide information on the marginal value, i.e. the economic impact of incremental changes in impacts or dependencies over a specific period. By translating biophysical changes (e.g., cubic meters of water filtered or tons of soil retained) into financial terms, valuation provides a common denominator that allows nature to be integrated into standard business tools like Cost-Benefit Analysis (CBA) and Internal Rate of Return (IRR) calculations. The practical utility of this approach was demonstrated in DP15. By demonstrating that nature-positive decisions and the implementation of green infrastructure significantly enhanced the market value of assets, the project created a resonance with clients that biophysical data alone could not achieve. This suggests that valuation can help transform environmental stewardship from a perceived cost into a tangible value-driver, and lead to executive buy-in for nature-based investments.

However, the use of monetary valuation is not without significant risk and must be applied with caution. A critical finding from DP14 was the frequent confusion between valuation (the estimation of economic importance) and valorization (the actual conversion of that value into direct financial revenue or cash flow for the organization). This misinterpretation can lead to the false expectation that an assigned monetary value will automatically appear on the company's profit and loss (P&L) statement/ account. An assessment might assign a high monetary value to a specific service, this does not necessarily translate into revenue for the organization, particularly where the benefits are public goods or externalities that the current market does not yet price in.

Advice for scientific partners:

- Avoid use of overly technical terminology and focus on translating benefits (i.e. flows of ecosystem services) to those that resonate with businesses,
- If technical language is used, ensure that the definitions and interpretation are aligned between scientific and private partners,
- Apply monetary values with caution, clearly articulating what the value represents, how it was generated (valuation approach) and what purpose the valuation approach can serve. For example, damage cost approaches may be suitable to help the private entity understand long-term risks and help understand (financial) materiality (EU CSRD), but other approaches such as mitigation costs can be helpful to undertake options appraisal. Whichever valuation approach is used, it should be

made clear to the client what constitutes direct market values (and potential revenues to the organisation) and other (indirect or non-use) values.

4.2 Integrate location-specific data into assessments

The technical implementation of the EA approach in the private sector is often hindered by a data paradox, whereby businesses are frequently overwhelmed by high-level global datasets but starved for the location-specific, actionable insights needed to inform site-level investments. The experience of DP12 highlights this systemic challenge. While current biodiversity risk tools (ENCORE, IBAT, BFFI) are adequate for initial portfolio screening, they often lack the granularity required for financial institutions to understand how to act on those risks at an asset level. This granularity gap suggests that while a firm can identify exposure to nature risk through desktop assessments, they often struggle to use that data to drive concrete mitigation strategies without more detailed, site-specific biophysical data. Indeed, various other data issues are often cited with private sector entities, including accessibility, infrastructure, quality and capacity issues, as demonstrated in the Figure 20.

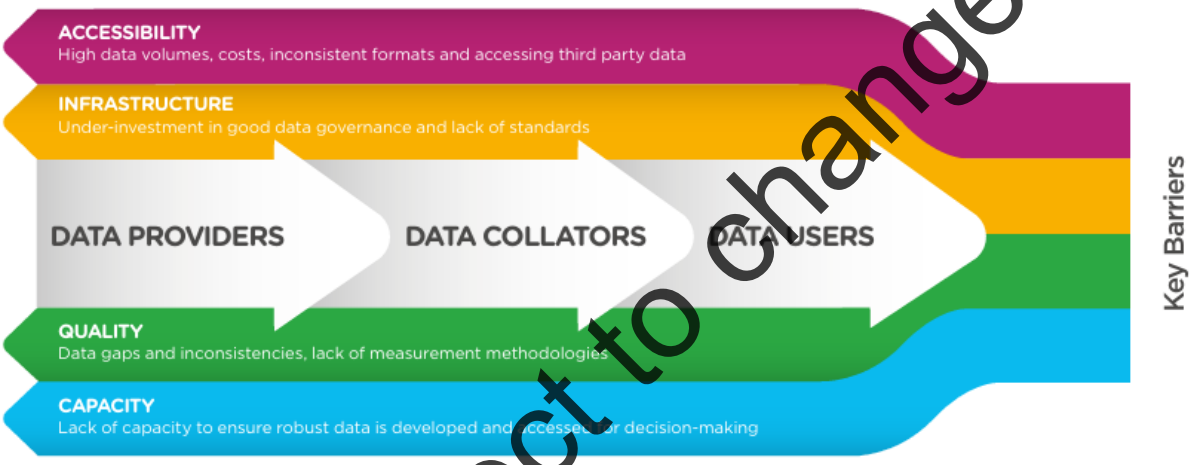


Figure 20. Key data challenges facing private sector entities conducting ecosystem service assessments. Taken from Natural Capital Coalition (2019) Data use in natural capital assessments. Assessing challenges and identifying solutions

To overcome these constraints, several DPs moved beyond static datasets toward high-resolution, dynamic technologies. DP8 utilized remote sensing-generated data for urban heat island (UHI) mapping, providing the biophysical detail necessary for municipal climate adaptation planning that generic satellite data could not capture. DP10 drew upon geo-referenced social media datasets to pinpoint tourism hotspots.

DP14 identified that data availability is not always a matter of missing information, but rather a lack of awareness of its existence within various departments. Private sector entities often sit on an abundance of in-house biophysical data that remains siloed from sustainability functions. To effectively implement EA approaches therefore requires a

translation of this existing "in-house" data into the standardized language of ES or natural capital accounting.

Advice for scientific partners:

- Clearly articulate the potential uses of global, low resolution data vs site-specific data, outlining what data types can be used for each decision-making purpose.
- Outline where publicly available data sources can help feed into analyses[22], and seek to tap into data sources from various departments within organisations to improve granularity. Biophysical data from organisations can be transformed into analyses outlining the societal impacts of operations through various approaches[23], which can help demonstrate to organisations the results of their actions.

4.3 Develop communication tools that resonate with end-users

Once the data is secured, it must be transformed into a format that facilitates engagement and buy-in. A key learning across the DPs was that technical implementation can be enhanced by the development of tailored communication tools that relay complex biophysical data into decision-useful contexts.

In DP9 and DP10, digital platforms were used as the primary bridge between the scientific assessment and the private sector. In the case of DP9, the development of a Digital Twin for a real estate developer (Hav Eiendom) allowed stakeholders across multiple departments to visualize the impacts of proposed developments on ecosystem extent, condition and ecosystem service flows as the project was being designed. The Blue-green factor (BGF) is an extent-condition proxy indicator for ecosystem services. By making the BGF calculations transparent and automated, the platform allowed for continuous, early-stage planning and design iterations. This transformed assessment of nature-based solutions from a final compliance check into a proactive design tool, minimizing the risk of costly mid-project redesigns. Furthermore, due to the platform transparently showing automated BGF calculations, the room for scaling this approach beyond the Oslo DP is now feasible. Ultimately, integrating these dynamic BGF into the platform allows developers to minimise the risk of surpassing regulatory thresholds and/or costly redesign mid-project to ensure BGF are met through their design.

[22] Multiple sources give insights into this, such as Bakker and Teske (2025). Guide to use public biodiversity data in the private sector. Biodiversa+ report; A-Track (2025) Building narratives through nature data Handbook for applying spatial datasets and metrics to assess locations and tailor nature strategies; A-Track (2025) Integrating nature information into decision-making An assessment of user needs.

[23] See: https://capitalscoalition.org/impact-value-standards-board-ivsb/

Similarly, DP10 demonstrated how interactive platforms can offer near-real time insights into the supply and demand for nature-based tourism. By visualizing where nature-based tourism hotspots exist, businesses can target communication campaigns more effectively, while government bodies gain temporal insights into ecosystem reliance. The success of these tools often depends on the participation of business partners in the design of the tools from the outset. DP10 also serves as an example of using communication platforms to manage competing stakeholder needs. The DP highlighted that while public authorities can use the ES tool to monitor tourism pressure and ecosystem health for conservation policies, private businesses were often looking to identify underutilized natural areas to drive revenue. By bringing these actors to a single digital platform, the DP has the opportunity moving forward to not just share data, but create a shared space to facilitate collaborative discussions on how to balance economic growth with the protection of the natural assets that the tourism sector depends upon.

As noted in DP8, the co-design of geospatial "heat maps" provided a direct pathway for the municipality to justify investments in urban parks and green roofs, essentially using visualization to prove the case for nature-based solutions. DP13 utilized a WebGIS tool to operationalize findings for a regional farmers' association. This platform showed how specific agricultural interventions could enhance service delivery across the region. Like the Digital Twin in DP9, this tool allowed for the integration of spatially-explicit ES results into actual territorial planning instruments, and allowed ecosystem service considerations to be systematically integrated into advisory activities, subsidy applications and territorial planning processes.

Advice for scientific partners:

- Develop a shared understanding with clients on the ultimate use of EA approach outputs, and co-develop formats to communicate results effectively. When working with larger clients (i.e. corporations) seek to understand the value chain of decision-making within the organisation and what outputs from the assessment resonates with each department.
- Develop tools which can bring together multiple stakeholders in order to facilitate a shared understanding of outputs. Seek (private sector) co-development in these tools to help translate scientific rigour into language which resonates with the private sector.

4.4 Seek alignment with broader initiatives/ strategies

For EA approaches to move beyond a one-off pilot for organisations and become embedded in their decision-making processes, it is helpful to align with existing internal and external strategic anchors. Alignment prevents EA approaches from being viewed as an additional administrative burden and instead positions it as a tool for achieving existing goals. DP9

exemplified this by using Doughnut Economics as a foundational framework for urban development. By aligning the project with the “ecological ceiling" and "social foundation" of the Doughnut[24],EA approaches became a practical tool for achieving the municipality's high-level sustainability goals.

Beyond academic frameworks, alignment with local policy is a powerful driver for uptake. DP13 successfully aligned its outputs into the Food District Plan (2022-2029), transforming nature-based solutions from individual agricultural choices into a collective regional strategy. Similarly, DP8 integrated its Urban Heat Island mapping into Local Climate Adaptation Plans, ensuring that the EA approach provided the evidence base for mandatory urban design standards. This policy-science interface ensures that the outputs of an ES assessment are immediately operationalized within existing decision-making pipelines. Both DP8 and DP13 found that without overarching strategies/ frameworks in place (including regulation) many terms, concepts and approaches will remain unfamiliar with actors involved in implementing actions from the EA approach.

Alignment does not always require high-level government regulation however it can be effectively achieved through market-driven industry standards. DP11 exemplifies this by integrating marine and island ecosystem indicators directly into the Sustainable Travel Finland (STF) programme, a national label managed by Visit Finland. By leveraging this existing, recognized strategic brand that tourism businesses already use for competitive advantage, the EA approach could be integrated in a top-down manner, potentially reaching broader implementation. By aligning ES goals with Visit Finland’s vision for regenerative tourism, the project transformed abstract ecological health into a tangible business asset by appealing to tourists inclined to more sustainable activities.

Advice for scientific partners:

- Understand the various (internal and external) policies and legislation the organisation currently face, and scan for potential other policies to align EA outputs with. Aligning assessment outputs with policies or disclosures that the organisation was currently unaware of can lead to a range of potential benefits for the organisation (greater attraction for potential investment, staying ahead of forthcoming regulatory requirements).

[24] Doughnut Economics is a framework used in sustainable development, published by Kate Raworth (2012). The framework consists of two main conceptual cores: a social foundation, representing that no one is left falling short on aspects relating to wellbeing (education, health, water, food, etc.), and an ecological ceiling, to ensure that humanity does not destabilise the life-supporting systems that sustain all life on Earth.

4.5 Build trust to ensure successful implementation

Trust is the invisible infrastructure upon which any successful ES assessment is built. Because nature-based strategies often require changes in decision-making processes, the sharing of sensitive operational data, and requiring vulnerability to learn new information, the relationship between the assessor (i.e. the scientific partner conducting EA approaches) and the stakeholder (i.e. the client or business) is paramount. DP13 provided a foundational learning in this regard, where farmers were often hesitant to share their land-use data with external scientists or corporate partners but were willing to do so when the process was endorsed by their Farmers' Associations. These associations act as intermediaries that possess the cultural and operational relational capital needed to vouch for the project's legitimacy.

Similarly, in DP11, a trusted intermediary was also key to the success of the project. Visit Finland and the STF programme acted as a crucial bridge, whereby its management board's approval of the new ES criteria provided the project with immediate legitimacy. Furthermore, trust was reinforced through leadership. On the same day the new criteria were launched, the national tourism body themselves signed the Baltic Sea Commitment. This act of institutional solidarity reduces the perceived risk for individual businesses, signaling that the EA approach is a collective industry commitment rather than an isolated corporate burden.

Building trust also requires moving from validatory engagement (where stakeholders are consulted only at the end) to participatory engagement. In DP9, trust was fostered through a thorough public participation process that included 10 specific recommendations from the community, which were then hard-coded into the project's goals. This ensured that the ecosystem services being assessed were those most valued by the people who would live in the intervention area.

Finally, often in the corporate world, trust is built through auditability. As DP14 highlighted, translating results into standardized natural capital accounting principles helped to "build trust in the results" for both internal executives and external auditors. When an organization can prove that its nature-positive claims are backed by rigorous, standardized, and transparent data, it can move from greenwashing to green proofing. This shift to auditable, evidence-based narratives can be integral in securing and embedding nature-related issues within decision-making.

Advice for scientific partners

- Seek to build trust from the initiation, engaging partners with language they are familiar with, and applying EA approaches transparently to encourage the joint development and shaping of outputs.
- Engage/ leverage trusted intermediaries with organisations to help identify/secure data, enhance engagement, or help understand the culture of the organisation in more depth.

4.6 Ensure cross-functional coordination

A key aspect captured by DPs, particularly those engaging with larger-sized organisations, is that the successful integration of EA approaches within organisations are rarely successful through the engagement of one department/function alone. With many decisions within the private sector fed through the C-Suite, it is often essential to ensure that outputs from the EA approach are aligned to operational needs. This touches on many of the aspects outlined in the sections above- the need for communicating clearly and engaging with leaders in a way that resonates with them (shared language, communication tools), seeking alignment with broader initiatives- to ensure that results of the EA approach do not remain siloed in sustainability departments but are actually embedded within organisational decision-making.

Communication tools, such as those mentioned in section 4.3, can be particularly useful in bringing various departments together to collectively discuss findings from the EA approach. By ensuring there is a common ground across departments, not only can such tools be further refined to incorporate all user needs, but they can also reduce internal friction and enhance the understanding of the EA approach as a whole so that it can complement/help achieve multiple organisational goals.

Intermediaries can also assist in this coordination, as demonstrated in DP11 and DP13. Coordination can often fail when it is purely top-down or purely bottom-up, it often requires a middle layer of trusted facilitators. In DP13, farmers associations helped to coordinate regional-level actions by reducing the administrative burden on individual actors. Through helping farmers align their practices with European agri-environmental payment schemes, the association provided a clear financial incentive for coordination with the EA approach. Similarly, DP11 reduced potential fiction with buy-in through integrating Baltic Sea health indicators into the existing Sustainable Travel Finland (STF) label.

Ultimately, the DPs emphasize that effective coordination is a two-dimensional endeavor, requiring both internal integration and external alignment. Internally, the transition from a siloed project to an embedded corporate strategy depends on the ability to bridge

departmental gaps, ensuring that ecological data is as legible to a Chief Financial Officer or Operations Manager as it is to a sustainability lead. Externally, this internal cohesion must be mirrored by a synchronized relationship with the evolving regulatory landscape. As seen in the engagement with frameworks like the CSRD (Corporate Sustainability Reporting Directive) and TNFD (Taskforce on Nature-related Financial Disclosures), successful coordination ensures that an organization's internal ES outputs are audit-ready and directly compatible with the requirements of external regulators, investors, and standard-setting bodies. By harmonizing these internal operational needs with external institutional pressures, organizations can move beyond mere compliance, positioning ecosystem assessment integration as a robust tool for resilience and strategic long-term value creation. To enhance inter-departmental coordination, the following key questions can be useful to ensure ES-related considerations are fully integrated into the decision-making processes.

Question	Function relevance	Organisational pillar relevance
How is the EA approach embedded into our organisational governance?	CEO	Governance & Strategy
Does the organisation have an accurate and institution-specific understanding of how our institution impacts and depends upon ESs?		
How are we integrating insights from our nature-related risk assessments into our overall business strategy and decision-making processes?		
How are nature-related factors included in financial planning and analysis?	CFO	Risk management
What is the return on nature-positive activities/ investments?	CFO	Finance
How are we ensuring alignment with existing and emerging nature-related reporting frameworks, such as TNFD, ESRS, and GRI, to provide comprehensive and transparent disclosures?	CFO	Disclosure/ Regulation
What are our institution's existing efforts and commitments on environmental and social themes?	CSO	Risk management
Which direct and indirect dependencies do our institution's activities have on ecosystem services and what is the magnitude?		
Has our organisation identified material nature-related opportunities?		

What specific measures have we put in place to align our portfolio targets with the global/national/regional frameworks and how are we tracking progress in achieving these targets?		Portfolio management
Do we have the right in-house capabilities and expertise within our institution to understand, assess, manage, and disclose nature-related impacts, dependencies, risks and opportunities?	HR	Governance & Strategy

Table 7. Key questions for departments/functions to ask to ensure ESs are embedded within organisations. Adapted from United Nations Environment Programme (2024). Nature in the Boardroom.

The questions provided above are designed to help translate complex environmental data into the operational language of Finance, HR, and Strategy. By leveraging these touchpoints, organizations can ensure that the EA approach remains a dynamic and embedded component of the organization's long-term strategy.

5 Conclusion & next steps

The landscape of ecosystem services assessments is fast evolving both within the scientific as well as in the business sector. This Deliverable shows the various applications an ecosystem service assessment can have and its benefits to private sector actors with various sectoral foci. Throughout the process of conducting the ecosystem services assessments many challenges were faced, both in terms of cross-collaboration between scientists and private sector actors, as well as challenges in assembling, assessing and acting upon the ecosystem assessment. The DPs show the benefit of applying an EA approach and provide practical solutions on how to communicate these benefits more clearly to businesses.

5.1 Impact

The DPs were asked to report on the Assemble, Assess and Act stages of the EAs. This report was intended to be a stock take up until at least the Assess stage as there is still another year in the project for the DPs to Act upon the assessment results. However, we do see that the DPs already impact the private sector and policies in various ways:

- DP8 Bulgaria, helped to shape an Urban Heat Island (UHI) strategy for the municipality of Sofia to mitigate the risks of UHI through the development of digital tools. This strategy is now already being scaled and applied to other municipalities in Bulgaria.
- DP9 Norway supports urban development projects in the municipality of Oslo by the creation of a digital tool, integrating ecosystem services into decision-making benchmarks. The tool looks at port development, so also includes blue factors, such as aquatic and marine areas. The project targets 1500 homes and 3000 workplaces. 30% of green structures are now ensured across the development. This digital tool

and collaboration platform now supports municipalities across Norway in Urban planning.

- DP10 in Malta has developed a tool to support the entire Maltese tourism sector to allow the national government to protect ecosystem services and tourism businesses to use ecosystems more sustainably.
- DP11 Finland improved Baltic Sea Management through the national policy of the Sustainable Travel Finland (STF) programme, incorporating marine ecosystems criteria resulting in the Baltic Sea Commitment. In a couple of months after the release of the updated STF indicators, nine businesses had already signed this commitment.
- To support the financial sector, DP12 conducted a desk analysis on how to enhance biodiversity risk screening tools by incorporating spatially explicit, asset-level data to improve accuracy and regulatory compliance.
- DP13 ensured that ecosystem services protection and enhancement were embedded in the Piedmonte Food District Plan for the period of 2026-2029, allowing for coordinated action at landscape scale through district-level planning.
- The primary outcome of DP14 was the successful transformation of complex ecological data into decision-useful financial and strategic metrics. By producing a repeatable methodology, key learnings from multiple applications across varying geographies, scopes, and use case contexts can be integrated when advising clients on how to act upon the assessment results, and how to increase organisational uptake of the results.
- DP15 developed a practical ecosystem services valuation tool for construction and real-estate projects. It applies a tiered approach to quantify services such as carbon sequestration, air quality, pollination, and real-estate value. By comparing business-as-usual and nature-positive scenarios, the tool translates biodiversity into monetary value, supporting early-stage design decisions, strengthening the business case for nature, and enhancing competitiveness in tender processes.

Further impacts are anticipated and will be captured in the Deliverable 9.4 (D9.4) Scalable solutions report.

5.2 Learnings

The DPs create impact on various levels of decision-making already. Although the outcomes from each of these DPs might seem different, commonalities in findings and application of the results were identified. Based on the experiences from the DPs six key learnings can be distilled:

- Develop shared language

- Integrate location-specific data into assessments
- Develop communication tools that resonate with end-users
- Seek alignment with broader initiatives/ strategies
- Build trust to ensure successful implementation
- Ensure cross-functional coordination

It was observed that a balance needs to be found between scientific complexity and usability of the approach. From an ecosystem services perspective, the scientific community has a role to play in terms of the development of shared language and the advancement of the uptake of location-specific data into assessments. SELINA supports this in terms of the development of a glossary. This glossary will be updated based on the insights shared by the DPs to align science and business language further where needed. This private sector specific glossary will also be taken up in the final D9.2 Guidance for the private sector.

To ensure ecosystem services are considered as a fundamental part of business operations, internal management is crucial. The learnings regarding communication, building trust and cross-functional coordination all refer to the challenge on how to integrate ecosystem services as an integral part of business conduct from a C-suite level to operations. To operationalise an EA approach alignment with other approaches that are known within business practices, such as Life Cycle Assessments or how to link with circular economy developments, should be considered. Potential pathways for this work could be considered in D9.4 in collaboration with EU Horizon projects such as A-Track in which work in this space is already being developed.

Several DPs raised the need of clearly communicating the intended benefits of adopting an EA approach. Clarification of the business case of the integration of the EA approach in decision-making is required, as currently costs of conducting an assessments outcompete the perceived benefits of adopting an EA approach. To support the business case development, strengthened collaboration could be sought with academics working within the field of business management, communication and accounting to broaden the understanding of the relevance of the field of ecosystem services for the private sector.

Although initially most DPs had the aim to work with the private sector solely, the reality of the DPs show that in order to apply an EA approach effectively, engagement with a variety of stakeholders is required, such as policy makers and networking agencies. In order for businesses to be interested and willing to adopt an EA approach, policies and legislation need to be in place. Especially in the case of working with SME's, creating support is crucial for the adoption of the EA approach. Authorities need to create an enabling environment. This legislation can either stem from a municipal level, national or intergovernmental level.

Many of the DPs had to link their project scope to frameworks and/or legislation to gain traction. This has been the case on a municipal level (DP08, DP09), regional level (Food District, DP12), national level (Sustainable Travel Finland, DP11) and intergovernmental level (EU Nature Restoration Law, DP10). DP13 showed that for farmers it is vital to link ecosystem services into operational end units familiar to end users, such as subsidy-relevant land units. These legislative frameworks all provided impetus to business interest in an EA approach. This shows the continuous importance of top-down policies to enable the adoption of the EA approach in decision-making and bottom-up action.

Digital tools developed by several DPs help to reduce the risk of non-compliance with legislation. There is an opportunity to upgrade many existing digital tools with ecosystem services data and understanding. Digital tools in many instances also support collaboration, decision-making and replicability. The digital tools developed within D9.3 have been valuable in raising awareness and supporting management decisions. There might be potential for some of these digital tools to become more standardised and widely used in the sectors they have been developed for. It is expected that the tools developed by the DPs and adopted by the involved private sector entities provide a competitive advantage to the involved businesses.

In terms of the delivery of the DPs it helped to get behind a common framework such as the FIEA to support the process management of the DPs. This framework provided guidance to the variety of applications that can be developed by the adoption of an EA approach. At the same time, it showed that it also provided sufficient room for adaptation in terms of stakeholder engagement for instance. It became evident that working with SMEs is highly time consuming when there is no supporting framework or legislation that provides SMEs with the impetus to adopt an EA approach. The DPs have been more effective in their delivery when they aligned with existing initiatives. Providing clarity and structure on the process by usage of the FIEA, but at the same time providing freedom and trust to the DP leads to overcome challenges has supported the timely delivery of the DPs.

5.3 Next steps

The SELINA project is entering its final year. This report doesn't mark the end of the DPs, but rather the starting point for acting upon the insights gathered within these projects. In the final year, Deliverable 9.4 (D9.4) Scalable solutions will be developed. Insights gathered from this Deliverable inform the activities that will be explored and or undertaken to scale the solutions that have been developed as part of D9.3. Below an overview is provided of the developments we foresee for the final stage of the project.

- Deliverable 9.4 will focus on scalable solutions derived from EA approaches developed by the DPs. Currently we think this deliverable will focus on these activities, but this might change slightly still due to workshop discussions:
    - Impacts that have been achieved through the implementation of the EA approach in the DPs;
    - Alignment and knowledge sharing across the DPs: understanding of potential for co-sharing and learning to come to tools and or solutions that would be more easily scalable and replicable;
    - Work with the SELINA consortium to understand whether there are solutions to address the location specific data gap that private sector entities identified.
    - Promotion of DP outputs and tools to relevant actors in an accessible way.
    - Potential creation of pathways to link the EA approach to other frameworks, such as circular economy, Life Cycle Assessment, Doughnut Economics, to align the EA approach with other proven concepts that have traction within the business community.

- Updated SELINA glossary with insights from D9.3 where relevant and inclusion of private sector specific glossary will also be taken up in the final D9.2 Guidance for the private sector:
    - Updated D9.2 Guidance for the private sector based on the experiences from D9.3.

- Support the finalization of D8.5 Solutions for shared private-public use of evidence on ecosystems and ES
    - D9.3 insights will inform D8.5 report and recommendations.

- In collaboration with WP4, Private Sector Guidelines for Issuing Terms of Reference (ToR) for Ecosystem Assessments are under development. This guidance document assists commissioners in translating their internal information needs into

a coherent ToR that contractors can respond to effectively. It also helps ensure that assessment results are usable, relevant, and aligned with internal governance and decision-making processes.

- WP9 will translate the outputs of D9.2, D9.3 and D9.4 into material to be included into the Compendium of Guidance (CoG). This includes the individual Demonstration Project narratives in form of case studies and revising the FIEA Implementation factsheets (see Annex B) with regard to formatting and content, noting that implementation details will be further updated beyond this deliverable.

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Disclaimer: AI has been used for text revision and grammar correction.

ANNEX

This document contains two annexes:

Annex A presents the reporting templates used to collect data from the individual Demonstration Project Leads. It includes:

1. A supporting template to apply the ecosystem services (ES) approach in practice, focusing on private sector decision-making considerations. The template contains its own annexes, including a glossary to support private sector actors as well as a comparison between FIEA and the Capitals Protocol.
2. The Framework for Integrated Ecosystem Assessment (FIEA) – draft private sector user template as developed by WP6.

Annex B compiles the FIEA applications by each Demonstration Project in the form of factsheets. These map project activities, methods, methodologies, and stakeholder engagement and communication strategies across the phases Frame, Scope, Design, Assess, Share and Act, as reported by the project leads. The factsheets are not yet final and will be further refined for inclusion in the Compendium of Guidance (CoG), including improvements to editing, readability, layout, and any implementation updates arising during the final year of the SELINA project.

Annex A

A1. Supporting template to put the ES approach in practice: private sector decision-making considerations

A2. Framework for Integrated Ecosystem Assessment (FIEA) – Draft User Template for private sector actors

SELINA Work Package 09
Deliverable 9.3

Supporting template to put the ES approach in practice: private sector decision-making considerations

Q4 2025

Introduction

Deliverable 9.3 *"Report on ES evidence generation and uptake within DPs"* will provide an analysis of the uptake of the Ecosystem Service (ES) approach by business, gather Demonstration Project (DP) best practices, and identify methods and materials that have supported private sector implementation of the ES approach. The report will contain the activities developed within each DP and outputs of these DPs.

To capture those activities, WP09 is collaborating with private sector DPs to populate two templates:

1. D9.3 supporting template to put the ES approach in practice: private sector decision-making considerations (further referenced as D9.3 supporting template)
2. The SELINA Framework for Integrated Ecosystem Assessment (FIEA)

The D9.3 supporting template will, together with FIEA, inform the D9.3 Report on ES evidence generation and uptake within the DPs. Its aims are to uncover how the ES approach was implemented by DPs, and understand in more detail the decision-making context, operational aspects, management considerations and barriers overcome when using ecosystem services concepts in business.

FIEA is a unified integrated ecosystem assessment framework that fits the specific decision context and needs. Together with FIEA, this template should provide a complete insight into how an ES approach can be put to use in the private sector. In the Annex of this template we have added a glossary of terms to define several of the key concepts used in the context of SELINA and the private sector Work Package specifically.

Integrating ES information into private sector decision-making

Before proceeding with an overview of the template of D9.3, a few critical elements are outlined to position this template within the decision-making context from a business-perspective. In the context of this template the term **Ecosystem Services Approach (ES approach)** is used to refer to the processes to incorporate ecosystem services in private sector decision-making and business conduct, this can include but is not exclusive to elements of the Framework for integrated ecosystem assessments (FIEA). In the following paragraphs an overview is given of three frameworks: ACT-D, the Capitals Protocol and FIEA. The intention here is to showcase how frameworks commonly used in the private sector align with the framework developed by SELINA-the FIEA and how to make these frameworks interoperable.

In the private sector, actors who wish to engage with nature commonly utilise two frameworks: **ACT-D** and the **Capitals Protocol** (successor to the Natural Capital

Protocol). ACT-D was developed as part of the High-Level Business Actions on Nature initiative, which focussed on helping align the process and terminology used in the action frameworks and guidance being developed for evaluating, managing, and disclosing nature-related impacts and dependencies. While developed with a focus on nature, the set of actions prescribed in ACT-D are equally applicable to other aspects (people, society). The actions fall under the categories of **A**ssess, **C**ommit, **T**ransform, and **D**isclose. A business can begin their nature journey by assessing impacts and dependencies in the Assess (A) step. Once a business has a clear understanding of its impacts and dependencies, it should Commit (C) to targets for improvement. Transform (T) is the process in which a business acts on the information and intentions set out in Assess and Commit and changes its practices to improve the value created for itself and for society. Finally, Disclose (D) is an (mandatory or voluntary) accountability process where a business publicly communicates progress.

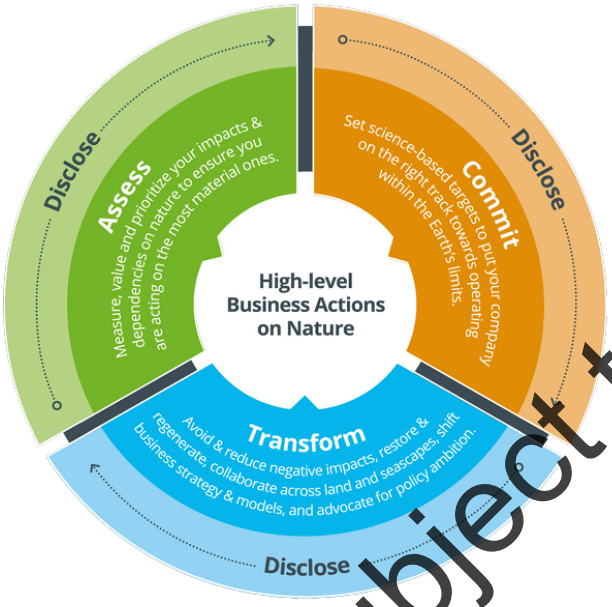


Figure 1 ACT-D Framework

Fitting within the ACT-D is the Capitals Protocol. Where ACT-D outlines 'what' businesses should do to integrate nature within their strategies, the Capitals Protocol outlines the 'how', providing an overview of how businesses can operationalize ACT-D and **assess** (thus building predominantly upon the 'Assess' stage of ACT-D) impacts and dependencies, and perhaps most importantly- trade-offs, between different capitals (natural, human, social, produced). The Protocol is composed of three stages:

1) **Assemble**-What needs to be considered when implementing an assessment

2) **Assess**-What needs to be considered in order to understand the significance, worth, or importance, in other words the value, of business impacts and dependencies on capitals.
3) **Act**- How can results of the assessment can be applied and embedded within the business

These stages are further broken down into 7-steps, as shown below.

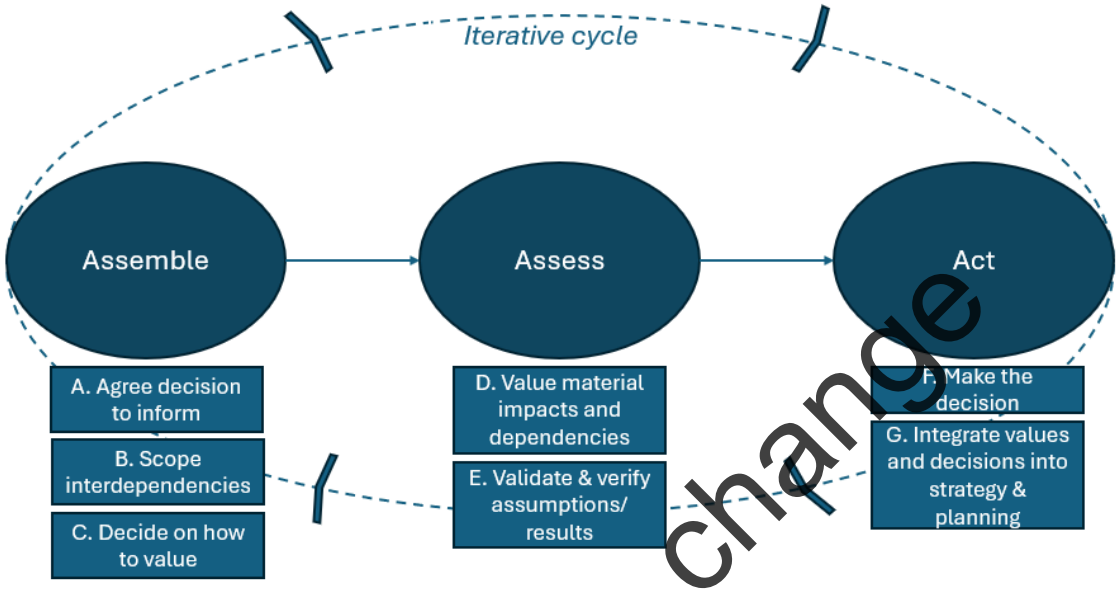


Figure 2 The Capitals Protocol

As part of SELINA, the **Framework for Integrated Ecosystem Assessment** (FIEA) has been developed- which is a comprehensive and systematic approach to the planning, implementation and evaluation of the ecological, economic and social aspects of an ecosystem assessment and explicitly aims at informing and supporting decision-making. Comparing the Capitals Protocol to the FIEA at a high-level shows many similarities and synergies between the two frameworks.

The **Assemble** stage covers most of the preliminary stages in FIEA- covering Frame, Scope and Design elements. The **Assess**, stage overlaps predominantly with its namesake in the FIEA, but also includes Design elements- particularly around valuation (which are covered in the Design and Assess stages of FIEA), and aspects related to dissemination. The **Act** stage ensures that decisions and actions made are scoped towards stakeholders and affected peoples- directly overlapping with the Share and Act stages of FIEA.

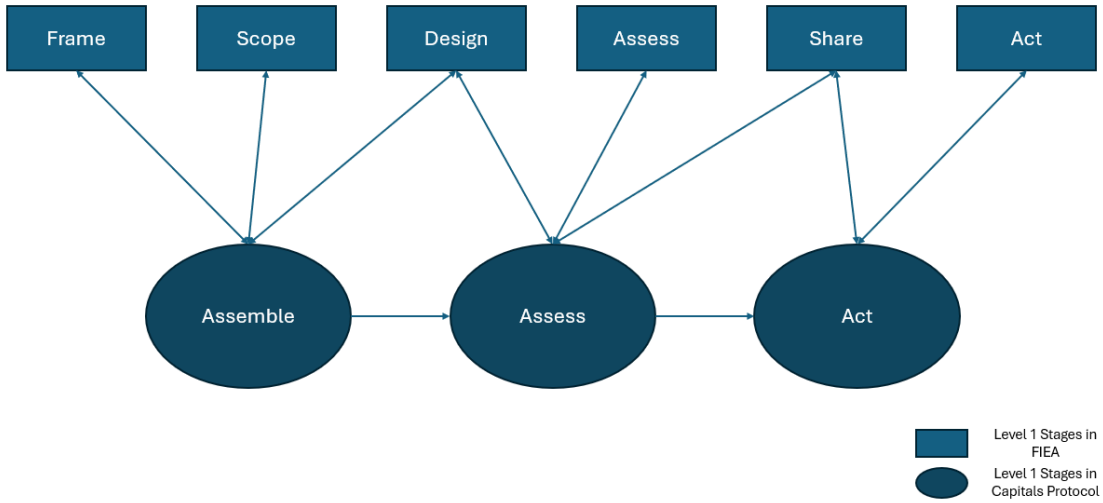


Figure 3 Level 1 comparison of FIEA and Capitals Protocol

The Capitals Protocol is deliberately positioned within business decision-making processes. Its core purpose is to connect assessments of impacts and dependencies directly to specific business applications such as strategic, operational or managerial contexts. In doing so, the Protocol provides a pathway for nature – alongside other capitals – to be systematically embedded into corporate strategy, governance, and day-to-day operations. The FIEA also seeks to connect ecosystem considerations to decision-making, particularly through its Design and Assess stages.

The underlying narratives of both frameworks are somewhat different however. In the private sector, companies tend to assess nature through the lens of impact and dependency pathways. This approach asks: Which business activities affect or depend on natural systems? How do those changes in turn create risks, opportunities, or value outcomes for the business itself? To operationalise this, firms often rely on **impact value and dependency risk factors**. These function as coefficients that translate changes in ecosystem state or services into decision-relevant values — such as financial costs, operational risks, or reputational impacts.

The FIEA provides more granular guidance into how to for instance analyse the extent and distribution of ecosystem types, assess ecosystem condition, and evaluate the ecosystem services they provide.

Given this variance in approach between the FIEA and assessment structures which the private sector are familiar with, we have structured the template below across three stages: Assemble, Assess, Act. In doing so, we have retained key elements of the FIEA, but embedded this within the decision-making processes which the private sector are familiar with.

D9.3 Supporting Template

In the first year of the SELINA project, we provided you with a D9.2 template that helped to shape your Demonstration Project. This supporting template builds on the D9.2a template. Answers provided to those questions can be used in this template too. It would be good to compare the initial plans outlined in D9.2a with what you ended up doing. Any changes to the information you provided at the time are relevant and also the reasons why things changed are informative.

Questions in this supporting template are designed to capture management considerations when applying an ES approach to a business, according to the three stages outlined above. For each stage, we would like to learn about the 1) context the DP was developed in, 2) engagement activities that were undertaken, 3) decisions that were made and 4) process considerations relevant to that stage. Several questions are repeated to capture potential shifts when going through the stages.

The aim is to capture opportunities and challenges encountered when applying an es approach in the private sector, to learn from these insight and report on them in D9.3. Through your responses we can gather a set of best practices to support other decision-makers in implementing an es approach within the private sector. This will help us to also build scalable solutions (D9.4) for the uptake of es in the private sector.

Demonstration Project leads role

The Deliverable 9.3 "Report on ES evidence generation and uptake within DPs" is due in June 2026. In order to develop the report, Demonstration Project leads are asked to complete their Demonstration Project by the end of 2025, in order to submit both this filled out D9.3 supporting template, as well as a filled out FIEA template by the **end of February 2026**. It is advised to use both documents as you progress the DP itself, as it might be harder to answer to questions in the templates after you finalize your project.

DP leads are asked to complete both templates in close collaboration with their business partners, reflecting on the business perspective of integrating ecosystem service approaches into a business. The experience and results of the private sector you worked with as a DP lead is central to our questioning. When relevant, you can also comment on the collaboration between you as a DP lead and the business you worked with.

ASSEMBLE: Preparations for the implementation of the ES approach

The Assemble Stage brings together the preliminary phases of the FIEA – including Scope, Frame, and Design elements. The bullet points below highlight the key aspects of this stage:The organisation **agreed to apply an ES approach** to their business context

- A decision was made on **what the organisation aims to inform** through the project
- The **key objectives** of conducting the project were outlined
- The organization broadly outlined **how the results of the project were to be utilised**
- If applicable, relevant **internal and external stakeholders were engaged** to inform the project
- The **scope, boundaries, and initial framing** of the Demonstration Project were established
- Information filled out in the **D9.2a template** at the start of the SELINA project compared to the actual roll out of the approach.

Context questions
1. Describe the context of the business(es) you are developing this DP with. In which sector does that business operate? What is the context in which the business operates?
2. Did the businesses you worked with for this DP apply an ES approach before?
• No, the businesses have not used these concepts before • No, but the businesses have been using the language before • Yes, the businesses have applied the ES approach before • Yes, the businesses are advanced in integrating ES into their decision-making
2. If applicable, please provide more context of the experiences the business has regarding the integration of ES into their decision-making

3. What size(s) are the business(es) you are working with within your DP?

- Small and Medium-sized enterprise (< 250 employees)
- Large enterprise
- Multinational corporation

Engagement Activities

4. Which teams/ departments in the businesses you worked with were involved in the decision to apply an ES approach within the SELINA project? Please specify further

- Executive Team
- Sustainability
- Procurement
- Marketing
- Other, please specify

5. What roles or positions do these actors hold within their businesses or in relation to the project?

6. Which, if any, external stakeholders were involved in making the decision to apply an ES approach within the business? How did these external stakeholders contribute to the decision-making?

7. Are there any other internal or external factors that influenced the design of the project within the DP business partner, which were not mentioned above?

Decisions made
8. Why did the business partner decide to apply an ES approach and participate in the SELINA project?
9. Which organizational strategies and management practices were crucial in deciding to adopt an Ecosystem Services (ES) approach in the business?
10. What was the intended application of the Demonstration Project? • Evaluate impacts and dependencies and assess risks and opportunities • Estimate total/net impact values and commit to targets • Compare options and transform outcomes • Internal and/or external communication and reporting • Other: ...
Process considerations
11. Looking back to your input into D9.2a, have there been any significant changes to the scope of the DP that would be relevant to mention here? If so, what changed and why?

ASSESS: Implementation of assessment

The Assess stage covers elements of the Design, Assess and Share phases in FIEA. The bullet points below highlight the key actions in this stage:

- The organisation delves into **ecosystem assessments using appropriate tools and frameworks**
- The organisation ensures that the assessment is **designed to generate business relevant insights**
- **Internal and external stakeholders are included to inform** the methodologies and outcomes
- The results of the assessment **generate the foundation of evidence** to inform decision-making

 Note: The majority of the actions in the ASSESS stage are covered by the FIEA, which can be used to effectively frame, design and implement an integrated ecosystem assessment. The questions formulated below focus on any insights that might not be gathered through the FIEA only.

Engagement activities
1. Were the same or different internal actors in the business involved in both the assemble and assess stage?

• Same
• Different:
  ○ Executive Team
  ○ Sustainability
  ○ Procurement
  ○ Marketing
  ○ Other…

2. If different internal actors were involved, what roles or positions do they hold within their business or in relation to the project?

3. Were external stakeholders* involved in the assessment? E.g. in the selection of suitable indicators, methods and variables and or the data collection itself? If so, who was involved and how? * *This can include the DP leads and other external stakeholders involved in the assessment phase*
4. Have affected communities been considered and consulted in the assessment?
Decisions made
5. Did the business application change throughout the ASSESS stage?
• Yes/ No • If yes, what change was made, in which stage and why did it change?
Process considerations
6. How did the organizational culture or structure support or hinder the assessment?
7. What have been challenges/obstacles the business faced in conducting this assessment?
8. What have been challenges/obstacles you as a DP lead faced in conducting this assessment?

9. Have you faced any institutional barriers (either internal or external) in conducting the assessment?

ACT: Implementation and Operationalization of findings

- The ACT Stage encompasses key components from both the Share and ACT phases of the FIEA. The following points outline the main considerations for this stageThe outcomes of the project, including the assessment results, are **translated into actionable business decisions**
- Ecosystem Service considerations are **integrated into business planning, accounting and operations**
- Findings and implications on stakeholders are **communicated**
- It is established how to **monitor and evaluate** the effectiveness of actions taken
- Key learnings, challenges and recommendations for **future projects and scalability of an ES approach** for the private sector are outlines

Engagement Activities
1. Were the same or different internal actors involved in the ACT stage?

• Same
• Different:
  ○ Executive Team
  ○ Sustainability
  ○ Procurement
  ○ Marketing
  ○ Other…

2. If different internal actors were involved, what roles or positions do they hold within their business or in relation to the project?

3. Which, if any, external partners/ stakeholders were involved in making the decision to act upon the assessment findings and incorporate these results into the business decision-making? How did external stakeholders contribute to the decision-making?

Decisions Made

4. Did the business application change throughout the ACT stage?

- Yes/ No
- If yes, what change was made, in which stage and why did it change?

5. What are the main findings of the project?

6. Which decisions were made based on the findings, what did the findings result in?

7. How are these decisions put into practice? Did the business consider Commitments, Transformation and/or Disclosure activities based on the project outcomes?

Process Considerations

8. What were crucial process considerations to come to the results?

9. Do you face any institutional barriers in acting upon the assessment results. If so, what are these?
10. What steps were taken to overcome challenges in implementation, if any?
11. Were there any other unintended consequences of insights that emerged during the ES approach?
12. Outline initial actions that were taken to implement the ES findings within the business (What were the first actions the business took to apply the approach?)
13. Does the business plan to continue using the ES approach?
14. If yes, how do they plan to integrate it into their ongoing operations?
15. If not, what are the reasons, and are there alternative approaches being considered?

16. Are there any lessons learnt that could benefit other organizations applying the ES approach?
17. Which solutions have been developed that could be scaled within the sector or for the business itself?
18. Does the business have any recommendations to scale up the usage of an es approach in business decision-making?

Annex

Glossary

Many terms are used both within the SELINA project as well as outside. The SELINA glossary (SELINA_T65_Internal_Glossary_v2.pdf) provides an overview of agreed terminology within the consortium. We refer to the glossary in case of any doubts of how to interpret a word in the context of the project.

In addition, we have provided some definitions that are more commonly used in the corporate sector to improve the readability of this document.

Ecosystem Assessment Approach

In the context of this template the term Ecosystem Assessment Approach is used to refer to the processes to incorporate ecological, social and economic aspects of an ecosystem assessment within private sector decision-making and business conduct, this can include but is not exclusive to elements of the integrated ecosystem assessment (FIEA).

ACT-D

The High Level business actions on nature were developed by Capitals Coalition, Business for Nature, WBCSD, TNFD, Science Based Targets Network, WEF and WWF. ACT-D stands for Assess, Commit, Transform and Disclose. ACT-D guides businesses

through the various tools, frameworks and initiatives to support them in assessing their relationships with nature, committing to action and target setting, transforming their practices and disclosing nature-related information. (Capitals Coalition, ACT-D, 2023)

Assessment

An assessment is the process to measure, value and prioritize a business 'impacts and dependencies on nature, and the resulting risks and opportunities, to ensure businesses act on the most material ones. The results of an assessment are used to help inform decision-making, strategy, target-setting, and reporting (Capitals Coalition, ACT-D, 2023)

Affected communities

People who are representing (working for or identifying with) the communities that experience the impacts of decisions and are often underrepresented in decision-making. This includes but is not limited to Indigenous Peoples and local communities. (Capitals Coalition, Valuing what matters: Pluralism, power, and business decision-making, 2025)

Biodiversity

Biodiversity is a state or attribute of a site or area and specifically refers to the variety within and among living organisms, assemblages of living organisms, biotic communities, and biotic processes, whether naturally occurring or modified by humans. Biodiversity can be measured in terms of genetic diversity and the identity and number of different types of species, assemblages of species, biotic communities, and biotic processes, and the amount (e.g., abundance, biomass, cover, rate) and structure of each. It can be observed and measured at any spatial scale ranging from microsites and habitat patches to the entire biosphere. (SELINA glossary)

Capitals

Any form of asset that translates value to people. The Capitals Protocol references four forms of capital: natural, human, social, and produced. (SELINA glossary)

- Natural capital
- Human capital
- Social Capital
- Produced capital

Corporate Natural Capital Accounting/Corporate Biodiversity Accounting

The systematic process of identifying, measuring, recording, summarising and reporting the biophysical state of biodiversity assets, and the periodic and accumulated net changes to those assets. (SELINA glossary)

Ecosystem condition

The quality of an ecosystem measured in terms of its abiotic and biotic characteristics. (SELINA glossary)

Ecosystem services

The contributions of ecosystems to the benefits that are used in economic and other human activity. (SELINA glossary)

Decision-making

The process of making decisions can happen at the individual level or amongst groups and entails the prioritisation of certain values. This prioritization greatly influences which issues are found worthy of consideration, do and do not become part of the agenda, as well as determine which decision-makers are considered socially legitimate to participate in the process (IPBES, Glossary of terms used in the methodological assessment of the diverse values and valuation of nature, 2022)

In the context of the SELINA project, decision-making is the process of generating ecosystem service assessment information to incorporate in policy-making and/or private sector decisions. The decisions based on this assessment information can subsequently be used to commit to targets, transform conduct, disclose information and in the case of policy-making change incentives.

Dependency

A reliance on or use of a capital stock or flow. (Capitals Coalition, Capitals Protocol, 2025)

Disclosure

Disclosure refers to the voluntary or required/statutory release of any information relevant to a company, security, fund or any third party. In financial accounting, disclosure refers to a statutory or good faith revelation of a material fact (or an item of information that is not generally known) on a financial statement or in the accompanying notes (footnotes). Biodiversity disclosures refer to the voluntary or required/statutory release of any biodiversity-related information to external stakeholders. (ALIGN, 2022)

DP

Real-world innovative examples supporting evidence-based decision-making within the SELINA Project. (SELINA glossary)

FIEA

The Framework for Integrated Ecosystem Assessment (FIEA) is a Framework, which is a comprehensive and systematic approach to the planning, implementation and evaluation of the ecological, economic and social aspects of an ecosystem assessment and explicitly aims at informing and supporting management decisions. (SELINA glossary)

Impact driver

A measurable input to, or output from, human activities, that results in impacts. (Capitals Coalition, Capitals Protocol, 2025).

Stock

The quantity of something (i.e., capital) existing at a point in time. (Impact Management Platform, 2024).

Flow

Provision of something (i.e. ecosystem service) over time. (Impact Management Platform, 2024).

Comparison of FIEA and Capitals Protocol

FIEA Level 2	Capitals Protocol equivalent	Differences	Result
Define Purpose	Step A- Agree the decision to inform. Step A1- Define the decision to make and the information needed to underpin it. Step A2- identify who will make the decision.	From the Protocol, end-users of the capitals assessment are featured right at the beginning (rather than in the 'design alignment' step in the FIEA).	Positioning the entirety of the assessment within a decision making process, clearer articulation of the end-user can be fostered- meaning that the (ecosystem) assessment can be positioned within a broader strategy/ direction of the organisation. This can create greater buy-in from other departments.
Conduct stakeholder analysis	Step A- Agree the decision to inform	As a sub-step in the Protocol (A3- Identify stakeholders and the appropriate level of	Protocol presents greater links to grouping stakeholders to decision rather than directly to the

		engagement). Stakeholders are grouped in relation to the objective at hand in the Protocol.	ecosystem. The Protocol can therefore potential encompass greater variety of stakeholders.
Identify risks and opportunities	Step D3-Explore changes in capitals- including risks/opportunities on the business and society	FIEA focuses here on risks/opportunities from changes in ecosystems and services. In the Protocol this comes much later (Step D3)- and looks at the risks/opportunities on the business and society.	FIEA is practical for environmental management. Protocol prepares information that CFOs or boards will recognize- again creating greater alignment with broader decision making- not just actions surrounding the environment.
Start engaging stakeholders	Step A3- Identify stakeholders and appropriate level of engagement and throughout the remainder of the Protocol to (in formulation of impact pathways, measurement of changes, valuation, and communication of results).	No significant differences. FIEA asks for stakeholder engagement throughout various stages.	-
Identify question/ theme/ objective	Step A1: Define objective	The Protocol is more focussed on the decision-making processes within organisations and the specific decision type (strategy, attracting finance etc). FIEA asks to define research objectives linked to ecosystem services/ ecosystem condition.	Many organisations are unfamiliar with ecosystem services and condition. Some departments within may have expertise, but linking this to broader organizational strategy can be challenging. This is why the Protocol has formulated impact pathways- to link business activities to impacts/ dependencies on capitals, to facilitate easier integration within business decision-making contexts.
Identify relevant impacts and dependencies	Step B- Scope interdependencies of capitals	Protocol stresses more on the linkages and trade-offs between various capitals, and again links business activities to impacts/ dependencies.	Allows more succinct linkage between business activities and changes to capitals. Impacts are also linked to business and to society- to allow a deeper analysis of trade-offs between people, planet, and financial outcomes for

			both business and society.
Define boundaries	Step B- Scope interdependencies of capitals	No significant differences- but the Protocol places greater, explicit stress on defining boundaries in relation to scopes which businesses are familiar with- operational, value-chain, spatial and temporal scopes- not explicitly focussing on ecosystem extent, condition and services.	-
Design alignment	Step A- Agree the decision to inform	No significant differences	As stated above, this is embedded right at the beginning in the Protocol to ensure that the assessment can be embedded within decision-making. This allows for alignment with regulations etc to be made explicit from the onset, and allows the assessment to be pegged-to/ aligned with broader strategy etc to create greater buy-in across the organization.
Design ecosystem type(s) and extent assessment Design ecosystem condition assessment Design ecosystem service(s) assessment Assess ecosystem type(s) and extent Assess ecosystem condition Assess ecosystem service(s)	Step C- decide on how to value Step D- value material impacts and dependencies	As with above sections, the Protocol focusses more on the impacts/dependencies on organizations linked back to ecosystems.	**Understanding the linkages of business activities to impacts/ dependencies on ecosystems/services is commonly done through impact value factors and dependency risk factors- which act as coefficients to understand changes in ecosystems linked to business activities. This avoids the need to map and assess ecosystems directly. A company doesn't necessarily have to measure ecosystem condition itself- it can apply existing factors from databases, literature, or sector guidance to estimate impacts/dependencies.**

Interpret results and develop solutions	Step D5- Collate results and attribute impacts Step F- Make a decision and agree recommended actions Step G- Integrate the decision and values of all capitals into decision planning and strategy	No significant differences- the Protocol does include stakeholder input here- stressing that alongside the valuation exercise it is important to retain clarity on the stakeholder groups and subgroups whom the valuation represents.	-
Elaborate results stakeholder-specif ically	Step D5- Collate results and attribute impacts	As above. Main difference is that the FIEA is requesting to tailor outputs to stakeholder groups, whereas the Protocol is requesting a distributional analysis to understand which groups are being affected to what extent by which impacts and where the groups are located.	-
Disseminate and communicate results Disclose	Step E- Validate and verify key assumptions and results Step F- Make a decision Step G- Integrate the decision and values of all capitals into decision planning and strategy	FIEA is more focussed on outreach, whereas the Protocol seeks to embed communication in decision-making and frame the results to different actors within the organisation to enhance adoption of proposed solutions.	By directing the results towards different actors within an organization/ towards different decision-making processes, the results of the assessment are more tailored to the language and terminology common within an organisation. Although the FIEA asks for results to be communicated in various formats, the Protocol asks for the decision making process/decision to be outlined at the forefront of an assessment to allow for the entire assessment to be directed towards particular personnel/ decision-making processes.
Adopt results (in public and private decision-making) Implement Monitor and evaluate	Step F- Make a decision Step G- Integrate the decision and values of all capitals into decision planning and strategy	No significant differences. Both stress iterative nature. Protocol places more significance on the ethics of decision made.	-

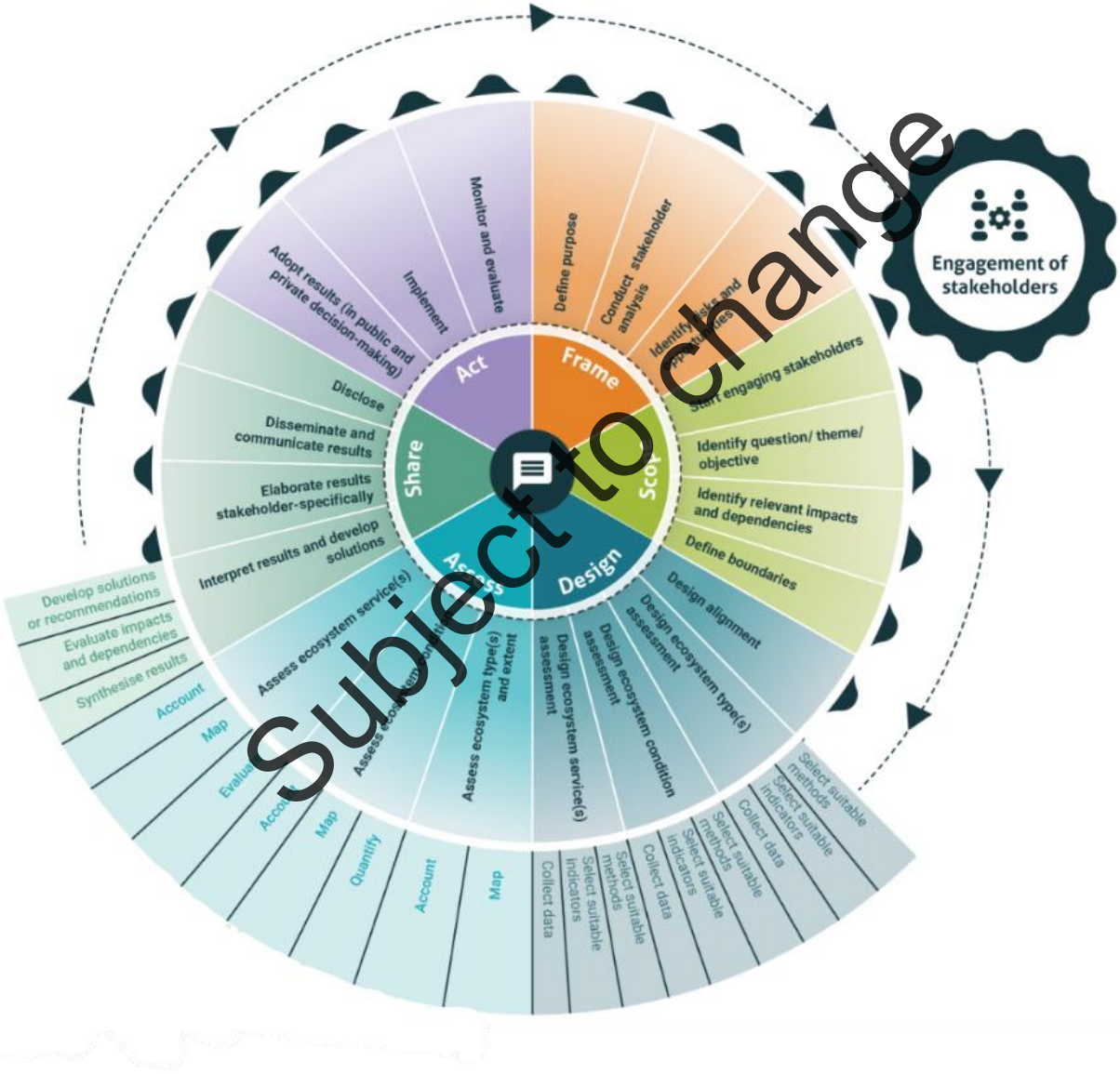
Level 1	Level 2	Level 3	Description - short version	Description - long version	Further details	Hypothetical example 1: Private decision-making context	Is there a general relevance of this step for your DP (regardless of whether the step has been/ will be executed)?	If there is no general relevance of this step for your DP, please, explain why not... *[mandatory, if general relevance of step = no]*	What is the status of this step in your DP? *[mandatory]* *Please, select one of the respective*	Description of all aspects relevant to this step in your DP *[mandatory, MOST RELEVANT COLUMN FOR DPs to FILL OUT!!]* *free text, here, please record the specifics, e.g. under Design > Design ecosystem service(s) assessment > Select suitable method: Specify which method(s) was/ were selected to assess which ecosystem service(s); you can consult the hypothetical examples for an*	Links between steps *[optional]* *free text, here, if applicable, feel free to record any kind of links between the respective*	Comments *[optional]* *free text, here, feel free to provide any kind of comment to e.g. your provided information*
Frame	Define purpose		Define the main purpose and expected outcomes of the assessment.	This step involves defining the main purpose and expected outcomes of the assessment, as well as identifying who would benefit from and apply the results. This step should ensure the legitimacy of the assessment process by investing in approaches that are inclusive, transparent, credible, equitable, and culturally sensitive, as well as making the process and its assumptions clear and accessible. A legitimate and participatory framing process increases the likelihood that the outcomes will be		The company defines the assessment's purpose as assessing how ecosystem condition underpins crop production and identifying sustainable practices to maintain ecosystem services relevant for the company (e.g. crop production) as well as for the local community (e.g. landscape aesthetics and recreation). The goal is to inform corporate land-use						
	Conduct stakeholder analysis		Identify and analyze stakeholders to support their meaningfull involvement in the assessment.	The stakeholder analysis involves identifying, mapping, and analysing the interests, influence, and relationships of relevant individuals, groups, or organisations that have an interest, influence, or impact on the ecosystem and its assessment or that are affected by the assessment. These stakeholders may include, but are not limited to, public sector representatives (e.g. ministries, municipalities), NGOs, private sector actors, industries, civil society organizations, scientists, data providers, technical	Special attention should be paid to inclusive representation, ensuring that underrepresented and vulnerable groups (e.g. Indigenous peoples	The company identifies key stakeholders: Internal decision-makers and staff (farmers, sustainability officers), scientific consultants and agricultural advisors, local community members, customers (who demand sustainably sourced products), public authorities and agencies, local farm associations, and local environmental NGOs. This analysis						
	Identify risks and opportunities		Explore how ecosystem changes may pose risks or create opportunities for people or sectors.	This step identifies potential environmental, social, and economic risks and opportunities that could arise from ecosystem changes and service dynamics ("What are the big risks and opportunities the assessment needs to be aware of and respond to?"). It connects the ecosystem assessment to real-world consequences by highlighting where environmental degradation could lead to costs (e.g. flooding, resource scarcity) or where ecosystem restoration or protection could yield benefits	They can be divided into two types: (i) General risks and opportunities are known or expected issues grounded in existing knowledge and	Business risks are identified, such as reduced yields from soil degradation or pollinator decline, regulatory non-compliance, and reputational damage if biodiversity is harmed. Opportunities are also noted: adopting nature-friendly farming can improve resilience, unlock eco-certifications or subsidies, and enhance the company's brand						
Scope	Start engaging stakeholders		Begin engaging identified stakeholders in co-de	This step involves taking decisions on the level of involvement of different stakeholders and actually starting to engage the relevant stakeholders in the process and defining their roles and responsibilities, such as public sector representatives (Ministries, Municipalities, etc.), NGOs, private sector, industries, as well as civil society organizations, scientists, data providers, technical experts, advisors, reviewers, communicators. It builds upon the results of the stakeholder analysis (cf. "Conduct		The company initiates engagement with the identified stakeholder groups. Stakeholder involvement is phased out throughout the whole assessment process. The specific form of stakeholder involvement is reported as "note" in each of the following framework steps.						
	Identify question/ theme/ objective		Define the research question, theme, or object	Based on the purpose (cf. "Define purpose") and risks and opportunities (cf. "Identify risks and opportunities") identified in the previous steps, this step entails identifying (a) specific question(s), theme, or objective that the assessment aims to address, and builds the foundation for a suitable research design and assessment. Within this step diverse pathways, solutions, and strategies for achieving transformative change could be explored (*e.g.* through scenario development that include futures that diverge from		The research objectives are formulated: (i) Identify ecosystem services critical to company operations and local communities; (ii) Assess the link between ecosystem condition and those ecosystem services; (iii) Support the development of land-use adaptation strategies.						
	Identify relevant impacts and dependencies		Prioritise the most relevant impacts and dependencies on ecosystems.	This step involves the evaluation and prioritization of relevant (to the objective, cf. "Identify question/ theme/ obejctive") impacts and dependencies, and to decide which ones to measure and value in the next steps. Impacts refer to the ways in which policies, actions, or decisions affect ecosystems and provided services, while dependencies refer to the ways in which people, organisations, or systems rely on ecosystems and its services. An impact or dependency on ecosystems is relevant if its		It is catalogued how farming operations impact nature (e.g. pesticide use impacting insects, irrigation affecting the stream) and how the business depends on nature (fertile soil for crops, wild pollinators for fruit set, clean water for irrigation). This impact/dependency mapping ensures the assessment will cover critical ecosystem services and						
	Define boundaries		This step defines the spatial, temporal, and thematic boundaries of the assessment. It considers relevant ecosystems, social groups, and contexts, ensuring alignment with the overall objectives and preparing the ground for identifying impacts and dependencies.	Boundaries should be informed by and aligned with the previously identified objective(s) as well as relevant impacts and dependencies (cf. "Identify question/ theme/ objective" and "Identify relevant impacts and dependencies"), and may be refined iteratively as the assessment progresses. This step involves identifying and explaining the limits and interactions within a specific system or study, as well as reflecting on the broader social, economic, and cultural contexts that shape		Boundaries are set: Spatially focusing on the company's owned farmlands and immediately surrounding habitats (hedgerows, stream catchment) in the region, and temporally focusing on current state with view toward the next 5–10 years. Ecosystem extent, condition as well as services will be assessed. However, due to system accounting						
Design	Design alignment		This step defines expected outcomes for each part of the assessment and begins shaping a strategy for how results will be used. It explores opportunities for policy alignment	This step involves identifying the main goals and expected outcomes of each relevant component of the ecosystem assessment, such as ecosystem types and extent, ecosystem condition, and ecosystem services. It entails breaking down the overarching objectives (cf. "Identify question/ theme/ objective") into actionable targets and		The intended use of the results is outlined early on, for example, to inform adjustments in land-use strategies, support alignment with corporate sustainability objectives and alignment with relevant EU policies (like common						
	Design ecosystem type(s) and extent assessment	Select suitable methods	Select appropriate methods to classify, map, and account for ecosystem types and extent, including uncertainty analysis and scenario development if relevant.	This step includes the identification and selection of appropriate methods for the assessment, mapping and accounting (if applicable) of ecosystem types and extent. The step should involve designing relevant uncertainty assessments and could (if applicable) include the development of scenario assessments.		It is decided how to characterize and map the relevant ecosystem types. The following customized land cover type classification will be used: Cropland, flower strips, hedgerows, woodland, and a stream. Field mapping and GIS-based land classification will be used to delineate ecosystem types.						
		Select suitable indicators	Identify indicators that support the classification and measurement of ecosystem types and their spatial extent within the assessment area.	This step involves identifying and selecting relevant indicators to characterize and classify different ecosystem types and their spatial extent. Indicators should allow for a reliable classification, delineation, and quantification of ecosystems within the defined assessment boundaries.		The following indicators will be used in the process: CORINE land use classes; Floral species count; Canopy cover. Note: Scientific consultants are involved.						
		Collect data	Gather spatial data to map and measure ecosystem types and their extent, using consistent and reliable sources like satellite data or land cover maps.	This step involves gathering and compiling spatial and attribute data to support the identification, assessment, mapping and accounting (if applicable) of ecosystem types. Data may come from various sources such as land cover databases, remote sensing and national mapping inventories. The collection should also consider the collection of all relevant metadata.		Existing spatial datasets (CORINE), the results of field mapping campaigns, and drone imagery will be used. Note: Scientific consultants are involved.						
	Design ecosystem condition assessment	Select suitable methods	Select appropriate methods to quantify, map, and (if applicable) account for ecosystem condition, including options for setting reference levels to compare against ideal or baseline states. Consider uncertainty and	This step includes the identification and selection of appropriate methods for the quantification, mapping and accounting (if applicable) of ecosystem condition. Methods should be chosen based on their ability to capture the structural, functional and compositional aspects of ecosystem condition that are relevant to the assessment objective. Depending on data availability (cf. "Collect data") , methods can include field		Soil sampling, field measurements and GIS analysis will be executed in order to assess ecosystem condition. Note: Scientific consultants and agricultural advisors are involved.						
		Select suitable *variables*	Choose ecologically relevant variables that reflect ecosystem condition, support change detection, and—where appropriate—can be compared to reference levels for integration into standardised condition assessments.	This step involves identifying and selecting relevant variables to assess ecosystem condition, in line with the assessment's objectives and spatial boundaries. Variables should be amongst other scientifically valid, relevant, have a directional meaning, sensitive to human influence, reliable, available, ideally comparable and comprehensive for assessing ecosystem condition (Czúcz et al. 2020). When		The following ecosystem condition variables will be assessed (listed per class) - Physical condition - soil condition: Bulk density; Chemical condition: Soil organic carbon content; Structural condition: Density of semi-natural area and landscape connectivity; Structural condition: Small Woody						
		Collect data	Collect ecological data to assess ecosystem health, using sources like monitoring networks, satellite imagery, or existing databases.	This step involves gathering and compiling data to support the quantification, mapping and accounting (if applicable) of ecosystem condition. Data may come from diverse sources, such as field monitoring, national or global databases, remote sensing, modelling outputs, or scientific literature. The collection should also consider the collection of all relevant metadata.		In-house scientists and contracted ecologists will collect data through seasonal field campaigns (Bulk density; Soil organic carbon content). Farmers will contribute local observations. Available spatially explicit data from e.g. the Copernicus Land Monitoring Service and the EU JRC European Soil Data						
	Design ecosystem service(s) assessment	Select suitable methods	Select suitable methods to quantify, map, and value ecosystem services, considering both qualitative and quantitative approaches, uncertainty, and scenarios if relevant.	This step includes the identification and selection of appropriate methods for the quantification, mapping and accounting (biophysical as well as monetary) (if applicable) of ecosystem service(s). The methods should correspond to the specific ecosystem service(s) in question and to the biophysical, socio-economic, or cultural dimensions to be assessed. These methods can be of a quantitative or qualitative		The following methods will be applied per ES: Pollination (Field measurements and field mapping; GIS-based landscape analysis); Crop production (GIS-based landscape analysis (incl. drone mapping), farmer surveys); Landscape aesthetics (participatory mapping, community						
		Select suitable indicators	Select indicators to measure ecosystem services in a way that fits the assessment's goals. These can be quantitative or qualitative.	This step involves identifying and selecting relevant indicators to assess ecosystem service(s). Indicators should be scientifically valid, easily measurable, sensitive, applicable at spatial and temporal scales, reliable and interpretable for assessing ecosystem service(s). Indicators should reflect both ecological and socio-economic dimensions where appropriate. Indicators can be of quantitative or qualitative nature.		The following indicators will be assessed in the process per ES: Pollination (Pollinator Species Richness as Number of pollinator species; Pollinator Abundance as Number of individuals per species; Visitation Rate to Flowers); Crop production (Biomass production); Landscape aesthetics						

		Collect data	Collect data on the services ecosystems provide using environmental, economic, or social sources.	This step involves gathering and compiling data to support the quantification, mapping and accounting (if applicable) of ecosystem service(s). Depending on the type of service and selected indicators, data may include biophysical (e.g. crop yield, water retention), economic (e.g. market prices), or socio-cultural information (e.g. surveys, participatory mapping). Sources can include statistical agencies, remote sensing products, scientific		The following data (sources) will be used per ES: Pollination (Ecosystem extent data; Field measurements); Crop production (Ecosystem extent data; drone data; company and farmers' databases); Landscape aesthetics (data developed in workshops through participatory							
Assess	Assess ecosystem type(s) and extent	Map ecosystem type(s)	Create spatial maps that show where different ecosystem types are located, based on collected data and classification rules.	This step involves spatially delineating and characterizing different ecosystem types within the study area using mapping and geospatial techniques and the collected data (cf. "Design ecosystem type(s) and extent assessment"). It entails identifying and classifying ecosystems based on their unique relevant biophysical characteristics. It provides valuable information on the spatial patterns, connectivity, and diversity of		Using the collected land cover data, maps of the farm landscape are produced showing fields (cropland), hedgerow networks, and water bodies. These maps visually highlight features like where (semi-)natural habitats intersect with croplands. The maps will be used as foundation within the							
		Account for (changes in) ecosystem type(s)	Measure the size of each ecosystem type and how it has changed over time, using accounting standards where applicable	This step involves using standardized ecosystem accounting **(!, see comment in cell C24)** methodologies to delineate the boundaries of ecosystems, providing a systematic framework for accounting for (changes in) ecosystem types/ their extent. This step specifically centers on quantifying the overall extent of ecosystems. Aligning with SEEA EA, this step supports tracking gains and losses in ecosystem extent and is essential for		*Irrelevant, as the assessment does not include ecosystem accounting approaches.*							
	Assess ecosystem condition	Quantify ecosystem condition (variables/ indicators)	Calculate the condition indicators to understand how well ecosystems are functioning or structured.	This step involves quantifying the condition of ecosystems using a variety of measurement, modelling, and assessment approaches, selected variables, based upon the collected data (cf. "Design ecosystem condition assessment"). Where required, the data are transformed using reference levels and rescaling techniques. Also, aggregated or composite indicators can be compiled. The step should involve relevant uncertainty	In some cases, the quantification and the mapping of ecosystem condition is executed in one step/ simultaneously.	The condition of the ecosystems is assessed based upon the methods, indicators and data outlined in the "Design ecosystem condition assessment" step. The soil data reveal, for instance, that some fields have moderate organic matter whereas others are depleted. Information is displayed e.g.							
		Map ecosystem condition (variables/ indicators)	Make maps to show how the condition of ecosystems varies across the landscape.	This step involves spatially visualizing the condition of ecosystems using maps and geospatial techniques. Each variable or indicator as well composite indicator (cf. "Quantify ecosystem condition") can be mapped across the assessment area, providing insights into localised differences in ecosystem condition. It provides valuable insights into spatial patterns, trends, and drivers of ecosystem change, enabling informed	In some cases, the quantification and the mapping of ecosystem condition is executed in one step/ simultaneously.	Maps are produced highlighting the spatial distribution of the assessed condition variables. This spatial depiction helps pinpoint problem areas (e.g. a section of farmland with poor soil condition).							
		Account for (changes in) ecosystem condition (variables/ indicators)	Record how ecosystem condition has changed over time in a structured account.	This step involves using standardized ecosystem accounting **(!, see comment in cell C27)** methodologies, providing a systematic framework for accounting for (changes in) ecosystem condition building on the results of the previous steps (cf. "Quantify ecosystem condition" and "Map ecosystem condition"). The step should involve relevant uncertainty assessments and could (if applicable) include scenario		*Irrelevant, as the assessment does not include ecosystem accounting approaches.*							
	Assess ecosystem service(s)	Evaluate ecosystem service(s) (indicators)	Assess ecosystem service indicators using quantitative or qualitative methods across biophysical, socio-cultural, and economic dimensions.	This step involves the quantitative and qualitative assessment of ecosystem service(s) (indicators). It encompasses measurement, modelling and further assessment approaches from the biophysical, socio-cultural and/ or economic domain (cf. "Design ecosystem service(s) assessment"). The step should involve relevant uncertainty assessments and could (if applicable) include scenario assessments. This step involves	In some cases, the evaluation and the mapping of ecosystem services is executed in one step/ simultaneously.	The ecosystem services are evaluated using the ecosystem condition findings (cf. "Assess ecosystem condition") in combination with additional collected data through the prior selected ecosystem service(s) assessment methods (cf. "Design ecosystem service(s) assessment"). Ecosystem							
		Map ecosystem service(s) (indicators)	Map ecosystem service indicators to show their distribution, intensity, and variation across the landscape.	This step includes the spatial visualisation of the assessd ecosystem service indicators (cf. "Evaluate ecosystem service(s)") across the landscape. Mapping allows for the visualisation of the distribution, magnitude, and spatial variability of ecosystem services, helping to identify e.g. areas of high provision, scarcity, or pressure. Results from biophysical, socio-cultural, and economic assessments—often expressed in	In some cases, the evaluation and the mapping of ecosystem services is executed in one step/ simultaneously.	If applicable, results are spatially visualized. For example, a map overlays the ecosystem extent map with pollination services, showing higher pollination in fields adjacent to abundant hedgerows versus lower in isolated fields.							
		Account for (changes in) ecosystem service(s) (indicators)	Record how the value or quantity of ecosystem services has changed over time in ecosystem accounts.	This step involves using standardized ecosystem accounting **(!, see comment in cell C30)** methodologies, providing a systematic framework for accounting for (changes in) ecosystem service(s) building on the results of the previous steps (cf. "Evaluate ecosystem service(s)" and "Map ecosystem service(s)"). Accounts may include physical flows (e.g. tonnes of carbon sequestered) and/or monetary values. The step should		*Irrelevant, as the assessment does not include ecosystem accounting approaches.*							
Share	Interpret results and develop solutions	Synthesise results	This step brings together all assessment results to reveal connections, trade-offs, and key insights across the diverse components of the assessment, supporting a holistic understanding.	This step involves integrating and synthesising the findings from the various previous components of the ecosystem assessment (cf. "Assess"). It aims to connect insights from the assessment of ecosystem types and extent, condition, and services in order to reveal interactions, synergies, and trade-offs. The aim is to support a holistic understanding of ecosystem dynamics and the socio-ecological system. Synthesising		The company interprets the findings to understand implications. They realize, for example, that fields with poor soil correspond to lower yields and that those fields also have fewer nearby pollinator habitats.							
		Evaluate impacts and dependencies	This step builds on earlier findings to re-examine how actions depend on or impact ecosystems. It clarifies the related risks and opportunities, helping to identify which issues are most important for decision-making and	This step involves revisiting and deepening the understanding of the ecosystem-related impacts and dependencies identified earlier in the process (cf. "Identify relevant impacts and dependencies"). Building on the integrated assessment results (cf. "Assess" and "Synthesise results"), it aims to better understand how (societal) actions rely on or affect ecosystems (i.e. their extent, condition and service(s)) (aka the		The company revisits the initial impacts and dependencies identified, now backed by data. They evaluate how their operations have impacted ecosystems (e.g. finding, for example, that intensive tillage caused lower soil quality in specific fields) and how much they depend on those							
		Develop solutions or recommendations	This step identifies pathways forward by proposing actionable, stakeholder-informed solutions that reflect the assessment's purpose and insights.	Informed by the previous steps, this step focuses on identifying pathways forward. It involves proposing and designing possible solutions or recommendations that align with the inital purpose of the assessment, potentially addressing the impacts and dependencies (cf. "Evaluate impacts and dependencies") and aiming at mitigating the risks or capitalizing on the opportunities uncovered. The developed solutions/		The prior interpretation leads to the development of potential solutions: e.g. planting cover crops or adding compost in low-organic-matter fields, and establishing flower strips or additional hedgerows in areas lacking pollinator habitat. In essence, the results are used to formulate							
	Elaborate results stakeholder-specifically		Tailor and present the assessment results to different stakeholders, including evidence-based options for decision-making.	This step involves presenting and interpreting the results of the ecosystem assessment and the developed solutions and recommendations (cf. "Assess" and "Interpret results and develop solutions") in a way that is relevant and understandable for each stakeholder, those involved in the process and those that were not (cf. "Conduct stakeholder analysis"). Generally, the results should clearly report on the assessment		Tailored outputs are prepared for: (i) Internal management (e.g. (sustainability) reports and dashboards); (ii) Public authorities and agencies (compliance-focused reports); (iii) Suppliers and partners (visual maps and diagrams highlighting benefits from ecosystem investments); (iv) Local							
	Disseminate and communicate results		This step ensures transparent sharing of assessment results with different audiences, using suitable formats and channels to support understanding, awareness, and engagement.	This step involves making the ecosystem assessment results (incl. uncertainties and limitations) (cf. "Assess, "Interpret results and develop solutions" and "Elaborate results stakeholder-specifically") transparently available and visible to diverse audiances, such as the scientific community, policy makers, industry and the general public. This involves selecting appropriate communication formats (e.g. policy briefs, maps,		The tailored outputs (in multiple formats: e.g. reports, story maps, public infographics, etc.) are disseminated using a variety of channels such as internal newsletters and strategy meetings, local stakeholder meetings and workshops. Communication emphasized not just findings from the							
	Disclose		Unlike the "Disseminate and communicate results" step, "Disclose" often follows formal, standardised reporting formats, which can be subject to public/audit scrutiny. Disclosure can both be mandatory (CSRD for some	This step refers to disclosing, the voluntary or required/statutory public release of any information relevant to a company, security, fund or any third party. In financial accounting, disclosure refers to a statutory or good faith revelation of a material fact (or an item of information that is not generally known) on a financial statement or in the accompanying notes (footnotes). Biodiversity disclosures refer to the voluntary or		Annual Sustainability Report: The company prepares and publicly releases an annual report detailing key biodiversity metrics, impacts on local ecosystems, actions taken to mitigate negative impacts, and performance against sustainability targets.							
Act	Adopt results (in public and private decision-making)		This step focuses on integrating the assessment results into relevant policy, planning, and management processes to support better decisions across sectors.	This step involves the uptake and integration of the results, in particular the developed solutions and recommendations (cf. "Develop solutions or recommendations") of the ecosystem assessment into the relevant decision-making, management or policy processes, potentially catalyzing transformative change. This can include the incorporation of results into amongst others local, regional, or national planning		The company's leadership adopts the assessment's recommendations into their decision-making. For example, they update the corporate farming policy to include ecosystem-based targets (such as minimum soil condition standards and habitat conservation objectives) and integrate							
	Implement		This step puts the assessment-informed strategies into action, ensuring delivery on the ground. It includes planning, resourcing, and coordinating implementation efforts.	This step involves executing the actions, policies, or strategies that were informed by the assessment (cf. "Adopt results (in public and private decision-making)") —such as land-use changes, restoration measures, conservation programs, or business operations. Implementation may occur through government plans, private sector initiatives, or multi-stakeholder partnerships. It might require translating assessment		The recommended actions are put into practice on the ground. The farm managers begin altering practices – e.g. planting cover crops in off-season to protect and enrich soil, and establishing new hedgerows or wildflower strips to boost pollinators. These implementation steps turn the							
	Monitor and evaluate		This step tracks the direct progress and outcomes of the ecosystem assessment as well as actions informed by the assessment. It checks whether objectives are being met, identifies needs for adaptation, and may lead	This step focuses on tracking progress and evaluating the effectiveness of actions taken based on the ecosystem assessment (cf. "Implement"). Evaluation considers whether intended objectives have been met, and how well the implemented measures have addressed the identified impacts and dependencies, as well as risks and opportunities. Monitoring and evaluation also support adaptive management: Insights from observed		The company sets up a monitoring program to track the outcomes of the actions. E.g. Soil indicators will be measured annually to see if improvements occur. The local community is regularly consulted to assess whether they experience changes in ES. The company also evaluate the effectiveness							
# Continuous improvement/ adaptive + iterating process				Iterate and improve the process, balance relevance, robustness and resources		*The assessment process itself is reviewed for learning. The*							

Annex B

Framework for Integrated Ecosystem Assessment (FIEA)

Application by WP09 Demonstration Projects



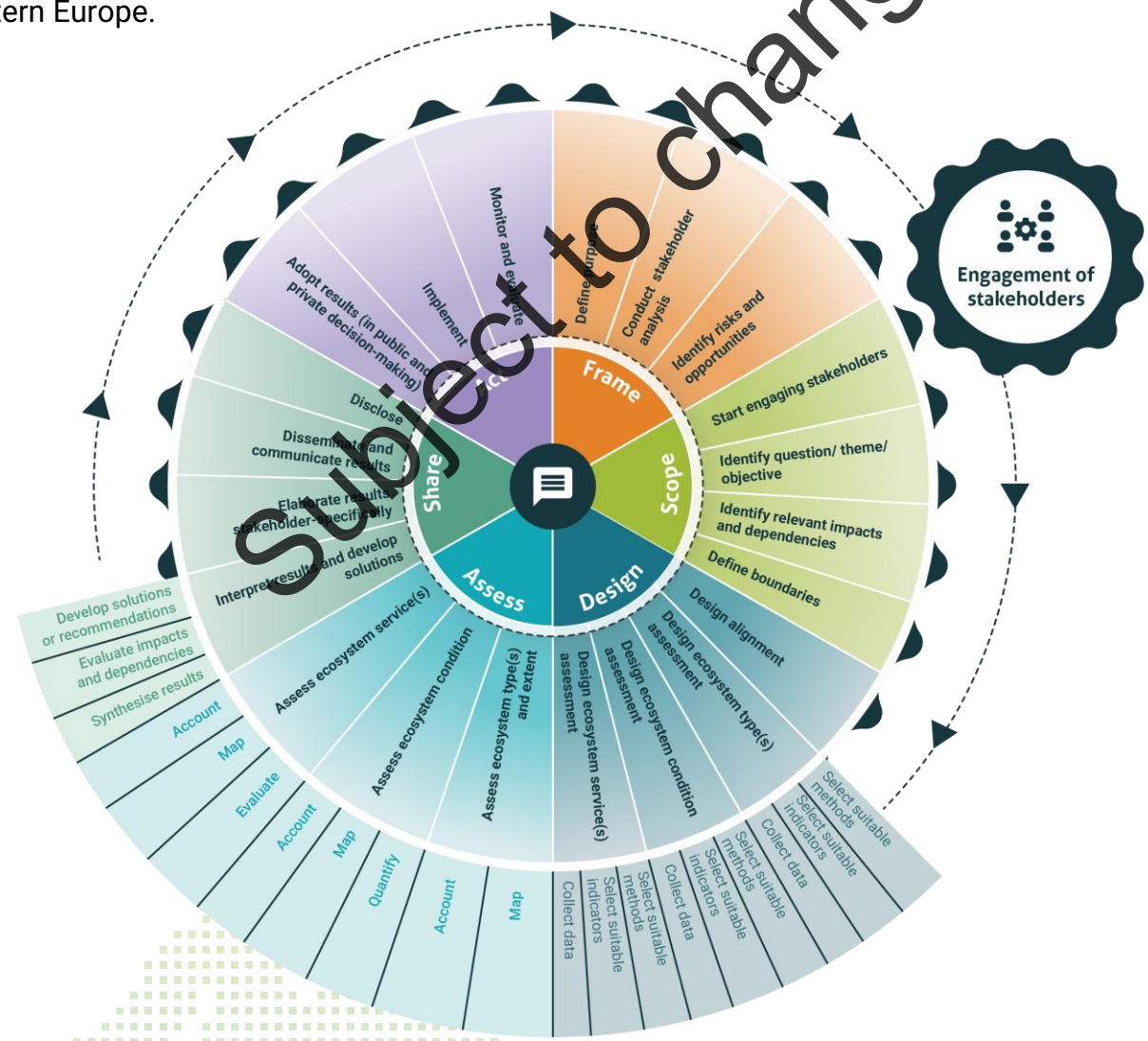
Framework for Integrated Ecosystem Assessment (FIEA)

Implementation in SELINA Demonstration Project (DP) 08

Integration of Urban Heat Islands and ecosystem services in urban and spatial planning

Location **Bulgaria** | **Sector** Urban Planning & Construction

The project contributes to local climate regulation, more specifically by studying, mapping, and assessment of the effects of urban heat island in the city of Sofia and the development of innovative analytic tools. The outcomes will be scalable to similar cities in Bulgaria and Eastern Europe.



FIEA		DP Implementation
Frame	Define purpose	To provide evidence on how urban ecosystems mapping can be applied in urban planning, especially by the private sector. The purpose is to provide better tools for more informed decisions and to integrate the issues of Urban Heat Islands (UHI) and ecosystem services in general into the urban planning processes. More specifically, the application will support the risk assessment of UHI effects and estimate the potential impacts. The expected results will be at the local (city) scale, and the specific solutions will be for the particular city. However, the recommendations will be valid for all cities in Bulgaria which have similar heat problems, e.g. general solutions could be provided at a national scale. Some of the solutions could also be upscaled to Eastern European urban areas.
	Conduct stakeholder analysis	Main stakeholders identified: - **Sofiaplan** (municipal enterprise) - high-level spatial and strategic planning of the Sofia Municipality, implementing ES in legislation and developing Sofia's plans for urban development) - **Local government** - **Sofia Municipality** - implementation of the strategic plans developed by Sofiaplan - **Burgas Municipality** - **Spatial and urban planners** - Sofiaplan - **NGOs** (More concrete planning needed - we are intending to organize workshops, dedicated to UHI and possible ecosystem based solutions for cooling the urban environment.)
	Identify risks and opportunities	**Risks:** - Increased average maximum temperature and temperature anomalies (with high temperatures), which led to a clear trend in heat waves after 2007.- In parallel, there are increased anomalies in the rainfall quantities, leading to potential risk for pluvial floods. **Opportunities**: The adaptation mechanisms require capacity building within the local communities. This coordination takes a long time, which could be used for applying, developing, and implementing the adaptation measures. Once adaptation measures are applied, the urban population will benefit from implemented solutions. **Further risks:** - ES are not included in the legislation.- The methodological framework for mapping and assessing the ecosystems and their services is still in preparation.The main barrier is that ES are currently not or barely included in spatial planning systems, including in the methodological guidelines. The main entry points of the inclusion of ES in legislation are connected with their implementation in the local tax system, as part of already existing taxes, and with the development of a new one. These are insights from our discussion with Sofiaplan.The postponement of preparing and publishing the methodological framework for mapping and assessing ecosystems and their services for Sofia Municipality is another barrier to ES evidence uptake, as the implementation is also being delayed. **Further opportunities:** - DP's stakeholders, as part of the Community of Practice (CoP), participate in the Bulgarian CoP.

Scope	Start engaging stakeholders	DP's stakeholders, as part of the SELINA Community of Practice (CoP), participate in the Bulgarian CoP and are therefore engaged on a continuous basis.
	Identify question/ theme/ objective	To develop an innovative analytic tool for supporting the decision-making processes in urban and spatial planning (to make more informed decisions on urban design and planning to mitigate for urban heat islands). The resulting information will be delivered to the decision-makers through a GIS-based application. 1. Develop the methodology for the mapping and assessment of the ecosystem service of regulation of temperature and humidity, including ventilation and transpiration (2.2.6.2, CICES 5.1). 2. Analyse the effects of the urban heat island in the city of Sofia. 3. Provide a better urban mapping methodology.
	Identify relevant impacts and dependencies	**Impacts:** The spatial planning of the neighbourhood does not fully take into account the local geographical characteristics (e.g., prevailing wind direction), which might negatively impact the natural ventilation and cooling potential of urban spaces. Urban spatial planning so far frequently overlooks local biophysical and geographical characteristics, leading to the disruption of natural microclimatic regulatory processes. This misalignment results in the functional attenuation of urban ecosystems, reducing the capacity of ecosystems to provide essential local climate regulation. **Dependencies:** The city of Sofia is heavily dependent on Local Climate Regulation, specifically the regulation of temperature and humidity provided by urban vegetation to maintain habitable conditions during heat waves. The measures for adaptation proposed from the Local Climate Adaptation Plan through a Digital Twin (2023, in Bulgarian) can have a positive effect on the case study: 1. Proposed green area through reducing absorption and reemission of heat 2. Reducing the risk of pluvial flood through increasing the absorption capacity and reducing the runoff 3. Reducing the heat-related diseases.
	Define boundaries	- Spatial Scale: Local to regional (The results are at the local city scale, and the specific solutions are for the Lyulin district of the city of Sofia) - Environmental Topics: Urban Heat islands - Broad ecosystem types: Urban - Key ES: Local Climate regulation (Regulation of temperature and humidity, including ventilation and transpiration, CICES 2.2.6.2) - ES relevant in urban and spatial planning, relevant for the private sector, specifically businesses that deal with spatial data through GIS-based applications. - Focus on urban heat island effects and impacts on climate change adaptation of the urban environment

Design	Design alignment		- Identified end users are private companies working with spatial data. Developed tools aim to integrate issues of UHI and ecosystem services in general into decision-making and urban planning processes. - The recommendations will be valid for all cities in Bulgaria which have similar heat problems, e.g. general solutions could be provided at a national scale. Some of the solutions could also be upscaled to Eastern European urban areas. - The outcome will be related to the local climate regulation, assessing the effects of UHI.
	Design ecosystem type(s) assessment	• Select suitable methods • Collect data	**Methods** - The proposed approach integrates data from UAS with the concept of Local Climate Zones, which will be an innovation for the mapping and assessment of urban ecosystems.The study is based on an integrated approach using thermal photogrammetry and standard geospatial processing and analysis methods. **Collect data** - Indicators: Characteristics and geometry of the urban morphology; spatial configuration and quantitative parameterisation of land cover. - The high resolution data is collected by the DP itself (geospatial datasets; Local Climate Zones; climate projection datasets) (Local Climate Adaptation Plan through a Digital Twin 2023; Dimitrov et al. 2024a, 2024b).
	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	**Methods** The study is based on a detailed digital twin of the Lyulin residential district, which was generated through the integrated use of various geospatial technologies, including: - Digital 3D photogrammetry based on an unmanned aerial system, which provided the opportunity for comprehensive mapping with high spatial resolution of the complex's territory, which subsequently allowed the generation of information about the characteristics and geometry of the urban morphology, the nature, spatial configuration and quantitative parameterisation of land cover, investigation of the problems of different types of spaces, etc. Thermal photogrammetry, which provided digital models enabling the precise determination of the thermal load of the different types of land cover, the objects within the territory of the complex, as well as their elements; - Laser scanning, enabling the specification and characteristics of the geographical features of the urbanized space to be detailed;- A specialized GIS application that provides integration capabilities for the collected geoinformation data with other geoinformation resources. **Collect data** - Suitable variables: Thermal load of different land-use-land-cover types; urban heat island (UHI) magnitude. - Data from the digital 3D photogrammetry, thermal photogrammetry and laser scanning
	Design ecosystem service(s) assessment	• Select suitable methods • Select suitable indicators • Collect data	**Methods** - Regulation of temperature and humidity, including ventilation and transpiration, CICES 2.2.6.2: digital 3D photogrammetry; thermal photogrammetry; laser scanning; GIS-based modelling; statistical analyses **Collect data** - Data from digital 3D photogrammetry, thermal photogrammetry, laser scanning, GIS-based modelling, and statistical analyses (Local Climate Adaptation Plan through a Digital Twin 2023; Dimitrov et al. 2024a, 2024b)

FIEA			DP Implementation
Assess	Assess ecosystem type(s) and extent	• Map • Account	The current extent of each ecosystem is assessed, and the case study is 5.7 sq.km., in which about 60% of the territory is designated for long-term use for building, while 25% of the territory is designated for transport infrastructure.
	Assess ecosystem condition	• Quantify • Map • Account	The condition of the ecosystems is assessed based upon the methods, indicators and data outlined in the "Design ecosystem condition assessment" step. Maps are produced highlighting the spatial distribution of the assessed condition variables (UHI magnitude, thermal load). This spatial depiction helps pinpoint problem areas (e.g. areas with high UHI intensity).
	Assess ecosystem service(s)	• Evaluate • Map • Account	The ES is analyzed with the collected data. The climate regulation is assessed by the model of local urban heat islands (UHI) intensity for the Lyulin neighbourhood. Maps are produced highlighting the spatial distribution of the climate (UHI intensity, Fig. 39). This spatial depiction helps pinpoint problem areas (e.g. areas with high UHI intensity risk, Fig. 40).
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	The Local Climate Adaptation Plan through a Digital Twin (2023, in Bulgarian) was publicly introduced to residents. It targets Sofia's largest residential area, Lyulin, and applies the toolkit developed within this DP. The Plan presents results from the analytical component (LCAP 2023, 57–61) and outlines potential solutions as its strategic component (LCAP 2023, 88–93). Existing spatial planning decisions obstruct key biophysical processes that support essential ecosystem services, including local climate regulation. The evaluation highlights the city's strong dependence on green infrastructure to reduce urban heat island (UHI) effects and heat-related illnesses, and on unsealed soils to lower pluvial flood risk. Key implementation risks include potential changes in municipal administration disrupting collaboration and limited administrative capacity. Effective climate adaptation for this highly vulnerable region requires a focused strategy with targeted measures across all urban sectors and spatial scales. The Plan includes: (1) short-term or rapid/temporary nature-based solutions (pocket parks, mobile forests, green parking using mobile structures, and mobile green cooling corridors and islands); and (2) long-term, comprehensive solutions (urban parks, green roofs and walls, permeable pavements, rain gardens, and floodplain restoration).

Share	Elaborate results stakeholder-specifically	The methodology and tools developed within the DP are also applied in education related to climate change and adaptation. Specifically, they were used in an initiative of the in a workshop entitled "Stakeholder Challenge," dedicated to the adaptation of cities to climate change and the urban heat island effect through nature-based solutions. Over 50 participants, students, researchers, lecturers, representatives of institutions and companies took part in a series of practical and discussion events based on the concept and methodology developed in the current DP. Divided into 5 international teams, the students were introduced to the format of the challenge and attended a lecture on "Adapting to climate change through the concept of smart cities and transformative geography." The program also included practical training in GIS and fieldwork in a selected urban area, during which participants collected geospatial data. On this basis, the students worked on a specific case study from the Lyulin neighborhood, where they had to propose nature-based solutions using collected and analyzed geodata related to the problem of the "urban heat island.
	Disseminate and communicate	Outputs are published on the Sofia Municipality website, also presented in town hall meetings, and shared through local media (Sofia Municipality).A student competition (T4EU 2025) was organised with the support of the Sofia Municipality, which decided on the thematic focus: Climate change and European cities: Adaptation to urban heat island effect and nature-based solutions.
	Disclose	N/A
Act	Adopt results (in public and private decision-making)	To help Sofia's urban areas adapt to climate change, a Local Climate Adaptation Plan through a Digital Twin (2023) has been developed for the city's largest residential area, Lyulin.The tool has been implemented in the Climate Atlas developed by the Burgas Municipality (2025). It is part of the Regions4Climate project, funded under the Horizon Europe program.
	Implement	The implementation stage is stil ongoing.
	Monitor and evaluate	Monitoring and avalution procedure is still in preparation.

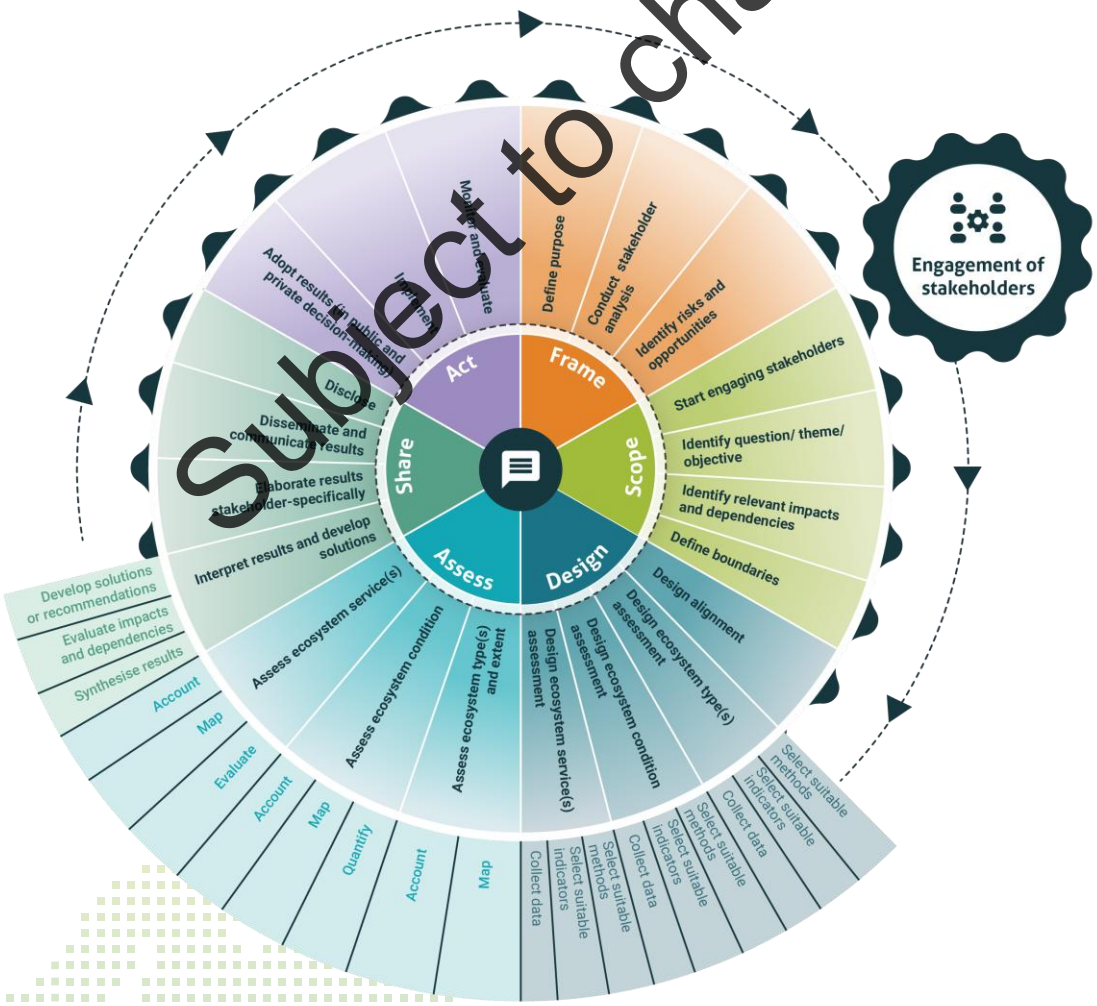
Framework for Integrated Ecosystem Assessment (FIEA)

Implementation in SELINA Demonstration Project (DP) 09

Integration of public-private ecosystem services knowledge in urban planning & design using 'digital twins'

Location **Norway** | **Sector** Urban Planning & Construction

The Digital Twin provide a powerful tool for analyzing and planning ecosystem services such as carbon storage, stormwater management, and urban nature planning. By developing a digital twin, the project aims to enhance decision-making, promote data sharing, and boost community engagement for sustainable, transparent urban design and ecosystem services in Grønlikaia.



FIEA		DP Implementation
Frame	Define purpose	The main purpose for private decision-makers is to calculate BlueGreen factor (BGF) efficiently in order to track performance and meet regulatory requirements.
	Conduct stakeholder analysis	Involvement and engagement from high level stakeholders in private companies is crucial to achieve a sense of ownership to the process and the final result. It will be useful to identify stakeholders on a higher level (such as sustainability manager) as the ones in charge of calculating BGF are often landscape architects or architects. All groups with relevant data for BGF calculations were identified as stakeholders.
	Identify risks and opportunities	Key risk for private companies is failure to comply with regulatory requirements or having to adjust the development project at a late stage to comply. Key benefits are increased awareness of ES and sustainability measures in their project, as well as motivation to overperform and include more than just necessary.
Scope	Start engaging stakeholders	All stakeholders needed to provide data must be engaged first. These stakeholders produce a one page "fact sheet" about their tasks, their needs from the digital twin and commit to their deliverables in to the digital twin. Once the first results of analyses are ready the higher level stakeholders were informed. The municipal stakeholders can be informed with the ongoing process to show progress in achieving the regulatory requirements.
	Identify question/ theme/ objective	Key objective will be to calculate BGF efficiently and comply with regulations using a digital twin of the project. Yet, there can be other objectives such as overperformance or complying with even stricter certifications.
	Identify relevant impacts and dependencies	The BGF measures are related to ES and by raising awareness of ES and EC the private companies typically choose to use the BGF measures as an opportunity to provide a better ES or EC than just the measure itself.
	Define boundaries	Typically the spatial boundaries are defined by the project boundaries or zoning permit, but the adjacent areas can both have influence on BGF measures. Inclusion of an influence area outside the project boundaries are necessary. Temporal boundaries are limited to approval from municipality to propose a new detailed zoning plan based on achievement of BGF minimum value for the project.

Design	Design alignment		BGF calculations must be carried out using the correct set of measures and factors. Each municipality may define its own criteria, and different areas within the municipality can have varying requirements or threshold values for the final result. Ensuring compliance with the applicable municipal guidelines and requirements is therefore essential. The main goals are to calculate BGF rapidly and to start calculations earlier in the development process. This will inform the project management of the status on compliance with regulatory requirements, and finally inform the municipality of BGF achievement.
	Design ecosystem type(s) assessment	• Select suitable methods • Collect data	**The measures in BGF are divided into 10 categories** (unofficial translation from Norwegian): Vegetation and water management, Green terrain, Green roof, Green wall, Rainbed, water surface and wetlands, Terrain countersinking, Partially open surface, Closed surface, Existing trees and New trees. All measures are listed here: Physical expansion of existing blue green structure, Restoration or creation of new habitat for biodiversity, Collection of run-off for irrigation and other re-use, Coordination of measures with adjacent areas, Re-opening covered streams and rivers, Green terrain - General, Green terrain - Existing bushes (<2m), Green terrain - New bushes (<2m), Green terrain - Existing ground layer, Green terrain - New ground layer, Green roof - General, Green roof - Depth growth medium ≥ 80 cm, Green roof - Depth growth medium 40–80 cm, Green roof - Depth growth medium 10–39 cm, Green roof - Depth growth medium 3–9 cm, Green wall - General, Green wall - Plant wall and vertical urban land use, Green wall - Climbing plants, Rainbed, water surface and wetlands - General, Terrain countersinking - General, Partially open surface - General, Partially open surface - Permeable green surface, Partially open surface - Semi-permeable grey surface, Partially open surface - Partially permeable grey surface, Closed surface - General, Existing trees - Very big trees (circumference > 200 cm), Existing trees - Big trees (circumference 90–200 cm), Existing trees - Small trees (circumference > 90 cm), New trees - Big trees (future height +10 meter), and New trees - Small trees (future height <10 meter). The scale of most projects allows for in situ data collection of present-day situation by manual mapping on the ground. Traditional remote sensing from satellites typically have too low resolution for the level of detail needed. Drone imagery from lower altitudes processed as orthophoto or RGB LIDAR may be used for support.
	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	N/A
	Design ecosystem service(s) assessment	• Select suitable methods • Select suitable indicators • Collect data	The BGF measures are only associated with ES and not a measure of ES as such. The measures are directly linked to each planned surface of the development project. This makes mapping and quantification fairly easy.Sometimes the initial BGF is calculated prior to development of an area. In these cases we need to map and quantify the entire area and link each surface to a BGF-measure. Each BGF measure has an associated ES given in the BGF instructions. Even though they are not ES as such, each surface of the planned development project is assigned one or more BGF measures.

FIEA			DP Implementation
Assess	Assess ecosystem type(s) and extent	• Map • Account	n order to calculate BGF we need to assign one or more measures to all surfaces of the digital twin. Once all surfaces have at least one measure we can run the automated BGF calculations. By providing a simple web map of the digital twin we allow for real-time updates and adjustments of measures. This allows for fast calculation of BGF.
	Assess ecosystem condition	• Quantify • Map • Account	N/A
	Assess ecosystem service(s)	• Evaluate • Map • Account	N/A
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	Results from BGF calculations are provided continuously throughout the planning process and provided to the project management. Final results are provided to the municipality for approval. By calculating BGF more rapidly based on digital twins the results can be incorporated in an iterative planning process where changes in the BGF results are shown in real time when changes are made to the project design. For municipalities the BGF data from developments projects provides a valuable input to larger scale natural accounting and should be harvested for future use. We are encouraging municipalities to start collecting the detailed data underlying the final BGF calculation results.Municipalities may also use these datasets to enforce maintenance of BGF measures that the developers committed to in their plans.
	Elaborate results stakeholder-specifically		N/A
	Disseminate and communicate		N/A
	Disclose		N/A
Act	Adopt results (in public and private decision-making)		This way of calculating BGF has become the de-facto standard for Asplan Viak when working with large scale development projects.
	Implement		We are implementing calculations of BGF continuously throughout the development project, so that the results can be monitored and acted upon as soon as possible.
	Monitor and evaluate		We are continuously evaluating and improving the solution for better performance and usability. At the same time we seek to re-use this approach when taking on similar tasks such as calculating nature positivity in projects.

Framework for Integrated Ecosystem Assessment (FIEA)

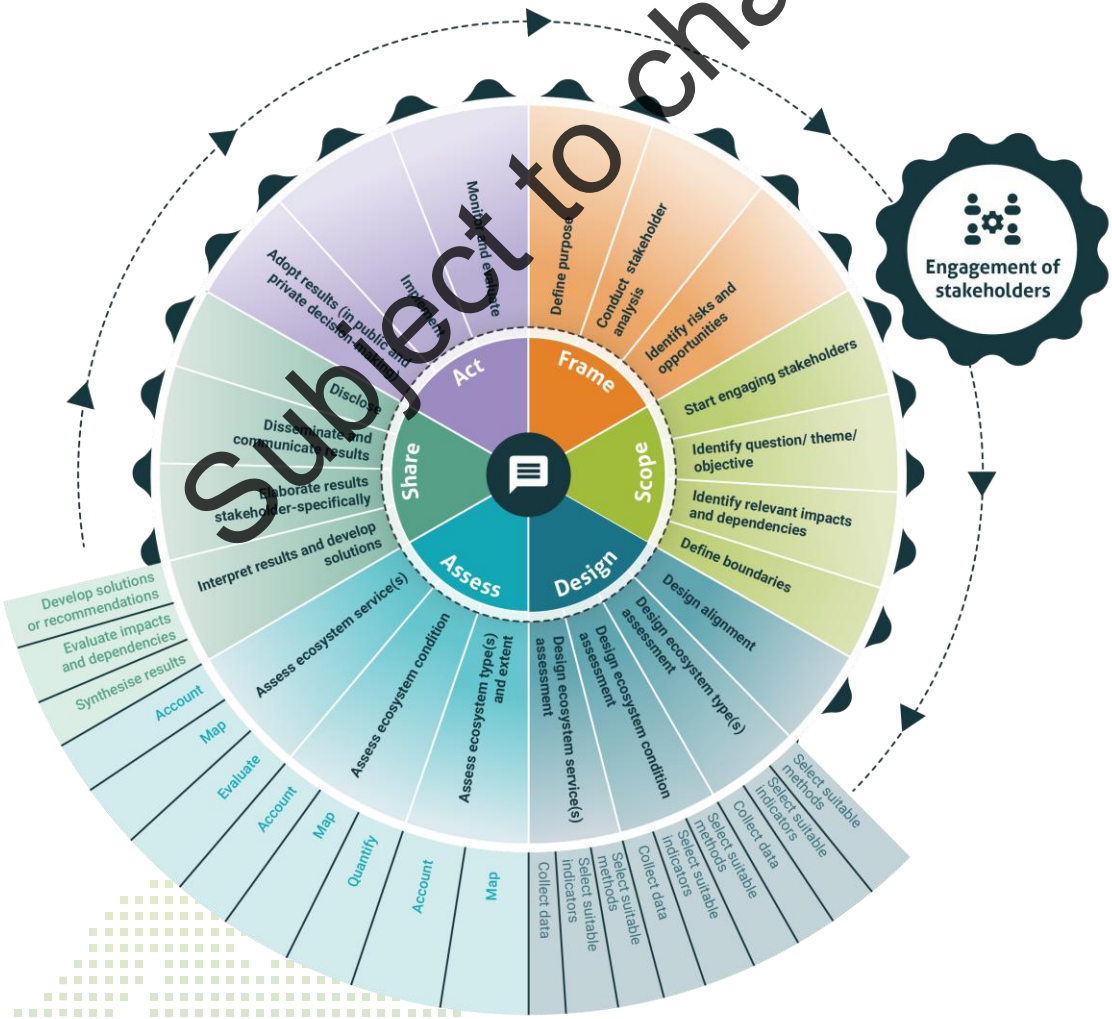
Implementation in

SELINA Demonstration Project (DP) 10

Integration of biodiversity and ecosystem services to develop nature-based tourism approaches

Location: Malta **Sector: Tourism**

The aim of DP10 is to develop a digital tool for nature-based tourism through the involvement of both businesses and tourists. The innovative approach applied provides a comprehensive, up-to-date, and dynamic understanding of Malta's natural attractions and their current conditions.



FIEA		DP Implementation
Frame	Define purpose	**The project aims to develop a prototype digital platform that integrates near-real-time environmental data with tourism activity to support nature-based tourism (NBT) activities and actions in Malta.** By combining data collection, stakeholder engagement, and user-centred analysis, the platform will inform tourists, residents, policymakers, researchers, and businesses on the recreational and ecological characteristics of locations promoting nature-based activities. The project addresses key gaps in sustainable tourism including data-driven planning, transparent access to ecosystem-relevant information, and support for adaptive, environmentally conscious decision-making.
	Conduct stakeholder analysis	We identified a diverse group of stakeholders to represent entities with a regulatory, academic, or commercial interest in nature-based tourism in Malta. To streamline further analysis and engagement, we grouped stakeholders into the following categories: • **Tourists and residents** • **Government and authorities** (Environment and Resources Authority (ERA), Malta Tourism Authority (MTA)) • **Business sector** (Local businesses offering or have interest in NBT services) • **Academia** (Researchers based in Malta, and other European countries; Open University of Cyprus (OUC)) • **Technical partners** (European Space Agency (ESA)) Potential use cases for selected stakeholders include: • **Tourists and residents** can observe NBT sites popularity over time, as well as access crowdsourced information about the site and site's conditions to make a decision regarding desire to visit. • **The Environment and Resources Authority (ERA)** is interested in evaluating the state of the environment across the Maltese Islands and to evaluate trends in time for regulation/enforcement purposes or to inform ecosystem restoration activities which have become a requirement under the EU Nature Restoration Law. • **The Malta Tourism Authority (MTA)** can explore correlations between NBT site popularity and their environmental conditions, using these insights to inform and implement new policies in the tourism sector. • **Local businesses**, particularly those offering eco-friendly products, services, or experiences, leverage the platform to identify NBT sites. • **Researchers and practitioners** in the public and private sector will be able use the application or export calculated indices for a specific timeframe to observe Maltese ecosystems and potentially incorporate that knowledge in other interdisciplinary topics.

FIEA		DP Implementation
Frame		The project involves a diverse range of stakeholders, each varying in their capacity to influence the project (power) and their level of interest or involvement. To support a targeted and effective engagement strategy, we have applied the power–interest grid to classify stakeholders. This approach enables us to prioritize interactions and allocate resources where they can have the greatest impact, while also laying the foundation for long-term collaboration. Based on this framework, stakeholders were grouped into four categories: **Manage closely** (high power - high interest): Environment and Resources Authority (ERA), Malta Tourism Authority (MTA). **Keep Informed** (low power - high interest): Local businesses, researchers, OUC, tourists and residents **Keep Satisfied** (high power - low interest): European Space Agency (ESA) **Monitor** (low power - low interest): No stakeholders have been identified in this category
	Identify risks and opportunities	**Opportunities** Below is a list of opportunities envisioned for each of the stakeholder groups involved in the development of the platform. • **Tourists and residents:** Tourists and residents can use the platform to make more informed and enjoyable visits to natural sites by combining insights on tourism trends with real-time and historical ecosystem condition data. The platform helps users identify which natural sites are currently under environmental stress and which offer high-quality, less crowded experiences encouraging more responsible travel choices. By exploring clusters of nearby natural sites and tailored itinerary suggestions based on interests like birdwatching, hiking, or swimming, tourists or residents can plan immersive, multi-site visits that align with their preferences. Historical visitation data further supports smarter planning by helping users avoid peak tourist seasons or heavily trafficked areas. Altogether, the platform empowers both locals and visitors to discover, enjoy, and care for Malta's natural heritage in a sustainable and personalized way. • **Environment and Resources Authority (ERA):** The platform prototype offers the ERA a comprehensive tool for monitoring and managing the impact of tourism on Malta's natural ecosystems, while allowing for a comparison with ecosystem conditions for less frequented areas. By analysing correlations between tourist activity and key environmental indicators,

	FIEA	DP Implementation
Frame		ERA can identify areas experiencing ecological stress and prioritize targeted interventions. The platform's ability to provide both historical and near-real-time data allows ERA to conduct baseline assessments, observe long-term trends, and detect shifts in ecosystem health. These insights support the development of evidence-based policies related to sustainable land use, access control, and tourism zoning. Furthermore, this project enables ERA to evaluate the effectiveness of implemented policies over time, fostering an adaptive management approach where regulations can be refined based on environmental outcomes and changing conditions. • **Malta Tourism Authority (MTA):** The platform provides the Malta Tourism Authority with a comprehensive data-driven tool to support the planning, management, and sustainable development of nature-based tourism across the islands. By visualizing historical and near-real-time visitor activity, identifying clusters of tourist flows, and analysing seasonal patterns, the platform helps inform strategic decisions related to marketing, site promotion, and congestion mitigation. Although qualitative feedback is not the focus at this stage, the potential future integration of crowdsourced insights and user-generated content could further aid MTA in understanding visitor preferences and satisfaction levels. The platform also supports policy evaluation by offering clear indicators of site visitation and environmental pressure, helping assess the impact of existing strategies. It facilitates evidence-based funding decisions and enables the identification of under-visited or emerging locations with strong potential for sustainable tourism growth, allowing for more balanced regional development and reduced stress on heavily visited area. • **Local businesses**: The platform provides local businesses with valuable insights into tourist behaviour at nature-based sites, allowing them to better understand where and when visitors are most active. By tracking peak periods, popular destinations, and emerging preferences, businesses can strategically time and target their marketing efforts to maximize visibility and impact. Seasonal and site-specific data also empower service providers to adapt their offerings in line with visitor demand and environmental conditions. For instance, they can promote sunrise tours during peak summer months or shift to quieter, off-season experiences in line with changing trends. Additionally, the platform highlights less frequented but increasingly popular NBT areas, enabling businesses to identify new opportunities for expansion. This opens the door to innovative services, such as eco-friendly cafés or bike rentals in locations where tourist interest is rising but supporting infrastructure is still limited. • **Researchers:** Researchers and practitioners in both the public and private sectors can use the platform to explore the complex relationships between tourism activity and ecosystem health, as well as to study each domain independently. By accessing and exporting datasets, including calculated indices of environmental condition and patterns of site visitation, they can conduct spatial and temporal analyses across Malta's nature-based tourism areas. This enables investigations into how tourism trends correlate with environmental degradation or resilience, and supports interdisciplinary work on sustainability, conservation planning, or tourism management. The platform offers a valuable research infrastructure for hypothesis testing,

FIEA		DP Implementation
Frame		• monitoring impacts of regulatory change, and informing evidence-based decision-making. • **Open University of Cyprus:** Open University Cyprus can use the platform as a case study for technology and policy transfer, assessing how the platform's approach to integrating tourism and ecological data in Malta can be adapted to the Cypriot context. By evaluating the transferability of its methodologies, indicators, stakeholder engagement practices, as well as the source code and technical documentation, the university can build on best practices while developing a roadmap for implementing a localized version of the platform tailored to Cyprus's ecosystems and tourism flows. **Risks** Malta is experiencing rapid urban growth, including both densification of the existing urban fabric as well as sprawl in more rural areas. Moreover, increasing tourism over recent years, which is further incentivised by the government for the future, will have a detrimental impact on Malta's ecosystems if unregulated. The development of this platform is critical for a number of reasons, which are detailed below: • **Knowledge gaps of the anthropogenic pressures on Malta's ecosystems:** Mapping visitation hotspots where ecosystem condition may be worsening due to a high concentration of visits by both residents and tourists. Without this information, unregulated tourism and visitation to these hotspots could severely degrade the ecosystem, leading to negative impacts both on the site's biodiversity, as well as deteriorating the environmental quality of the site which attracts visitors in the first place. • **Generic policies for ecosystem protection, without considering the greater vulnerability of some sites over others:** Although there are European and national directives protecting natural sites across Malta, such as the Natura 2000 network and other local nature reserves, a 'one size fits all' approach to ecosystem conservation neglects the consideration of greater anthropogenic pressure on some sites over others. Such vulnerability may be due to widespread advertisement of some sites over others, or perhaps due to easier access making it more frequently visited compared to more remote sites. • **Lack of development of the nature-based tourism sector and valuation of natural sites:**By providing information on the sites that are visited by tourists and residents, the value of the ecosystem and its protection increases since the long-term degradation of the ecosystem would lead to a reduction in visitation and tourism, which the government is trying to increase. Local businesses dependent upon these ecosystems would also have a vested interest in their preservation, since their customers are drawn to the area due to its natural beauty. The platform could therefore support the development of a sustainable nature-based tourism industry in Malta.
Scope	Start engaging stakeholders	To conduct stakeholder engagement for each of the categories outlined above (cf. "Conduct stakeholder analysis") we used the following engagement methods: • **Tourists and residents (surveys):**To support the development and contextual relevance of the platform, we conducted a dedicated survey to better understand how both tourists and residents engage with nature-based activities in Malta and Gozo,

FIEA		DP Implementation
Scope	Start engaging stakeholders	as well as their perceptions of outdoor recreational experiences. While the survey was not exclusively focused on the platform prototype, its findings are highly relevant for informing the platform's use cases, spatial features, and overall stakeholder needs. Specifically, the survey was designed to provide qualitative insight into NBT preferences, spatial information about where NBT activities are currently taking place and scaling of the importance of nature in decision-making. The survey was created and administered using the Maptionnaire platform, enabling the integration of both qualitative and spatial data through interactive mapping features. Participants were able to respond either in-person, using a tablet facilitated by the research team, or remotely, through a survey link shared via email. Two sets of comparable but slightly different questions were developed for tourists and residents, reflecting their differing relationships to outdoor activities in Malta. However, both groups were ultimately asked to propose improvements to the natural landscape (open question) and to mark points and lines on an interactive map, illustrating locations they associate with nature-based tourism or recreation. **ERA and MTA** (one-on-one meetings): Each meeting was prepared using a structured interview guide designed to gather feedback on use cases, success criteria, and key challenges. The guide consisted of mostly open-ended questions aligned with each stakeholder's domain and interest in the project. Prior to scheduling the meetings, an initial outreach email was sent to stakeholders, outlining the purpose of the engagement and inviting their participation. The email also included a consent statement regarding audio recording and the use of their names and email addresses, allowing stakeholders to provide written approval in compliance with GDPR. During each meeting, we followed a structured meeting guide to ensure consistency across interviews. All meetings were conducted via Microsoft Teams. A team member was designated to take structured notes in case consent wasn't given following meeting summary template, otherwise the sessions were recorded. Summaries of stakeholder input were compiled immediately after the sessions and used to refine the respective use cases and define or adjust indicators. **Local businesses** (e-mail outreach): To understand the needs, challenges, and potential roles of local businesses in Malta's nature-based tourism (NBT) ecosystem, we adopted a two-phase engagement methodology. In the first phase, we conducted a structured online survey targeting over 200 businesses operating in sectors related to tourism and outdoor activities. Businesses were identified across the following categories: Agritourism, Guided walks, Outdoor recreation (categories: sport fishing, water sports, scuba diving), Rentals and tours (categories: bike, car, scooter, quadbike), Tour operators, Hotels and accommodation. The survey was sent via email between August and September 2024, and 22

FIEA		DP Implementation
Scope	Start engaging stakeholders	businesses fully completed the questionnaire. Building on these survey insights which confirm strong interest in nature-based tourism, we followed up with the second phase of engagement through email outreach. This phase focused specifically on the platform and its relevance to local business needs. The goal is to validate proposed use cases, gauge potential platform use, and identify businesses interested in future collaboration. The message was intentionally concise, engaging, and accessible, acknowledging that small business owners often have limited time. It avoids technical jargon while clearly communicating the project's purpose and the potential value of the platform. **Researchers** (general input): While no direct engagement activities (e.g. interviews or surveys) were conducted with researchers or academic institutions, their input has been integrated into the platform development through a combination of prior collaborations, expert knowledge of the research team, formal communications received from academic stakeholders and a review of academic literature and project reports that outlined recurring data gaps, platform requirements, and methodological preferences. Additionally, a formal letter of recommendation from the Open University of Cyprus, outlines their interest in adapting the platform model to their own national context and expresses support for our methodological direction.
	Identify question/ theme/ objective	**Primary use cases of the platform for the public and private sector** For each stakeholder group, a series of primary use cases was drafted, with relevant research questions that then formed the foundation of the stakeholder engagement activities to understand what type of information they would find useful on the platform: **Environment and Resource Authority (ERA)** a) Monitor the impact of tourism on ecosystem condition: Which environmental indicators are most important for assessing ecosystem condition? Have you considered any specific indicator/s to detect tourism- and site visitation-related impacts on ecosystem condition? How frequently should an assessment of the impact of site visitation on ecosystem condition, using earth observation, should, ideally, be carried out? What thresholds or changes are likely to act as an early warning system of a degradation on ecosystem condition? b) Evaluate historical and near-real-time ecosystem conditions: What timeframes (e.g., seasonal, annual) are most relevant for environmental assessments? How soon after a satellite observation would you like the derived indices to be available? Would you prefer to access raw data and subsequently perform analysis, or are you interested in ready-to-use indices and indicators? you could offer in lesser-known or emerging NBT sites?

FIEA		DP Implementation
Scope	Identify question/ theme/ objective	a) Inform, evaluate and shape environmental policies: What type of validation you require for the full utilization of the provided data? What indicators would best reflect the success of nature restoration or protection measures? Would you be interested in having UAV-based vegetation data for certain high-traffic or environmentally sensitive sites? **Malta Tourism Authority (MTA)** a) Monitor NBT clusters and visitor dynamics: Which types of tourist site-visitation data are already collected by the MTA/tourism stakeholders in Malta? And, do you see benefit with collecting other data through earth observation and crowdsourcing? Which types of visitor activity data (e.g. volume, peak periods) would be most useful for your planning? How frequently would you like updated information on new visitors? Would you consider expanding the scope to more tourist activities, rather than just nature-based ones? b) Correlate visitor activity with environmental indicators: Do you consider it important to have access to environmental data for sites visited by tourists? Which environmental indicators are most important for assessing tourism-related pressures, and which affect tourism activity? Would knowledge of resourceful yet under-visited areas support more balanced regional development? c) Policy and planning: What kind of evidence (that can be calculated with our data) would be most useful in prioritizing funding for improvements? Are there existing policies that could benefit from being reviewed considering new insights into environmental and tourism trends?3) **Local businesses** a) Access tourist trends to promote services: What kinds of visitor trend data would be most helpful for your marketing? How often would you like updates on tourist activity at NBT sites? Would you use this data to plan staffing, inventory, or special offers? b) Discover new business opportunities in under-served NBT areas: Are you interested in expanding into new or emerging locations? What information would help you assess the viability of a new NBT-related service? Would it be useful to see gaps in services around certain NBT sites? c) Customize products and packages by season or site: Do you currently adjust your services or offerings seasonally? Would site-specific visitor data help you design more targeted packages? Are there services you could offer in lesser-known or emerging NBT sites?
	Identify relevant impacts and dependencies	**Impacts on Malta's ecosystems** The platform is being developed due to the increasing touristic pressure and high site visitation occurring at various locations across the Maltese islands. Although the aim is not to directly analyse the impact of tourism on ecosystem condition, the DP intends to produce a prototype platform that will enable various public authorities, private actors and civil society to access NBT data and features of naturalistic importance. The development of the platform would provide evidence of where the ecosystems most vulnerable to overtourism and high visitation are located in Malta and their potential impact on ecosystem condition. Since tourist numbers are continuing to increase each year.

FIEA		DP Implementation
Scope	Identify relevant impacts and dependencies	**Dependencies of each stakeholder group on Malta's ecosystems:** • **Tourists and residents**: Both residents and tourists enjoy the various beaches and coastal environments around the Maltese islands, being one of the main attractions for foreign visitors. Moreover, many tourists engage in nature-based activities such as hiking and scuba diving. If Malta's ecosystems continue to degrade due to high site visitation, the ecosystems that visitors are coming to enjoy would deteriorate and in turn affect the attractivity of natural sites around Malta. As such, tourists and residents alike are greatly dependent on recreation activities throughout the archipelago, not only in coastal environments, but also in rural landscapes and urban green spaces. • **Government and authorities** (ERA & MTA): Much of the Natura 2000 Network in Malta also hosts some of the highest visitation for nature-based activities. By ensuring that these ecosystems are protected and managed in such a way that they ensure long-term biodiversity conservation, EU biodiversity objectives are met. Moreover, the tourism industry, one of the largest sectors in Malta, will continue to bring income to the nation throughout the year due to the variety of seasonal outdoor activities conducted in both the wet and dry seasons. Additionally, since coastal ecosystems are hotspots of visitation, targeting these areas for conservation will also aid in the resilience of coastal areas in the face of climate change. • **Local businesses** which are offering or have interest in NBT services: Businesses offering daily excursions, guided hikes, scuba diving and water sports depend on the attractiveness of the natural area in question. If the ecosystems are degraded, the area may receive fewer visitors of time due to the poor quality of the service provided. This may be especially true for active interactions with nature, such as guided hikes or scuba diving. If the local biodiversity decreases over time, customers may feel underwhelmed by the quality of the experience.
	Define boundaries	**Spatial boundary:** The platform intends to cover the entirety of the Maltese Islands, focusing on the three largest inhabited islands of Malta, Gozo and Comino. The coverage involves all terrestrial and coastal areas where nature-based tourism takes place, including near-share marine tourism (e.g. scuba diving). Ecosystem types and extent are classified into five main recreation areas, as follows: 1) Water and Wet 2) Urban 3) Cropland 4) Open Natural Land 5) Woodland and Forest

FIEA		DP Implementation
Scope	Define boundaries	Ecosystem condition boundaries are defined by analyses that can draw on large datasets covering the entire archipelago and which draw upon satellite, crowd-sourced and fieldwork data. The ecosystem services included will consider any nature-associated activity, covering the spectrum from more 'passive' (e.g. sunbathing on beaches) to more 'active' (e.g. birdwatching) interactions with nature. **Temporal boundary:** The development of this platform is highly relevant due to the ever-increasing numbers of tourists visiting the country's beaches and natural landscapes. Additionally, in summer 2025, the government launched an online booking system to access the Blue Lagoon on the island of Comino, a protected island with European-level habitat protection, but also one of the most visited locations in the whole country. This booking system was designed to limit the numbers of residents and tourists accessing this site per day. The development of the platform is therefore coming at a time when Malta is trialling methods of reducing the impact of tourism in natural areas of the archipelago. **Social boundary:** The stakeholders involved in the project include public authorities and local businesses which are either engaged directly in the tourism, nature or nature-based tourism sectors. All residents and tourists willing to contribute to the Maptionnaire survey were included and questioned specifically about the natural sites of interest they choose to visit and the activities performed there (e.g. swimming, hiking, birdwatching). These stakeholder groups were deemed most relevant to the project due to their association with either the tourism, natural or nature-based tourism aspects of this project.
Design	Design alignment	**Alignment with stakeholder needs**: To ensure that the design of the platform aligns with stakeholder needs, following the engagement activities mentioned earlier, the primary use cases hypothesised for each stakeholder group were then evaluated to see if they aligned, or were updated if they required further refinement. Additional primary use cases suggested by the stakeholders were also incorporated. Moroever, metrics were drafted to ensure that the use cases of each stakeholder group are addressed during the development of the prototype platform. The progress of these metrics is being tracked throughout the project to ensure that stakeholder needs are being met. **Methods used to analyse the feedback from stakeholder engagement:** Stakeholder feedback was analysed using a combination of qualitative and quantitative methods, depending on the nature and format of the data collected. The primary approach was qualitative thematic or content analysis, which was applied consistently across most stakeholder inputs to identify key needs, interests, and areas of alignment with project use cases. In addition, we proposed metrics to support ongoing development, validate outcomes, and ensure that the platform remains responsive to stakeholder priorities.

FIEA			DP Implementation
Design	Design ecosystem type(s) assessment	• Select suitable methods • Collect data	**Ecosystem type(s) and extent:** Extraction of satellite data to map ecosystem types relevant for NBT. Data is verified through ground-truthing using an unmanned aerial vehicle (UAV). **Extraction of satellite-derived imagery:** Data was extracted from Sentinel satellite imagery. The potential indices that could be derived include: biophysical variables for vegetation monitoring and phenology studies; LULC classification; urban area mapping; soil moisture; flood delineation in coastal and riparian zones; mapping of shallow water bodies and turbidity; atmospheric correction; algal bloom detection; preliminary water quality assessment; cloud and aerosol studies; drought and biomass analysis; land & sea surface temperature; urban heat island; night-time environmental observations; NO_2, O_3, CO, SO_2, CH_4; aerosols; UV index, among others. While not all datasets/bands will be used for the indices outlined in the proposal, all datasets are collected following stakeholder interests. The satellite-derived imagery was used for both ecosystem type mapping, as well as the calculation of the indices used to assess ecosystem condition. The ecosystem classification engine, still in development, will be used to delineate the five final NBT recreation areas: 1) Water and Wet 2) Urban 3) Cropland 4) Open Natural Land 5) Woodland and Forest The outputs from the satellite data will be used to delineate the ecosystem types and their extent. All satellite imagery was sourced from the Sentinel program, under the Copernicus initiative.
	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	**Ecosystem condition:** Various indices are calculated using the satellite imagery to understand the condition of ecosystems across the Maltese Islands. In addition, species distribution models are generated using crowdsourced citizen science species data. The satellite imagery used for the ecosystem type and extent aspect of the project will also be used to assess ecosystem condition through various satellite-derived indices. In addition, crowdsourced data from the iNaturalist platform will be used for species distribution modelling of fauna. **Extraction of satellite-derived imagery**: Data was extracted from Sentinel satellite imagery. The potential indices that could be derived include: biophysical variables for vegetation monitoring and phenology studies; LULC classification; urban area mapping; soil moisture; flood delineation in coastal and riparian zones; mapping of shallow water bodies and turbidity; atmospheric correction; algal bloom detection; preliminary water quality assessment; cloud and aerosol studies; drought and biomass analysis; land & sea surface temperature; urban heat island; night-time environmental observations; NO_2, O_3, CO, SO_2, CH_4; aerosols; UV index, among others. While not all datasets/bands will be used for the indices outlined in the proposal, all datasets are collected following stakeholder interests. The satellite-derived

FIEA			DP Implementation
Design	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	The satellite-derived imagery was used for both ecosystem type mapping, as well as the calculation of the indices used to assess ecosystem condition. The ecosystem classification engine, still in development, will be used to delineate the five final NBT recreation areas:1) Water and Wet 2) Urban 3) Cropland 4) Open Natural Land 5) Woodland and Forest **iNaturalist** The iNaturalist platform was used to extract crowdsourced data for various species of fauna, along with their geolocation, which were then used to generate species distribution maps. **The following ecosystem condition indicators will be assessed across the entire archipelago:** Vegetation indices (e.g. NDVI) Tree canopy cover Land surface temperature Air quality models (e.g. CO, NO2, SO2, O3)- Species distribution models (e.g. mammals, reptiles, amphibians, bees, including crowdsourced data from iNaturalist) Integration of other datasets, (e.g. soil, elevation, aspect, habitat maps) All satellite imagery was sourced from the Sentinel program, under the Copernicus initiative.
	Design ecosystem service(s) assessment	• Select suitable methods • Select suitable indicators • Collect data	**Ecosystem services:** PPGIS and surveys were undertaken with residents, tourists and businesses to understand site visitation across the archipelago, along with complementary data regarding NBT activities carried out at the specified sites, satisfaction with the quality of the site and suggestions for improvement. • **Flickr and iNaturalist** (Costadone and Balzan, 2023, Ecosystem and People): This is an image-sharing platform where users upload photographs enriched with metadata such as timestamps, geolocation, and descriptive tags, which can together with an image serve as proxies for tourism activity and landscape appreciation. • **Twitter:** Twitter (now X) enabled us to obtain tweets relevant to nature-based tourism. Tweets relevant to nature-based tourism were systematically filtered and we are using machine learning to identify nature interactions for Twitter photos. • **PPGIS and surveys on site visitation conducted with residents and tourists:** Maptionnaire surveys allow for the collection of questionnaire and geospatial data on a single platform, so was used to gather NBT data from both residents and tourists. Maptionnaire surveys were conducted online and in person, across various locations in Malta and Gozo, in summer 2023

FIEA			DP Implementation
Design	Design ecosystem service(s) assessment	• Select suitable methods • Select suitable indicators • Collect data	Drawing on the data sources, below is a general list of broad indicator topics used to assess nature-based tourism: • **Flickr and iNaturalist** - NBT site visitation based on social media analysis • **Twitter**- NBT site visitation based on social media analysis • **PPGIS** and surveys on site visitation conducted with residents and tourists- NBT site visitation based on questionnaires, with geospatial analysis of NBT hotspots/ Personal level of importance and interest regarding nature/outdoor activities for residents and tourists/ Type of activity conducted at mapped location/ Season of visit (wet/dry)/ Frequency of visit to site in question/ Mode of transport to access site/ Rating experience at the site based upon: environmental conditions, upkeep, accessibility, facilities, safety Nature-based tourism data was collected from the following platforms • **Flickr and iNaturalist**: Georeferenced social media posts and metadata • **Twitter (now X):** Georeferenced social media posts and metadata • **PPGIS platform 'Maptionnaire':** Geospatial and qualitative data
Assess	Assess ecosystem type(s) and extent	• Map • Account	This step will be conducted once the ecosystem classification engine has been constructed and run.
	Assess ecosystem condition	• Quantify • Map • Account	This step is in progress, as the relevant data is still being extracted and processed.
	Assess ecosystem service(s)	• Evaluate • Map • Account	**Evaluate** Although preliminary statistics have been run, the final comprehensive analysis is pending and will be undertaken within the scope of the project. **Map** Nature-based tourism data was mapped using the following methods: • **Flickr and iNaturalist (Costadone and Balzan, 2023, Ecosystem and People):** NBT visitation patterns modeled based on local factors. • **Twitter**: Machine learning was used to identify nature interactions. • **PPGIS and surveys on site visitation conducted with residents and tourists:** A preliminary heatmap was produced using the Maptionnaire platform, comparing the similarities and differences in site visitation between residents and tourists. The update will involve the generation of a final map incorporating all NBT data.

FIEA			DP Implementation
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	**Ecosystem type and extent assessment:** All satellite imagery has been sourced from the Sentinel program, under the Copernicus initiative. The ecosystem classification engine is being constructed by our geospatial engineer and, once it has been operationalised, it will be used to classify ecosystem types and their extent across the Maltese Islands. **Ecosystem condition assessment:** The satellite imagery intended for the ecosystem condition assessment is also sourced from the Sentinel program. Once it has been extracted, ecosystem condition indicators based on remote-sensing algorithms (e.g. NDVI) will be run to analyse the condition of all ecosystem types identified by the ecosystem classification engine mentioned above. **Ecosystem services assessment:** The outputs from the social media analyses and PPGIS surveys highlight NBT hotspots across the Maltese Islands. The PPGIS surveys in particular highlight the similarities and differences in site visitation between residents and tourists. Although preliminary statistics have been run, the final comprehensive analysis is pending and will be undertaken within the scope of the project. **Integration of all assessments:** Once all the data has been collated on ecosystem types, extent, condition and services, they will be integrated into the final platform. The interface is still to be developed but will enable all end-user groups previously mentioned to view different data layers depending on their needs. **Impacts and Dependencies** **Impacts on Malta's ecosystems**: As mentioned in the impacts and dependencies of the Scope section, the platform is being developed due to the increasing touristic pressure and high site visitation occurring at various locations across the Maltese Islands. The ecosystem services assessment, entailing social media analyses and PPGIS surveys, identified hotspots of NBT activities across the archipelago. Once the ecosystem classification engine has been operationalised to assess the ecosystem types, extent and condition, the ES assessment can also be overlaid to understand if there are. **Dependencies of each stakeholder group on Malta's ecosystems**: • **Tourists and residents:** Since the social media analyses and PPGIS surveys showed that there are indeed visitation hotspots throughout the archipelago, the condition of these ecosystems must be assessed to ensure both biodiversity conservation at the sites in question, as well as ensuring that NBT activities do not further degrade the sites. If no restorative interventions, access restrictions or data-driven policies are put in place, the decline in the quality of these ecosystems may in turn have a negative impact on nature-based activities, since the ecosystems present could become so

FIEA			DP Implementation
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	• authority charged with environmental protection and enforcement of associated regulations. To ensure that EU-level designations, such as the Natura 2000 Network, are maintained and the biodiversity within these and other natural sites is fully protected, these data-driven insights into how visitation pressure may be affecting local ecosystems will be fundamental in informing policy changes and necessary interventions for site protection. The MTA can then work alongside ERA to ensure that tourism does not negatively impact these sites, as their degradation may in turn cause a loss in visitor numbers, with a ripple effect impacting local businesses. Moreover, the MTA can use this data to encourage and advertise lesser-known sites to alleviate the visitation pressure on the most heavily impacted NBT sites. This collaboration between the two entities can help to balance the pressures of tourism density with ecosystem conservation to ensure a mutually beneficial and more sustainable way forward for both sectors. • **Local businesses which are offering or have interest in NBT services:** Both NBT businesses and amenities in close proximity to visitation hotspots are highly dependent on visitor numbers, either seasonally or throughout the year, to ensure viable long-term operations in the area. As such, those businesses most dependent upon ecosystem condition may be the first to suffer a decline in customer numbers if the ecosystem becomes so degraded that the nature-based activity ends up losing its attractiveness due to a lack of biodiversity or aesthetic value. This may occur, for example, with guided nature hikes, birdwatching, snorkelling or scuba diving. The amenities in the area may also begin to suffer financial deterioration if visitors previously frequented food establishments, cafés and local shops, consequently having a chain reaction that leads to local economic decline. Ultimately, these businesses depend upon the integrity of the local ecosystems to provide either satisfactory NBT service to customers, or non-NBT services which provide visitors with other local amenities. **Develop Solutions** The development of this platform will enable all end-user groups to access site-specific visitation and ecosystem condition data through a user-friendly interface. The solutions and recommendations derived from this DP are described below, according to the end-user group: • **Tourists and residents** can use the platform to plan more enjoyable and responsible visits by combining tourism trends with real-time and historical ecosystem health data, helping them avoid stressed or overcrowded sites and build tailored multi-site

FIEA			DP Implementation
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	• itineraries. Once the platform has been released, its uptake and utilisation by residents and tourists should be analysed to advertise the platform and to troubleshoot issues with the usability of the interface. • **For the Environment and Resources Authority (ERA) and Malta Tourism Authority (MTA),** it serves as a powerful monitoring and decision-support tool to detect visitation pressure on ecosystem condition, analyse visitor flows, guide sustainable zoning and policy, and evaluate long-term management outcomes. Where visitation hotspots are detected, it would be ideal to implement either restorative or preventative measures to reverse ecosystem degradation. • **Local businesses** benefit from insights into where and when nature-based tourists are active, allowing smarter marketing, seasonal service adjustments, and new opportunities in emerging destinations. Focus groups could be held with local businesses to ensure uptake of the platform once it has been released. An analysis of customer flow and expenditure over time would provide valuable information to understand long-term trends that may be explored in relation to ecosystem condition and NBT offerings in the area. These trends could then highlight opportunities for new marketing niches in local NBT activities. Moreover, these trends could also reveal where NBT offerings may be saturated or lacking. • **Researchers** can access and export integrated datasets to study links between tourism and ecosystem change, supporting interdisciplinary sustainability and conservation work. For example, the Open University of Cyprus can use the platform as a transferable case study, adapting its methods, indicators, and technical framework to develop a similar tool suited to Cyprus' environmental and tourism context. This could also facilitate the establishment of a knowledge-sharing consortium across the Mediterranean with the development of best practices focused on enhancing and protecting ecosystem condition in areas of high visitor density
	Elaborate results stakeholder-specifically		Follow-up meetings are planned with the public authorities (ERA and MTA), as well as outreach to the local businesses. **Mixed-methods survey analysis for tourists and residents:** For survey data from residents and tourists, we applied a mixed-methods approach, combining statistical and natural language processing (NLP) techniques. The only stakeholder group for which quantitative methods were used was tourists and residents, surveyed via an online and in-person questionnaire. Closed-ended questions were analysed using descriptive statistics to summarise

FIEA		DP Implementation
Share	Elaborate results stakeholder-specifically	demographics, importance ratings, and activity patterns. Open-ended responses were analysed using natural language processing (NLP) tools and large language models (LLMs). For activity preferences, responses were pre-processed using spaCy (lemmatisation, stopword removal, standardisation), then manually mapped into standard activity categories. To assess whether suggestions had design implications for the platform, responses were passed through a locally hosted LLaMA 3 model, using a consistent prompt. Responses were classified based on their relevance to: *Historical or real-time tourism data* and *Historical or real-time environmental data*. A majority-vote system (5 iterations per response) determined final classification. Responses flagged as relevant (4/5 and 5/5 iterations marked as relevant) were retained for qualitative content analysis and used to revise use cases. This approach was reviewed and validated through random manual sampling and collaborative review by the project team. **Qualitative content analysis** This method was applied to feedback from the following stakeholders: a) ERA and MTA: In-depth interviews were coded manually by the project team and reviewed collaboratively. b) Local Businesses: Written responses were grouped into thematic categories, with direct comparisons to use cases to identify business needs. c) Researchers: Internal feedback was gathered through self-reflective analysis, structured internal discussions, and expert elicitation sessions. Insights were validated and enriched through the review of academic literature and related EU project outputs. d) Open University of Cyprus (OUC): Their letter of interest was analysed to extract statements of intent, thematic focus areas, and implied needs relevant to research collaboration.
	Disseminate and communicate	Develop marketing strategies to raise awareness among tourists, businesses and government agencies about the platform capacities. Promote the platform as a tool for sustainable tourism and environmental conservation.
	Disclose	A potential report on the results may be considered for the ERA and MTA, as well as for the Malta Business Bureau, but the specifics of this approach will be consolidated once the platform is ready to be launched.
Act	Adopt results (in public and private decision-making)	**Public decision-making** The one-on-one interviews conducted with the Environment and Resources Authority (ERA) and Malta Tourism Authority (MTA) highlighted relevant policy changes as part of the primary use cases. The possibility of reviewing existing policies was discussed in light of emerging evidence-based NBT trends and ecosystem condition that would be identified through the development of the platform and integration of the data collected.

FIEA		DP Implementation
Act	Adopt results (in public and private decision-making)	**Private decision-making** The applicability and usefulness of the platform in identifying emerging markets and opportunities within the private sector was discussed with local businesses during the stakeholder engagement activities. Planned dissemination activities to launch the prototype of the platform could further explore the possibility for uptake within the private sector.
	Implement	**Concretely planned** The prototype of the platform, with a basic interface, will be ready by April 2026. **Envisioned** Subsequently, the prototype will be trialled, inviting stakeholder feedback, before incorporating this input and proceeding with the finalisation of the platform. The date for the final launch is still to be confirmed.
	Monitor and evaluate	We intend to monitor and evaluate user engagement and feedback for the prototype platform in Malta. In regard to the long-term, we intend to establish a plan for ongoing maintenance, updates and technical support for the platform. This will involve continuously assessing performance of the platform, as well as the impact of tourism on the environment. We also plan to incorporate user feedback and new solutions (e.g. addition of trails, AI to link users to sites and businesses) to further enhance the platform.

Framework for Integrated Ecosystem Assessment (FIEA)

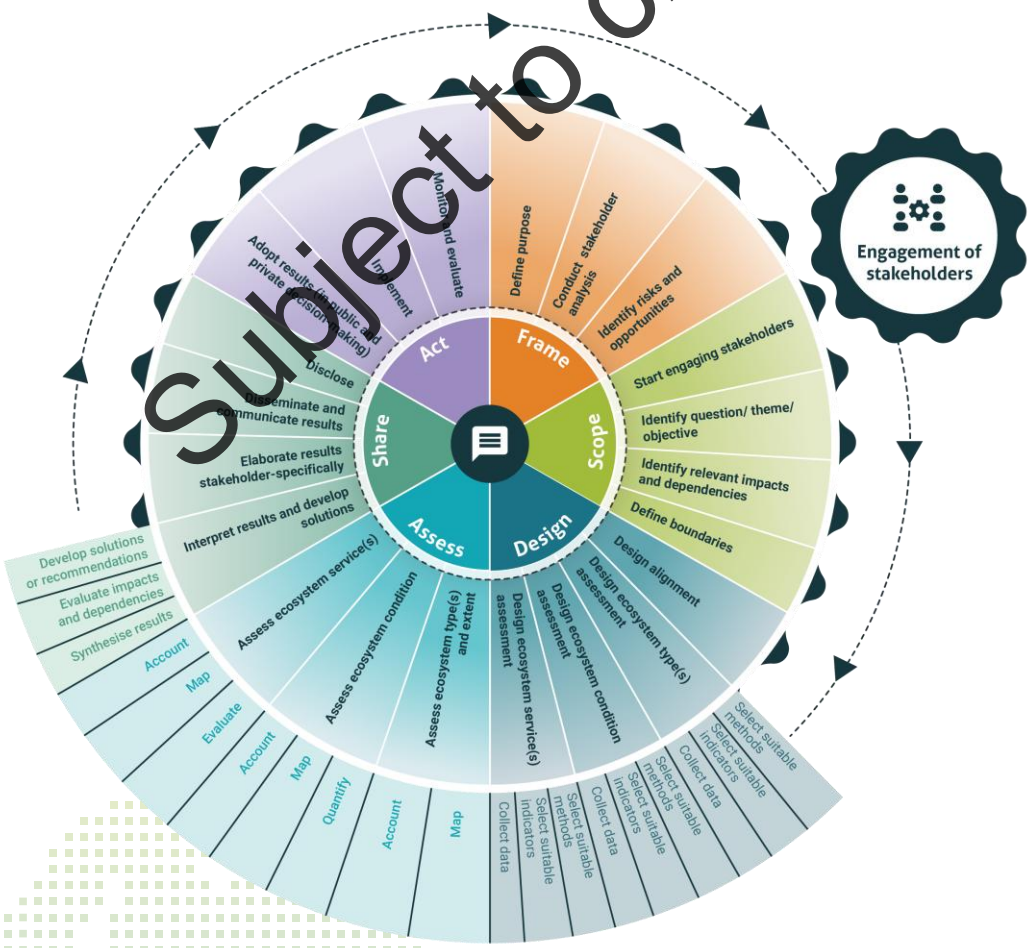
Implementation in

SELINA Demonstration Project (DP) 11

Integration of biodiversity and ecosystem services to develop nature-based tourism approaches

Location Finland | **Sector** Tourism

The project aims to increase understanding of the impacts and dependencies of tourism on marine ecosystems and enhance regenerative tourism practices. The project leads have collaborated with the Sustainable Travel Finland programme working on marine-related criteria and indicators which allow enhance sustainable tourism in the Finnish coastal areas. ,



FIEA		DP Implementation
Frame	Define purpose	The starting point was to support tourism businesses operating in the City of Helsinki's archipelago with knowledge about ecosystems, biodiversity and ecosystem services so that the businesses can benefit from this knowledge in their operations but even more importantly, be able to make a good impact on the condition of especially marine ecosystems and biodiversity and that way the sustained and improving flow of ecosystem services. Later in the process the purpose of DP11 was redirected to concern all tourism businesses in Finland by developing Visit Finland's (part of Business Finland) Sustainable Travel Finland (STF) programme to include criteria and indicators that allow to assess and diminish the impacts of tourism on marine ecosystems and their condition, and more ambitiously, to leave a positive impact in the ecosystem. Visit Finland's vision is to make tourism regenerative.
	Conduct stakeholder analysis	At the beginning, our aim was to identify businesses operating in the City of Helsinki's archipelago and start co-creating solutions for better integration of ecosystem knowledge in their operations. However, after initial stakeholder mapping and trying to make contact with the businesses, we realized that the businesses are so small (even 1-2 persons running the business only) that they do not have the capacity to participate in any kind of projects which consume their precious time. In addition, we learned in the City of Helsinki's Sustainable Travel Forum - in which one of our researchers at Syke is a member - that the businesses are often busy trying to get the Visit Finland's Sustainable Travel Finland (= STF) label. It is an ambitious, constantly developing programme based on the most recent knowledge. Any tourism sector company or a destination can join the programme and pursue the certificate. The businesses need to fulfil multiple criteria across a wide range of sustainability topics to be able to attain the STF label. The label is an acknowledged achievement and comparable throughout Finland which makes it useful for showing the responsibility of the business in a standardized way and thus very good for advertising a company's business as a good choice for tourists. Even small businesses can be interested in getting the STF label and putting their effort in the sustainability work through that rather than participating in any fixed-term projects. In addition, Visit Finland gives more visibility in their international marketing to those businesses that have the STF label. Therefore, we needed to shift the focus of the Demonstration Project. We contacted Visit Finland's Head of Sustainable Development and asked their willingness to cooperate with us. It appeared that the STF programme did not include any marine ecosystems related criteria and thus our interests matched. Additionally, Visit Finland supports regenerative, nature-positive tourism and was willing to collaborate in that sense as well based on the research partner's robust, scientific knowledge.

	FIEA	DP Implementation
		We started from "wave-level" (cf. grass-root level; bottom-up) and ended up to "sky-level" (top-down) as well as from one city's archipelago tourism business level to having an impact on all tourism businesses in Finland whenever they have even a remote connection with the marine ecosystems (e.g. through discharge finally ending to the Baltic Sea or using locally produced sustainable fish for catering).
Frame	Identify risks and opportunities	A common risk in developing environmental actions for businesses is focusing on low-impact actions instead of actions resulting in real environmental impact. This risk is even more prominent when the target is in developing nature-positive tourism, i.e. leaving the ecosystems in better condition than they were due to business activities. This is a big challenge and needs to be addressed carefully. To be able to assess the direction and magnitude of impact, the base level of the ecosystem condition of the impacted ecosystem types needs to be known or assessed first. Then, both the type (drivers) and the magnitude (pressure) of the use of ecosystems and the condition of ecosystems must be monitored to see if there is any change taking place and what kind of change it is. Actualising risks cannot be identified and controlled without monitoring. Opportunities are manyfold. Having an impact on marine and archipelagian ecosystems through the STF programme is a great opportunity. The condition of marine ecosystems of the Baltic Sea is poor and the islands are susceptible to wear caused by tourism although the number of tourists (and recreationists) in the archipelago is pretty low. However, the island ecosystems are very fragile. Through the Baltic Sea - related actions of the STF programme, especially through the new criterion and indicator of signing the Baltic Sea Commitment and fulfilling its objectives, there will be a great impact on the marine ecosystems of the Baltic Sea.
Scope	Start engaging stakeholders	Syke's SELINA researcher team engaged with Visit Finland to develop the Sustainable Travel Finland programme. We also discussed with Going Green Oy (LLC) in regard to possible review of marine and freshwater-based activities provided by tourism businesses. To get a STF label, companies also need to get a certification from one of the certification service providers. Going Green Oy is one those service providers. The collaboration with Going Green Oy has not been possible as planned due to lack of time in the frame of DP11.Marine ecosystems researchers inside Syke were engaged to be able to better assess tourism and biodiversity relations, and also a team of legal design students of a University of Applied Sciences was recruted to work on the topic as part of their service design exercise. The students assessed the identified marine ecosystems related STF criteria and indicators in their excercise

FIEA		DP Implementation
Scope	Identify question/ theme/ objective	The main focus was on including marine ecosystems, their condition and ecosystem services in the Sustainable Travel Finland criteria and indicators and thus part of the STF programme.
	Identify relevant impacts and dependencies	Tourism businesses are fundamentally dependent on healthy marine and coastal ecosystems, which provide critical ecosystem services such as clean water, attractive landscapes, and recreational opportunities that underpin nature-based tourism demand. In the context of the Baltic Sea and Finnish archipelagos, these services directly influence visitor experience, business attractiveness, and long-term economic viability. At the same time, tourism activities can place pressures on these ecosystems through pathways such as nutrient and effluent discharge leading to eutrophication, littering and waste generation, construction and infrastructure development, and the physical disturbance of fragile habitats. hrough initiatives such as the STF programme, the sector has the potential to reduce its impacts and contribute positively to ecosystem condition, shifting towards a regenerative model that supports both environmental sustainability and long-term tourism benefits. The STF programme covers all aspects of sustainability (economic, social, cultural, ecological). We have assessed the programme's existing ecological criteria and indicators and identified those that have an impact on the marine ecosystems, their condition and eventually the ecosystem services. The main pressures on the marine environment come from construction, litter and effluent. Additionally, we have added a new criterion in the programme: the business should sign the Baltic Sea Commitment provided by the Baltic Sea Challenge initiated by the cities of Helsinki and Turku. The Baltic Sea Challenge network invites organizations to commit to the protection of the Baltic Sea. The network already has 330 organizations from Finland and other Baltic Sea countries. The fourth season of Action Plans spanning to 2028 was launched in January 2024. The Action Plan has six goals addressing the most significant threats to the Baltic Sea's condition and key solutions: 1) Promoting sustainable use of the seas 2) Preventing litter 3) Reducing harmful substances 4) Increasing biodiversity 5) Curbing eutrophication 6) Increasing cooperation and inclusion The Baltic Sea Commitment has a relevant impact on the marine ecosystems and thus its inclusion in the STF programme will gradually result in improved condition of marine ecosystems.

FIEA			DP Implementation
	Define boundaries		The focus is on Finnish tourism sector operators that have straight, indirect or teleconnected impacts on marine nature. It is important to acknowledge that through the STF programme all tourism businesses in the entire Finland are involved. Any business either inland, along the coast or in the archipelago must check the marine criteria and indicators and tick whether they meet them.
Design	Design alignment		Marine ecosystem types, their condition and ecosystem services assessments and mappings have been carried out in separate studies by Finnish Environment Institute (Syke). Further, a SELINA Test Site for marine ecosystem condition complements the existing data and knowledge. Based on the scientific knowledge, the STF programme was revised to contribute to the improvement of the condition and therewith also ecosystem services delivery of the marine ecosystems. Through the STF programme, this work will be mainstreamed to any tourism business in Finland wanting to pursue the programme and receive the STF label. Thus, the impact on the marine ecosystems can be considerable.
	Design ecosystem type(s) assessment	• Select suitable methods • Collect data	Underwater marine ecosystems of the Baltic Sea, including the Helsinki archipelago, have been studied and mapped in earlier research using place-based methodologies. In DP11, this accumulated scientific knowledge served as the foundation for collaboration with Visit Finland, particularly in selecting marine ecosystem–related criteria and indicators that capture relevant impacts across different ecosystem types. Pre-existing maps of marine ecosystems were used as background information to identify the STF programme criteria and indicators that affect marine ecosystems, with particular attention to the most vulnerable ones.
	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	The condition of marine ecosystems in the Baltic Sea has been investigated in previous studies using, a.o., place-based methodologies. This existing body of knowledge was used as a foundation for the current work. A range of variables describing the condition of marine ecosystems is available; however, these were used solely as background information to identify the STF programme criteria and indicators that influence marine ecosystem condition.

FIEA			DP Implementation
	Design ecosystem service(s) assessment	• Select suitable methods • Select suitable indicators • Collect data	**N/A**
Assess	Assess ecosystem type(s) and extent	• Map • Account	No new assessment or mapping of marine ecosystems, their condition, or the ecosystem services of the Baltic Sea was conducted; instead, the development and review of the STF programme criteria and indicators drew on knowledge accumulated across a broad body of research from multiple studies conducted over time.
	Assess ecosystem condition	• Quantify • Map • Account	
	Assess ecosystem service(s)	• Evaluate • Map • Account	
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	The STF programme has very clear criteria and indicators. Including the marine ecosystems-related ones will presumably widen the understanding of the even far-reaching impacts of the tourism business operations and eventually have an impact on marine ecosystems. After integrating the marine ecosystems-related criteria and indicators in the STF programme, the tourism businesses will have the opportunity to evaluate how its operations impact the marine ecosystems. The concrete impact on the marine ecosystems, their condition and the ecosystem services will be seen in a bit more long-term focus. If and when the condition of the marine ecosystems improves, the dependency of nature-based tourism on the marine ecosystem condition will become even more visible. It is possible to evaluate the uptake of the STF programme, implementation of the marine ecosystem related criteria and number of signed Baltic Sea Commitments as part of the STF programme, for example yearly. The STF programme provides targets as criteria and indicators and the business needs to decide the solutions which help to achieve the targets, e.g. how to manage the effluent so that it does not eventually end up in the sea where it eutrophicates and possibly pollutes the water, too. When experience piles up, solutions and recommendations to achieve the STF targets can be gathered or co-created and shared to all tourism businesses via Visit Finland.

FIEA		DP Implementation
Share	Elaborate results stakeholder-specifically	Visit Finland has the mandate to collect data on the implementation of the STF programme and elaborating the resuls to the tourism sector and various stakeholders according to their knowledge needs. Also, individual businesses may decide themselves how it wants to present its STF programme targets and achievement both for internal community and externally including the public authorities and customers.
	Disseminate and communicate	Visit Finland has the key role in disseminating and communicating the results both nationally and internationally for different audiences. Visit Finland regularly publishes a new edition of the Sustainable Travel Guide for the tourism sector. In 2026, the Baltic Sea is included in the guide and a separate section of important actions to improve marine ecosystems and their condition will be written by the Syke researchers. Visit Finland's the Baltic Sea theme of the year was published during a travel fair in Helsinki, Finland, on January 15, 2026, in connection to a Baltic Sea related presentation session. Two Syke researchers (Samuli Korpinen and Leena Kopperoinen) gave presentations on the ecosystems of the Baltic Sea and their condition, as well as on the actions that the tourism sector can take to improve the ecosystems. Representative of the Business Helsinki (business marketing department of the City of Helsinki) presented tourism in the Helsinki Archipelago and finally, the Head of Sustainable Tourism at Visit Finland presented the updated STF programme and officially announced the start of the Baltic Sea thematic year in Finnish tourism. The session was organised at the Business Helsinki's stand in a visible location at the travel fair. Presentations were given in English because the professional day at the fair was targeted to international tourism operators. At individual business level, The STF label - and even being in the process of pursuing it - is worth disseminating and communicating to potential customers in various ways in the marketing. Additionally, the business can gain benefit also by disseminating it to public authorities.
	Disclose	Tourism businesses pursuing the STF programme will eventually finalize their actions based on the criteria and indicators in the programme and get the STF label. They can then disclose this information in their yearly reports. Visit Finland grants the label, which then can be added to business' website, marketing materials, etc. In addition to this, Visit Finland gives more visibility in its international marketing to those tourism businesses which have the STF label. Visit Finland discloses the information on the number of businesses pursuing the STF programme, granted STF labels, signed Baltic Sea Commitments, etc. in their regular reports and web page.

FIEA		DP Implementation
Act	Adopt results (in public and private decision-making)	The tourism business pursues the STF programme and takes actions to meet the criteria and indicators set for improving the condition of the marine ecosystems and therewith their capacity to produce ecosystem services. By signing the Baltic Sea Commitment, the tourism business commits to the following: *We are joining the free Baltic Sea Challenge network for the years 2024–2028.With this commitment, our organization recognizes its responsibility in balancing the pressures of sea use and improving the state of the sea. We challenge ourselves and our organization to work for a healthy and productive Baltic Sea, strengthening the shared sense of ownership and responsibility for the well-being of our local waters.* *We voluntarily respond to the common challenge by doing more for the water bodies than what the law and the requirements of our core operations demand. We commit to concrete actions to reduce the burden our activities place on local waters and the Baltic Sea.* *Our organization commits to the Baltic Sea Challenge and to promoting the common vision by initiating one or more Baltic Sea actions related to the following themes within the next 12 months.* The Baltic Sea Challenge requests an annual voluntary report on the progress of the actions, which you can respond to in the manner and scope you prefer. INSTRUCTIONS: The commitment requires the contact information, as well as information about your concrete Baltic Sea actions. The form is divided according to the themes of the Baltic Sea Challenge. You can write actions under the most suitable theme or upload them as a separate file. For example, if your organization has its own environmental program that includes Baltic Sea/water issues, you can attach it to the form. Please note that the actions in the commitment are public information. Description of our Baltic Sea actions *[the tourism business must fill in actions under the following topics*] Mitigating eutrophication: The goal of mitigating eutrophication is to reduce the load of suspended solids and nutrients, such as phosphorus and nitrogen, entering inland waters and the Baltic Sea, and to enhance nutrient cycling. Harmful substances: The goal of reducing harmful substances is to decrease and prevent the entry of harmful substances, such as toxic chemicals, plastics, and oils, into water, soil, and air. Increasing biodiversity: The goal of increasing biodiversity is to prevent biodiversity loss and secure the diversity of species and habitats by combating invasive species and protecting and restoring natural environments.

FIEA		DP Implementation
Act		Promoting sustainable use of the seas: The goal of promoting sustainable use of the seas is to ensure the environmental friendliness of maritime traffic, recreational use, and other maritime industries. Preventing littering: The goal of preventing littering is to minimize the amount of generated waste by sorting waste appropriately and removing already accumulated litter from the environment Increasing cooperation and participation: The goal of increasing cooperation and participation is to enhance water protection collaboration within and between organizations, increase knowledge of best practices, and incorporate consideration for the Baltic Sea into the normal operations of the organization.“
	Implement	This step requires the tourism companies to start implementing the actions that are needed to get the STF label (and for example, the Green Key certification), including the work according to the Baltic Sea Commitment. This step is out of our hands as researchers but Visit Finland will closely follow the process. Due to diminishing personnel resources at Syke team, researchers involved in DP11 might not be able to collaborate with Visit Finland as hoped before.
	Monitor and evaluate	The adoption of the STF programme and pursuing the label will be monitored by Visit Finland. The first sensible monitoring checkpoint is at the end of 2026 or at the beginning of 2027.Collaboration with the Visit Finland will continue if researcher resources allow and other possible marine ecosystems-related criteria and indicators can be considered to complement the existing ones. The STF programme is meant to be a continuously improving programme. The feasibility of the existing criteria and indicators needs to be evaluated and the programme updated based on the experiences gained during the first 1-2 years after the publication of the marine ecosystems related criteria and if more impactful criteria and indicators are identified.

SELINA

Framework for Integrated Ecosystem Assessment (FIEA)

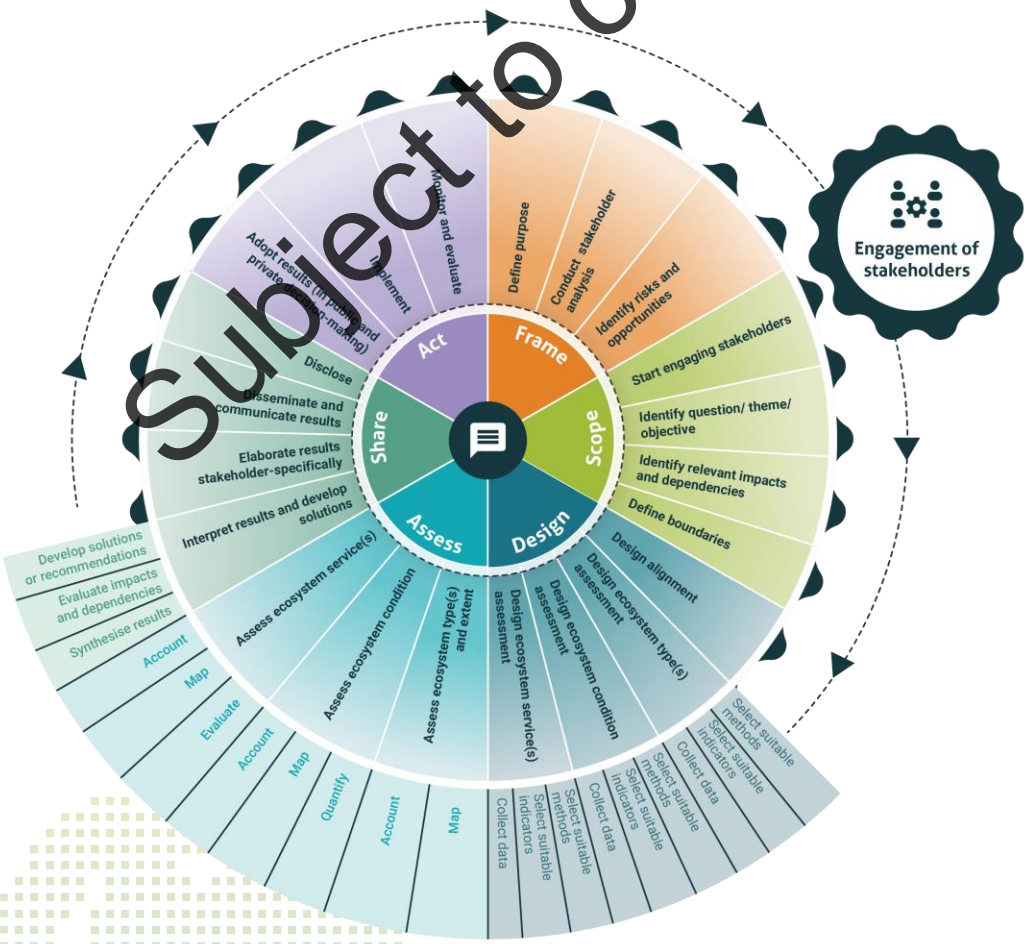
Implementation in

SELINA Demonstration Project (DP) 12

Nature risk screening tools in finance: A review of knowledge gaps in biodiversity metric

Location **Europe** | **Sector** Corporate Strategy & Finance

The project aims to provide guidance for the financial sector to assess ecosystem and biodiversity impacts, screen nature-related risks, and prioritize investments. It focuses on the evaluation of the current state of nature risk screening tools used by financial actors to assess biodiversity risks and their alignment with requirements of the European Sustainability Reporting Standards (ESRS) E4 on Biodiversity and ecosystems.



FIEA		DP Implementation
Frame	Define purpose	The main purpose of the assessment was to evaluate the current state of risk screening tools used by financial institutions to assess biodiversity risks and their alignment with regulatory disclosure requirements (CSRD ESRS E4) and voluntary guidance frameworks (TNFD and GRI).
	Conduct stakeholder analysis	Our research drew on a desktop analysis of risk screening tools supplemented with feedback from tool providers, and semi-structured interviews with stakeholders from multistakeholder initiatives, platforms, coalitions, and financial institutions (e.g., banks or pension funds).
	Identify risks and opportunities	Our research drew on a desktop analysis of risk screening tools supplemented with feedback from tool providers, and semi-structured interviews with stakeholders from multistakeholder initiatives, platforms, coalitions, and financial institutions (e.g., banks or pension funds).
Scope	Start engaging stakeholders	We engaged stakeholders throughout all stages of our desktop study to ensure the assessment was both scientifically sound and relevant to end users. Two online meetings were held with stakeholder boards representing financial institutions, tool developers, and experts working with finance and nature. During the first meeting, we refined and adjusted our research questions based on stakeholder feedback to better align the study objectives with practical needs in finance. In the second meeting, we presented and validated our initial findings, receiving valuable input that helped to clarify key assumptions, identify data gaps, and strengthen the interpretation of results.
	Identify question/ theme/ objective	Our research was clear from the start, as we wanted to evaluate the state of risk screening tools used by financial institutions to assess biodiversity risks and their alignment with regulatory disclosure requirements (CSRD ESRS E4) and voluntary guidance frameworks (TNFD and GRI).
	Identify relevant impacts and dependencies	We did not explore any impacts and dependencies in our desktop analysis of the tools.
	Define boundaries	Our research focused solely on biodiversity and ecosystem services measurement approaches (hereafter referred to as 'biodiversity risk screening tools') that have been reviewed and rigorously examined by Finance for Biodiversity (2024). Twelve tools that met the criteria of being highly relevant to the financial sector and currently explored or used within it have been listed and analyzed by us. Another boundary of our assessment was related to datapoints listed in Lammerant et al. (2024) who compiled metrics from CSRD ESRS E4 requirements and used them as a reference to compare to two other voluntary standards – the TNFD and GRI, where such disclosure metrics were explicitly mentioned. Since ESRS E4 does not specify which biodiversity metrics companies are required to report, and species-specific metrics remain voluntary across all disclosure initiatives, the paper by Lammerant et al. (2024) helped us to set the boundary of our research scope.

FIEA			DP Implementation
Design	Design alignment		The outcome of this step was a traffic light diagram, which enabled us to assess whether each biodiversity risk screening tool fully provided, partly provided, or did not provide biodiversity-related metrics or outputs useful for evaluating the relevant ESRS E4 metrics. This visualization helped clarify tool capabilities and gaps in relation to regulatory and voluntary reporting requirements.
	Design ecosystem type(s) assessment	• Select suitable methods • Collect data	We selected a desktop analysis as the primary method to systematically review the descriptions, functionalities, and documentation of biodiversity risk screening tools. This was complemented by direct consultations with tool providers to validate the findings and clarify methodological assumptions where public information was limited. Additionally, we conducted semi-structured interviews with stakeholders from financial institutions and multi-stakeholder initiatives to incorporate practical perspectives, ensure relevance, and strengthen the interpretation of the results. We selected indicators (datapoints) based on the ESRS E4 biodiversity and ecosystem metrics (listed by Lammerant et al. 2024), focusing on those most relevant for assessing actual and potential biodiversity impacts at the asset level. These indicators were including similar metrics from voluntary frameworks such as TNFD and GRI to ensure a comprehensive evaluation of tool outputs against both regulatory and best-practice reporting standards. • Data were collected from publicly available sources, including tool documentation, user manuals, scientific publications, and online platforms describing each biodiversity risk screening tool. Where information gaps existed, additional data were obtained through direct communication with tool developers and feedback from stakeholders to ensure completeness and accuracy of the assessment.
	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	• N/A - our study did not assess ecosystem conditions and points on methods, indicators and data collections are answered above. • N/A • N/A
	Design ecosystem service(s) assessment	• Select suitable methods • Select suitable indicators • Collect data	• N/A

FIEA			DP Implementation
Assess	Assess ecosystem type(s) and extent	• Map • Account	• N/A
	Assess ecosystem condition	• Quantify • Map • Account	• N/A
	Assess ecosystem service(s)	• Evaluate • Map • Account	• N/A
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	• We synthesized the results by comparing each tool against the selected ESRS E4 and voluntary biodiversity indicators, using a traffic light system to classify their coverage and usefulness. Tools were evaluated as fully providing, partially providing, or not providing relevant metrics, highlighting strengths, weaknesses, and gaps in relation to asset-level risk assessment. This synthesis allowed us to identify patterns across tools, prioritize areas for improvement, and generate actionable insights for both financial institutions and policymakers. • We implicitly evaluated impacts by examining how each tool accounted for the effects of economic activities on biodiversity, including pressures such as land-use change, water use, and invasive species. Dependencies were assessed by identifying whether tools captured the reliance of financial activities on nature, which is critical for understanding the full scope of nature-related risks. • Based on our study, we recommended enhancing biodiversity risk screening tools by incorporating spatially explicit, asset-level data to improve accuracy and regulatory compliance. We also suggested adopting a modular approach, combining high-level portfolio screening with site-specific assessments to better capture actual impacts and dependencies. Finally, we emphasized the need for standardized metrics, transparent methodologies, and stakeholder collaboration to ensure tools are robust, comparable, and actionable for financial decision-making.
	Elaborate results stakeholder-specifically		Results were communicated to stakeholders in a targeted manner, highlighting financial institutions' exposure to biodiversity risks and the limitations of tools for asset-level decision-making. For tool developers and policymakers, the findings emphasized gaps in spatial resolution, transparency, and metric standardization, providing guidance for improving tool design and aligning outputs with ESRS E4 and voluntary reporting requirements.

FIEA		DP Implementation
	Disseminate and communicate	The results were disseminated through the publication of a peer-reviewed paper in the Journal of Forest Business Research, providing a detailed analysis of biodiversity risk screening tools and practical recommendations for financial institutions and policymakers. Full citation: Chudy, R. Barton DN. 2025. Biodiversity risk screening tools in finance fail to meet the need for local project risk screening. J.For.Bus.Res. 4(2): 47-64. https://doi.org/10.62320/jfbr.v4i2.74
	Disclose	In our published study, all conflicts of interest were disclosed, and the study acknowledged funding from the European Union's Horizon Europe Research and Innovation Programme under grant agreement No 101060415.
Act	Adopt results (in public and private decision-making)	• N/A
	Implement	• N/A
	Monitor and evaluate	• N/A

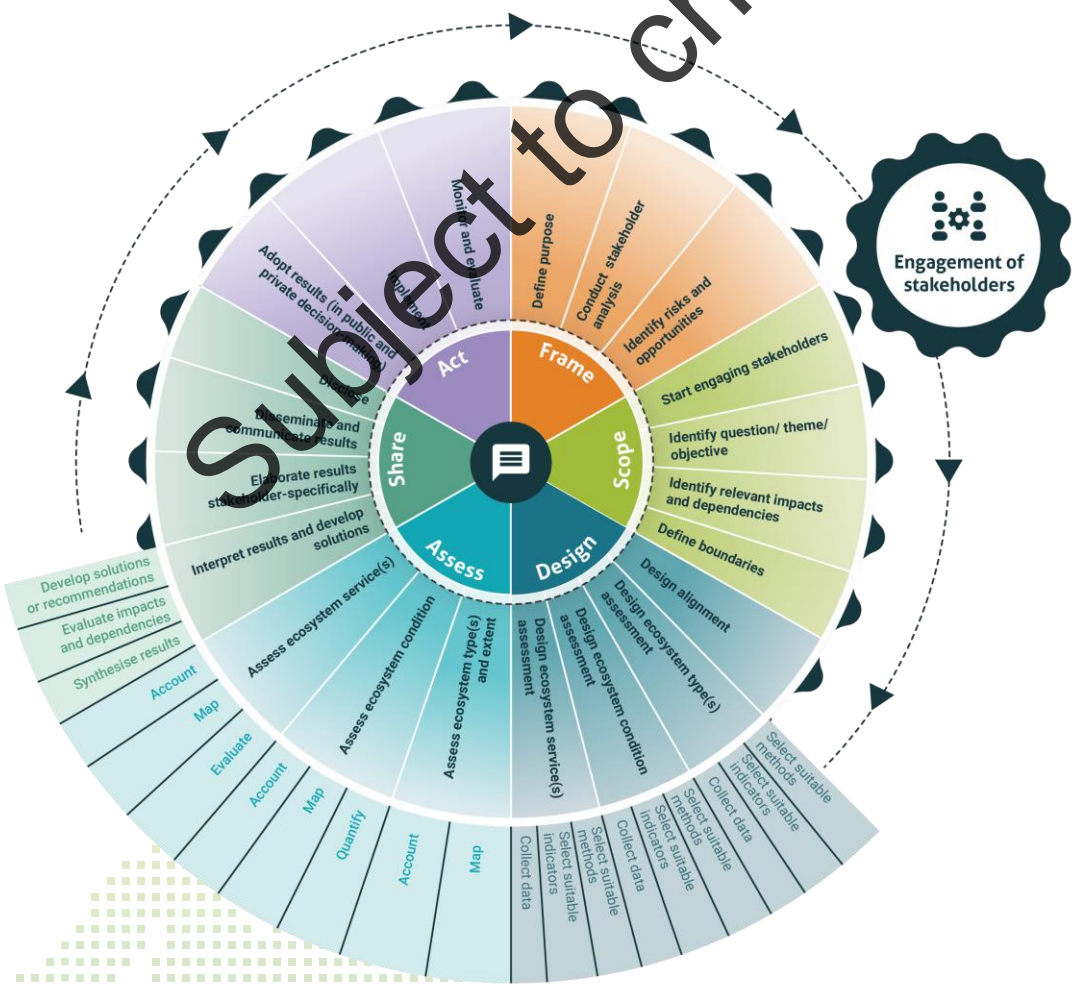
Framework for Integrated Ecosystem Assessment (FIEA)

Implementation in SELINA Demonstration Project (DP) 13

Improved management by increasing synergies between farming activities and ecosystem services provided by agroecosystems to foster biodiversity-based agricultural practices

Location Italy | **Sector** Agriculture

The project aims to create a master plan to promote sustainable farming by reducing input costs, boosting income, enhancing farm landscapes, improving soil and water quality, strengthening ecosystem services, fostering ecosystem synergies, and building climate resilience.



FIEA		DP Implementation
Frame	Define purpose	The assessment performed in DP13 is an action based on the Food District need to define a strategy for climate change adaptation and sustainable water management to preserve agriculture in the new climate scenario. The methodology applied in SELINA Project is therefore a consequence of the Food District requirements. The purpose and the goals of the assessment were defined and shared with the stakeholders in order to define a path allowing the exchange of information, results and other contributions.
	Conduct stakeholder analysis	Stakeholder analysis was already available since the beginning of the actitivies as SEAcoop conducted this task for the creation of the Food District. This element played a key role in the analysis conducted for the drafting of the district plan, as there was already a relationship of trust and recognition of expertise on the part of stakeholders. With the drafting of the plan, several elements proposed within the project had already been introduced and considered as added value for local agricultural production.
	Identify risks and opportunities	Risk and opportunities analysis was initially focused on natural risks related to climate change and effect on local agriculture. With the definition of the approach it was possibile to integrate the analysis including all co-benefits that were identified according to ecosystem services framework. The adptation strategy based on the concept of ecosystems and their services allows to better depict all positive externalities and benefits for the communities. These are the main elements from the SWOT analysis performed to define the goals of the Food District Plan: **Strengths:** The District benefits from a strengthened legal structure that enhances its capacity to access public funding, as demonstrated by the successful acquisition of SRG07.1 (MOC Project) resources. It operates within a well-developed and territorially widespread agricultural system characterized by high-quality local and typical productions, diversified landscapes, and crop variety. Its territorial branding and communication strategy—supported by the “Oltre Collina Torinese” brand and the progressive consolidation of initiatives such as “Lunch is Served”—contribute to growing visibility and identity. The District also relies on an expanding network of collaborations with tourism, cultural, and agri-food stakeholders, as well as institutional and project-based support from regional and local innovation actors. Established partnerships with restaurants, other Food Districts, and Agri-Food Centers further strengthen its integration within the broader territorial ecosystem. **Weaknesses:** The District faces structural and cultural constraints, including resistance to innovation within the agricultural sector and persistent distrust among small producers regarding the strategic value of Food Districts. The production system remains fragmented, with limited integration—particularly in the livestock sector—and uneven development of a shared territorial vision. Communication efforts lack full integration and effectiveness, especially in promoting agrobiodiversity as a unifying theme. Institutional dialogue and cross-sector coordination are often complex, and small municipalities remain marginally involved in District activities. Additional vulnerabilities include limited generational turnover, reduced investment capacity among small enterprises, difficulty in attracting tourist flows, and increasing exposure of crops to climate-related physiological and phytosanitary stresses.

FIEA		DP Implementation
Frame	Identify risks and opportunities	**Opportunities:** The external environment presents favorable dynamics, including growing consumer demand for high-quality food and alignment with European policy frameworks such as the Farm to Fork Strategy and the Common Agricultural Policy. Dedicated financial instruments supporting Food Districts create further development potential. The renewed interest in proximity and experiential tourism opens opportunities for territorial valorization, while the presence of neighboring Food Districts offers possibilities for inter-district cooperation in food policy implementation and integrated territorial development strategies. **Threats:** The District operates within a context marked by increasing uncertainty and systemic risks. These include the recurrence of global health crises, growing impacts of climate change—manifested through extreme weather events, plant diseases, invasive species, and livestock epidemics—and geopolitical instability affecting market dynamics. Economic volatility, inflation, rising operational costs, and competition from foreign producers further pressure local agricultural enterprises. Limited awareness of the role of Food Districts and the growing perception of agriculture and meat production as contributors to climate change represent additional reputational and structural challenges.
Scope	Start engaging stakeholders	Stakeholders were engaged since the beginning of activities as the Food District involves private and public operators of the reference territory. The following stakeholder categories were considered: • local authorities • local representatives of national farmers' organisations • local producers' associations • vocational training bodies • cultural associations • community foundations Representatives of stakeholder categories were interviewed during activities of "Operative Tables" (agroenvironment, products quality, territorial marketing). A draft version of the results was shared with all the Food District memebers in order to receive feedback and to refine the final version.
	Identify question/ theme/ objective	The objectives of this DP were identified as: (i) identification of ES critical for the DP and local farmers (ii) identification of links between ES and EC (iii) to support local farmers and the Food District to define adaptation strategies Objectives I and III were considerd and achieved. Objective II was not fully considered due to lack of resources as the analysis should be done at a detailed scale (field surveys and laboratory analyses) that were non critical for the scale of the study, but are crucial in case of activities conducted at farm scale. For the LCA we colleted field data about crops managed by the farms involved in the assessment. For the ES assement EC were integrated into the analysis by considering proxies such as parcels for organic farming, soil organic carbon content, High Nature Value Areas.
	Identify relevant impacts and dependencies	Dependencies were considered focusing on water demand for farming acitivites. Also impacts (#) were identified and assessed through the analysis of the results of ecosystem services modelling. At farm scale dependencies and impacts were considerd during the LCA of meat and milk production.

FIEA			DP Implementation
Scope	Define boundaries		Boundaries were defined according to Food District extension. This decision is related to the two main aspects: main dependencies (soil fertility and water availability) are linked to local processes and main impacts affect local environmental components. The assessment covers land use recorded in 2023 and 2024. The assessment of ecosystem services was carried out for these two years in order to identify any significant changes in the study area. The results showed that no significant changes occurred between the two years. In this context, the time scale adopted corresponds to the duration of the Food District Plan: 3 years. Ecosystem extent, condition (only indirect) as well as services will be assessed. No ecosystem accounting approach will be applied. The following ecosystem services will be included in the assessment: Crop production, carbon sequestration, pollination, habitat quality, water provision and nutrient retention. In parallel to the Ecosystem Assessment of the Food Disctrict, at the farm scale an LCA assessment was executed. This LCA assessment is not the focus of the Ecosystem Assessment described here, therefore it not specifically mentioned in the Design and Assess steps. However, the LCA results at the farm scale are considered in relation to the regional Food District work and contribute to the knowledge base informing the Masterplan SWITCH.
Design	Design alignment		The results were aligned to be of use for the Masterplan SWITCH (ecosystem Services and Water management for the InTegration of Climate Change adaptation and Habitat quality) in order to define actions to reduce impacts on environemtnal components (mainly soil, water and habitat quality) and to promote synergies between agroecosystems and natural ecosystems.
	Design ecosystem type(s) assessment	• Select suitable methods • Collect data	Classification was bed on the Regional Topographic map (1:10.000) integrated with other information obtained from Piedmont Region Geoportal (https://geoportale.igr.piemonte.it/cms/; i.e. High Nature Value Areas, Organig Farming parcels, Farming landuse [CAP regional database], Piedmont Region Forestry Territorial Plan, etc.) Indicators selected: Land use classes were correlated with Eunis standard, Corine Land Cover classification (third level), Piedmont Land Cover (fifth level of Corine LC standard). Land use data were collected from public database (Farming landuse [CAP regional database], Piedmont Region Forestry Territorial Plan, Regional Topographic map) were validated according to high resolution
	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	Indirect EC assessment was performed according to information from different database: Piedmont Region farming parcels; Piedmont Regione protected areas shapefile; Soil organic carbon content. To select suitable variables for the the indirect EC assement we used data on the distribution of organic farming parcels, protected areas and soil organic carbon content. For this DP, field surveys would also have been suitable, but they were not economically sustainable.

FIEA			DP Implementation
Design	Design alignment		The results were aligned to be of use for the Masterplan SWITCH (ecosystem Services and Water management for the InTegration of Climate Change adaptation and Habitat quality) in order to define actions to reduce impacts on environemtnal components (mainly soil, water and habitat quality) and to promote synergies between agroecosystems and natural ecosystems.
	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	With reference to the data used for the indirect assessment of ecosystem condition, the references are listed below: - organic farming parcels: farming landuse [CAP regional database]; - protected areas: Natura 2000 shapefile, protected areas shapefile (national, regional protected areas); - soil organic carbon content: Piedmont Region Soil Analyses Database. Mandatory environmental monitoring activities should extended to direct assessment of EC related indicators, like it is done for surface and underground water according to water directive.
	Design ecosystem service(s) assessment	• Select suitable methods • Select suitable indicators • Collect data	GIS models were applied (InVEST: Carbon storage, Habitat Quality, Crop pollination, Seasonal Water Yield, Nutrient Delivery Ratio). Crop production was based on the KIP-INCA model and specifically the EcoConcrops coefficient application. Indicators: Crop production derived from RICA (Agricultural Accounting Information Network) and KIP-INCA for Eco-Con Crops indicator (4th Natural Capital Report - Italy). The following datasets were used for each ecosystem service (ES): • Carbon sequestration: ecosystem type and extent data; National Forest Inventory and Forest Carbon Reservoirs of Italy (INFC); Piedmont Region Soil Analyses Database. • Pollination: ecosystem type and extent data; crop types. • Crop production: ecosystem type and extent data; crop types; Integrated Production Standards of the Piedmont Region; production data from the Council for Agricultural Research and Economics (RICA-CREA). Habitat quality: ecosystem type and extent data; crop types; Regional Ecological Network Map of the Piedmont Region; Organic Crops Map; Wetlands Map of the Piedmont Region. • Water provision: ecosystem type and extent data; meteorological data from the Regional Agency for Environmental Protection (ARPA Piemonte); Hydrographic Basins Map; Soil Hydrologic Groups Map; Digital Elevation Model (DEM); crop coefficients (Kc); Curve Number (CN). • Nutrient retention: ecosystem type and extent data; Hydrographic Basins Map; Digital Elevation Model (DEM); Integrated Production Standards of the Piedmont Region; Piedmont Region Soil Analyses Database; Potential Runoff Map.

FIEA			DP Implementation
Assess	Assess ecosystem type(s) and extent	• Map • Account	By integrating data on forest cover, crop types, wetlands, watercourses, and urban areas, we defined the land use and land cover types (according to the CORINE Land Cover Level III classification), identified the habitats (according to the EUNIS classification), and then produced a map of the ecosystem types. Based on this map, we analysed the distribution and extent of ecosystem types within the study area. During the analysis and mapping phase of ecosystem types within the study area, changes in ecosystem extent through time were not taken into account, as the primary objective was to evaluate existing ecosystems, their current extent and their associated ES, in order to identify hotspots and coldspots of ES provision within the examined territory and consequently guide intervention planning
	Assess ecosystem condition	• Quantify • Map • Account	Assessing ecosystem condition is relevant for evaluating the actual, rather than potential, provision of ecosystem services. However, we did not carry out an elaborated assessment, as we lacked the necessary technical and operational tools to quantify ecosystem condition and integrate it into the evaluation of ecosystem services. Nevertheless, we took into account the presence of organic farming as indirect assessments of ecosystem condition. Mapping ecosystem condition is relevant for evaluating the actual, rather than potential, provision of ecosystem services. However, we did not carry out this assessment, as we lacked the necessary technical and operational tools to map ecosystem condition and integrate it into the evaluation of ecosystem services. Nevertheless, we took into account the presence of organic farming as indirect assessments of ecosystem condition (see L17).
	Assess ecosystem service(s)	• Evaluate • Map • Account	The GIS-based moddeling apporaches (InVEST and the KIP-INCA model) were applied to assess the ES of interest: Crop production, carbon sequestration, pollination, habitat quality, water provision and nutrient retention. For some models ecosystem conditions were considered (e.g. organic farming). The assessment of ecosystem services was updated once during the course of the project. The first assessment was carried out on the basis of agricultural land use data relating to CAP declarations for 2023. In 2025, the analysis was updated taking into account agricultural use data for the year 2024. The spatial Ecosystem Service Assessment was used for Multiservices assessment in order to identify ES hotspots and cold spots as a reference term for ecological corridor enhancement. The analysis is based on the following thematic maps: • regional technical map (Piedmont Region 1:10,000) • digital terrain model (5 x 5 m) of the Piedmont Region • map of agricultural land use at cadastral parcel level (Piedmont Region, CAP declarations) • map of parcels used for organic farming (Piedmont Region, CAP declaration) • map of the Regional Ecological Network (Piedmont Region geoportal) • map of the surface hydrographic network (Piedmont Region geoportal)

FIEA			DP Implementation
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	The results of the assessment form the basis for the implementation of the Master Plan. The Masterplan provides guidelines and intervention type to increase resilience to CC and to increase Biodiversity and ES provision. Any information relating to changes in non-agricultural and agricultural land use can provide an overview of the effects of the Master Plan's implementation. The results of the assessment form the basis for the implementation of the Master Plan. The Masterplan provides guidelines and intervention type to increase resilience to CC and to increase Biodiversity and ES provision. Any information relating to changes in non-agricultural and agricultural land use can provide an overview of the effects of the Master Plan's implementation. The Masterplan provides guidelines and intervention type to increase resilience to CC and to increase Biodiversity and ES provision. In particular, it identifies areas of the territory that require interventions to improve ecosystem conditions and promote the provision of ecosystem services, such as groundwater recharge, habitat quality, and nutrient retention, by modifying the current "balance" that exclusively favours agricultural production. To this end, the masterplan proposes a set of interventions, including infiltration basins, infiltration forests, wetland restoration, forest improvements, buffer strips and linear elements (hedges and tree rows), and permanent grasslands.
	Elaborate results stakeholder-specifically		The results of the LCA were presented first to the owners of the companies involved, then to stakeholders, in particular representatives of trade associations, in relation to the possibility of the latter supporting companies in their decisions regarding participation in the agri-environmental payments provided for in the Rural Development Plan.
	Disseminate and communicate		N/A
	Disclose		N/A
Act	Adopt results (in public and private decision-making)		N/A
	Implement		N/A
	Monitor and evaluate		N/A

Framework for Integrated Ecosystem Assessment (FIEA)

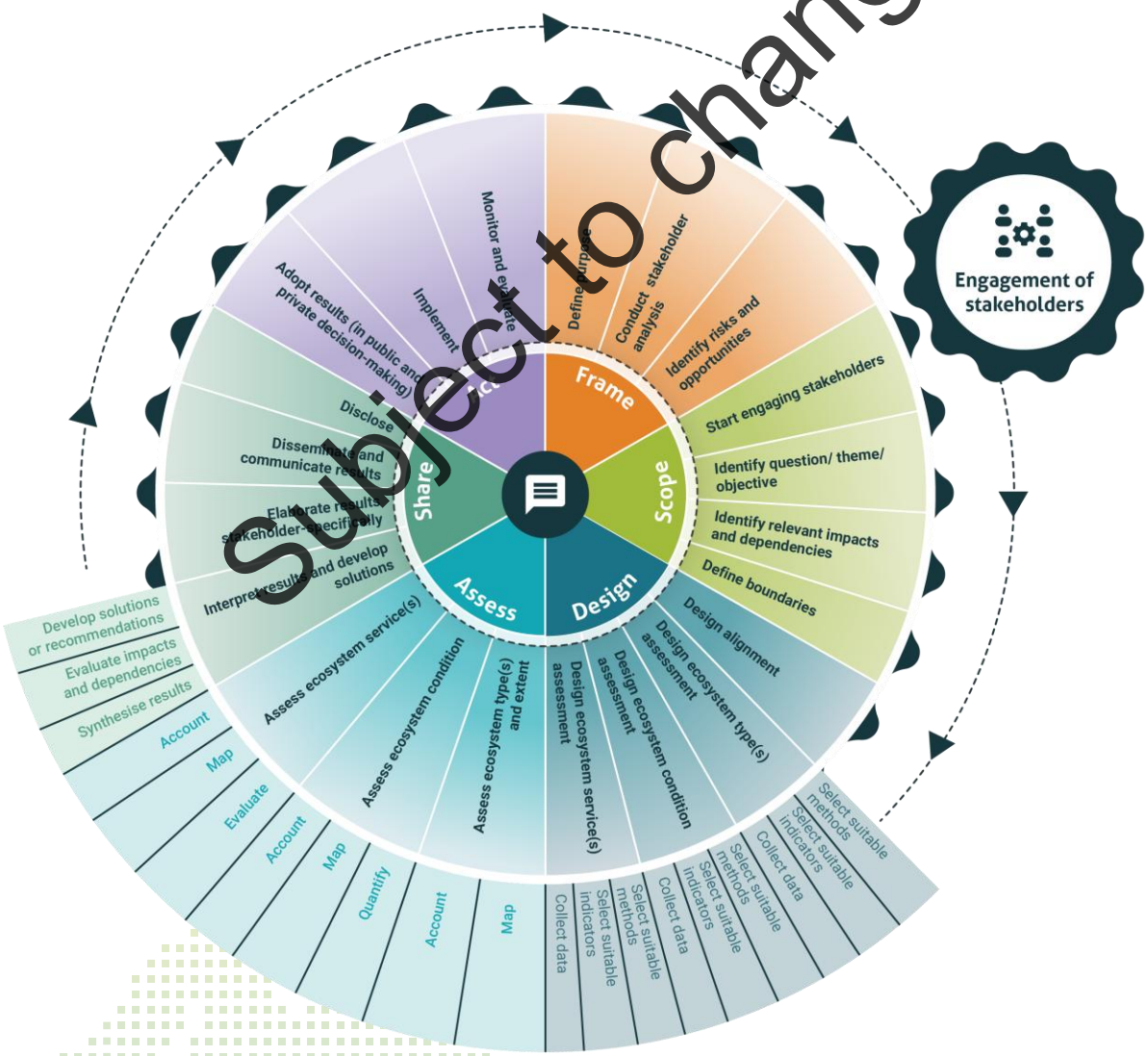
Implementation in

SELINA Demonstration Project (DP) 14

Investing in Nature-Based Solutions to Support Corporate Transition Plans

Location Europe | **Sector** Corporate Strategy & Finance

The project focuses on developing a standardized ecosystem services valuation approach to support corporate transition planning and strategic decision-making.



FIEA		DP Implementation
Frame	Define purpose	DP14 develops a generic EY denkstatt methodology for applying ecosystem service assessment and valuation in corporate nature protection and restoration projects. The purpose is to help EY teams and clients translate nature-positive activities into decision-relevant evidence on ecosystem condition, ecosystem service flows, stakeholder benefits and value. The approach is designed for typical corporate users: large companies and multinationals that need to assess multiple sites, often across geographies; align with sustainability, nature and corporate reporting expectations; conduct fast-track, desktop-based pre-feasibility assessments; and work under practical constraints such as limited ecological data, low internal familiarity with ecosystem service concepts, and reliance on externally implemented restoration or protection projects. DP14 draws on EY's experience in projects with various clients including Coca-Cola. The expected outcome is a standardised, auditable assessment approach that can be applied consistently across projects while remaining flexible enough to reflect site context, data availability and client priorities.
	Conduct stakeholder analysis	Stakeholder analysis is core to the DP14 methodology. Stakeholders are treated not only as audiences for results, but also as key informants, data providers and validation partners, especially where site visits and primary measurement campaigns are not feasible. Stakeholders are identified jointly with client representatives, typically sustainability or nature leads, and usually include: • - Internal stakeholders: executive management, sustainability teams, operations, supply chain, finance, communications and technical specialists. • - External stakeholders: restoration or conservation partners, technical providers, land stewards, public authorities, community representatives, NGOs, academics and other potential beneficiaries. DP14 applies a common stakeholder typology across projects to support consistent assessment and valuation. Typical beneficiary groups include the company, local communities, agriculture and other businesses, public authorities, tourists or recreational users, academia and researchers, global society and future generations. These stakeholder groups are linked to valuation methods because ecosystem service value is experienced by people and institutions.
	Identify risks and opportunities	The DP14 approach focuses on assessing positive changes generated by nature protection and restoration activities. Relevant opportunities are considered where they directly relate to the assessment results, such as improved prioritisation of restoration actions, communication of stakeholder benefits, identification of corporate dependencies, preparation for external

	FIEA	DP Implementation
Frame	Identify risks and opportunities	assurance, or potential valorisation through carbon, nature or ecosystem service markets. Nature dependencies are assessed insofar as the company analyzed is a direct beneficiary of ecosystem services in certain areas. The approach itself can be applied for a pure dependencies risk assessment if the scope of work necessitates this.
Scope	Start engaging stakeholders	Stakeholder engagement is implemented in a phased and proportionate way. The DP14 process starts with a kick-off involving the client project team and relevant internal functions to confirm the purpose, assessment boundaries, intended use of results, available data and responsibilities. Subsequent engagement focuses on: • dentifying existing data on ecosystem extent, condition, interventions and site management; • validating ecosystem types and relevant ecosystem services; • identifying beneficiaries and practical use of ecosystem services; • sense-checking assumptions, counterfactuals and model inputs; • reviewing results and limitations before communication. External stakeholders or implementation partners may be involved where they hold relevant site knowledge or data, acting as "key informants". Engagement is deliberately practical: it supports data discovery, validation, auditability and interpretation rather than being treated only as a consultation exercise.
	Identify question/ theme/ objective	The generic assessment objective is to quantify and communicate the ecosystem service benefits generated by corporate nature protection or restoration activities. More specifically, DP14 aims to: 1. identify ecosystem services linked to the relevant ecosystems and interventions; 2. assess changes in ecosystem extent and condition against a baseline or counterfactual; 3. quantify changes in ecosystem service flows where feasible; 4. assign benefits to relevant stakeholder groups, including the company where dependencies are material; 5. value benefits using appropriate biophysical, monetary or qualitative methods; 6. document data sources, calculations, assumptions and limitations in a way that supports internal review and external assurance. The method is intended to support prioritisation, management decisions, communication, sustainability reporting and preparation for third-party verification where required.
	Identify relevant impacts and dependencies	DP14 focuses primarily on positive impacts from nature protection and restoration activities and on corporate dependencies where the company is a beneficiary of ecosystem services.

FIEA		DP Implementation
Scope	Identify relevant impacts and dependencies	The method assesses change in benefits compared with a baseline or counterfactual, rather than only describing the current state of nature. Relevant impacts are identified by linking client interventions to expected changes in ecosystem extent, ecosystem condition and ecosystem service flows. Dependencies are considered where the company benefits directly or indirectly from ecosystem services, such as water availability, flood regulation, erosion protection, carbon sequestration, nature credits, recreational value for employees, reputational value or other decision-relevant benefits. The approach prioritises impacts and dependencies that can influence decisions or claims. This includes services with material value, services important to stakeholders, services linked to company strategy, and services where data quality can support credible conclusions.
	Define boundaries	Assessment boundaries are defined for each application of the DP14 method. Spatial boundaries are normally provided by the client as site polygons, project areas or other operational boundaries. Where the benefit extends beyond the site, additional analytical boundaries may be used, such as buffers for recreation or visual amenity, catchments for water-related services, or exposed assets and populations for regulating services. Temporal boundaries are usually defined as an annual ecosystem service flow, with optional projection over time where benefits accrue or persist beyond the assessment year. Time profiles, attribution and drop-off are documented explicitly where benefits are projected. Thematic boundaries include ecosystem types, condition variables, ecosystem services, stakeholder groups and valuation perspectives. Boundaries are refined iteratively as data availability, modelling requirements and stakeholder validation clarify what can be assessed credibly.
Design	Design alignment	Design alignment translates the purpose of DP14 into practical assessment outputs. The method is designed to produce results that are useful for corporate decision-making, communication and assurance. Expected outputs include: • a documented inventory of ecosystem types and extent; • condition variables or rubrics linked to the selected ecosystem services; • biophysical ecosystem service models with transparent assumptions; • monetary or qualitative valuation where appropriate; • results by site, ecosystem type, ecosystem service and stakeholder group; • standardised templates supporting audit trails and external assurance.

FIEA			DP Implementation
Design			DP14 is aligned with the logic of ecosystem service assessment, natural capital valuation and corporate sustainability assurance. It also uses standardised templates so that data inputs, assumptions, calculation steps and limitations are documented consistently across projects, enabling traceability and auditability for robust external claims.
	Design ecosystem type(s) assessment	• Select suitable methods • Collect data	Ecosystem types and extent are assessed using the best available client and secondary data. Clients provide project documentation, site polygons, habitat maps, restoration plans, land cover information, ecological surveys or partner reports. EY supplements this with light GIS assessment or public datasets where appropriate. A practical ecosystem typology is selected to support modelling. Where possible, ecosystem types are linked to a recognised classification such as IUCN Global Ecosystem Typology or other relevant classifications. However, the method also allows simplified classes where these are more useful for valuation models, provided the mapping logic is documented, as underlying model data often relies on classifications other than GET (such as e.g. IPCC land use types). The main methodological requirement is that ecosystem classes are sufficiently clear to support parameter selection, condition assessment and ecosystem service modelling. The step on selecting suitable methods is not usually executed. Ecosystem extent is typically defined directly from client-provided polygons, habitat maps, land cover classes or project documentation. Where additional indicators are needed to classify ecosystem type or extent, they are selected pragmatically based on available evidence, such as vegetation cover, land cover class, habitat description, canopy cover, hydrological features or other site-relevant characteristics. The chosen indicators are documented only to the level required to support transparent classification and subsequent modelling. The classification is done with client ecology experts and external key informants where relevant. Data for ecosystem type and extent is collected from existing sources rather than new field campaigns. Sources include client project documentation, spatial files, ecological or habitat surveys, restoration plans, management records, satellite-derived land cover datasets, public geospatial layers and implementation partner inputs.The data collection process is standardised through templates that record source, date, spatial coverage, classification logic, assumptions, limitations and data quality tier. This supports auditability and helps identify where future data improvements would strengthen the assessment.
	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	Condition assessment methods are selected to maintain a clear link between ecosystem condition and ecosystem service value. In DP14, the main principle is that ecosystem service modelling should include at

FIEA			DP Implementation
Design	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	at least one variable that reflects how protection or restoration changes ecosystem condition or service delivery capacity. The variable needs to be responsive to changes that are within the control of the company/client. Because corporate projects often lack systematic condition monitoring, DP14 uses a flexible hierarchy of methods: • direct measurements or monitoring data where available; • locally relevant geospatial or statistical data where suitable; • tacit condition data held by client teams, site managers, restoration partners or local experts, especially where site knowledge exists but has not been formalised in datasets. Structured condition rubrics are used to elicit, organise and document tacit condition data in a consistent and auditable way. Rubrics ask knowledgeable stakeholders to score or describe observable features, such as vegetation cover, habitat quality, management intensity, degradation signs, hydrological function or accessibility. This makes otherwise implicit knowledge usable for ecosystem service modelling while recording the rationale, evidence base, uncertainty and limitations behind each score. Condition assessment is documented transparently, including rationale, source, uncertainty and implications for valuation. The method prioritises practical, auditable condition indicators over overly complex indicators that cannot be supported by available data. Condition assessment methods are selected to maintain a clear link between ecosystem condition and ecosystem service value. In DP14, the main principle is that ecosystem service modelling should include at least one variable that reflects how protection or restoration changes ecosystem condition or service delivery capacity. The variable needs to be responsive to changes that are within the control of the company/client. Because corporate projects often lack systematic condition monitoring, DP14 uses a flexible hierarchy of methods: - direct measurements or monitoring data where available; - locally relevant geospatial or statistical data where suitable; - tacit condition data held by client teams, site managers, restoration partners or local experts, especially where site knowledge exists but has not been formalised in datasets. Structured condition rubrics are used to elicit, organise and document tacit condition data in a consistent and auditable way. Rubrics ask knowledgeable stakeholders to score or describe observable features, such as vegetation cover, habitat

FIEA			DP Implementation
Design	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	quality, management intensity, degradation signs, hydrological function or accessibility. This makes otherwise implicit knowledge usable for ecosystem service modelling while recording the rationale, evidence base, uncertainty and limitations behind each score. Condition assessment is documented transparently, including rationale, source, uncertainty and implications for valuation. The method prioritises practical, auditable condition indicators over overly complex indicators that cannot be supported by available data. Condition data is collected from client documentation, site surveys, monitoring reports, restoration partner knowledge, public datasets, literature and expert judgement. DP14 recognises that condition information is often fragmented: it may exist in ecological surveys, internal expert knowledge, field notes or partner reports without being available as a standardised dataset. DP14 therefore uses data collection templates and scoring rubrics to translate available evidence into documented model inputs. Each input is assigned a data quality tier: • Tier 1: primary or site-specific data; • Tier 2: locally relevant statistical or geospatial data; • Tier 3: literature values, averages, assumptions or expert judgement. This tiering supports transparent communication of certainty and helps clients identify which measurements would most improve future assessments.
	Design ecosystem service(s) assessment	• Select suitable methods • Select suitable indicators • Collect data	Ecosystem service methods are selected according to the service, stakeholder group, data availability and intended use of results. DP14 combines biophysical quantification and valuation in standardised modelling templates. Biophysical approaches include: • water supply or replenishment: available water stock or flow adjusted by use, stress or abstraction indicators; • biomass and genetic material: stock or production potential combined with sustainable extraction or use rates; • pollination and biological control: crop production or relevant output modified by dependency ratios and condition factors; • soil and sediment retention: changes in erosion-related model parameters compared with a baseline or counterfactual; • flood and storm mitigation: avoided exposure or damage to assets or land uses compared with a baseline or counterfactual; • global climate regulation: changes in carbon stocks or sequestration using recognised carbon factors;

FIEA			DP Implementation
Design			DP14 is aligned with the logic of ecosystem service assessment, natural capital valuation and corporate sustainability assurance. It also uses standardised templates so that data inputs, assumptions, calculation steps and limitations are documented consistently across projects, enabling traceability and auditability for robust external claims.
	Design ecosystem type(s) assessment	• Select suitable methods • Collect data	
	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	
	Design ecosystem service(s) assessment	• Select suitable methods • Select suitable indicators • Collect data	• water purification and filtration services: pollutant load or filtration capacity multiplied by avoided treatment, abatement or health-related values where data allows; • recreation, visual amenity, education, symbolic and other cultural services: visitor use, exposed population, accessibility or benefit transfer functions, modified by ecosystem condition where appropriate. Monetary valuation is based on marginal prices. DP14 deviates from the SEEA-EA approach of using exchange values and utilizes also welfare value, as this is deemed more decision-useful for stakeholders. Exchange values are still used where sensible for decision-making e.g. damage costs for floods. Suitable indicators include: cubic metres of water supplied or retained; tonnes of biomass; pollination-dependent crop yield; tonnes of soil or coastal erosion avoided; flooded area/depth avoided; tonnes of CO2e stored or sequestered; pollutant load avoided or filtered; number of visitors/beneficiaries. Data for ecosystem service assessment is collected through a standardised data hierarchy and template system. Inputs include client measurements and project records, locally relevant statistics, geospatial datasets, scientific literature, standard valuation factors, market prices, benefit transfer functions and expert judgement. Each input is recorded with its source, unit, spatial and temporal scope, assumptions, uncertainty and data quality tier. The tier structure is used both for auditability and for explaining confidence in the results: - Tier 1: primary or site-specific data; - Tier 2: locally relevant public, statistical or geospatial data; - Tier 3: literature values, averages, assumptions or expert judgement. The same template logic is applied across ecosystem services so that results can be reviewed, compared and improved consistently.

FIEA			DP Implementation
Assess	Assess ecosystem type(s) and extent	• Map • Account	In DP14 ecosystem service mapping is in most cases a data input, not an analysis step - it is provided from existing client studies. Where necessary, ecosystem types are mapped or otherwise spatially delineated using available site data or reclassified to relevant classifications for modelling (e.g. from GET to IPCC land use/ecosystem types). The output is a documented representation of ecosystem extent by site and ecosystem type. The level of spatial detail depends on the data available and the modelling needs. Where maps are not prepared as final outputs, the underlying spatial assumptions are still documented because they affect service modelling, stakeholder exposure and valuation. DP14 accounts for changes in ecosystem extent against a counterfactual but does not produce formal SEEA-style spatial ecosystem extent accounts. For protected ecosystems, the counterfactual is hypothetical: it represents the expected ecosystem extent or condition trajectory without the protection activity. For restored ecosystems, the baseline is normally the pre-project state before restoration took place. Changes in ecosystem extent are recorded at an aggregated level per ecosystem type in the project area. They are documented as modelling inputs for ecosystem service assessment rather than as separate spatial accounts. The method records the assumed baseline or counterfactual, the evidence supporting it, the extent change used in calculations, and the implications for ecosystem service flows.
	Assess ecosystem condition	• Quantify • Map • Account	DP14 quantifies ecosystem condition primarily through structured condition rubrics. This is in response to the fact that client condition data is often disparate or tacit and not necessarily aligned with ES modelling requirements. The rubrics translate available evidence and tacit site knowledge into documented condition scores. They are used to assess relevant condition features for each ecosystem-service relationship, such as vegetation cover, habitat quality, degradation level, management intensity, hydrological function, accessibility or other service-specific factors. Each rubric score records the evidence used, the rationale for the assessment, the data quality tier and key uncertainties. The resulting condition score is then used as an input or modifier in the ecosystem service model. Condition mapping is not normally produced as a standalone deliverable in DP14 unless the client needs maps for communication or decision-making. The method is primarily model- and template-based.

FIEA			DP Implementation
Assess	Assess ecosystem condition	• Quantify • Map • Account	Where spatial variation matters for service modelling, spatial inputs are still used and documented. Examples include catchment position, buffer populations, proximity to assets (e.g. for coastal flooding), exposure zones, accessibility. These inputs are assessed using simple GIS tools or manual spatial screening, but the final output remains a tabular model rather than a map. DP14 does not produce formal SEEA-style ecosystem condition accounts. Instead, condition is documented as an input to ecosystem service assessment and valuation. Condition change is typically inferred from changes in land use types, reflected by relevant parameters e.g. curve numbers, carbon stocks, or erodibility coefficients.
	Assess ecosystem service(s)	• Evaluate • Map • Account	Ecosystem services are evaluated by applying the selected biophysical and valuation models to the documented site inputs, condition variables, stakeholder assumptions and counterfactuals. The assessment focuses on marginal changes attributable to the protection or restoration activity, rather than total ecosystem value. Results are calculated for each relevant site, ecosystem service and stakeholder group. Biophysical flows are calculated first and then converted into monetary values using the selected valuation approach. DP14 does not produce ecosystem service maps. Ecosystem services are assessed through tabular models using documented inputs on ecosystem extent, condition, beneficiaries, valuation parameters and counterfactual assumptions. Spatial information may be used as an input where relevant, for example to define the project area, identify affected beneficiaries, estimate exposure or apply service-specific parameters. However, the output is an aggregated ecosystem service assessment by site, ecosystem type, service and stakeholder group, not a spatial map of ecosystem service supply or value. Changes in ecosystem service flows and values are calculated within the assessment model and may be projected over time where needed. Where benefits are projected over time, the method documents accrual curves, persistence assumptions, attribution, deadweight and drop-off. Results are tabular and not spatial.
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	Results are synthesised to show how ecosystem protection or restoration creates value across sites, ecosystem types, ecosystem services and stakeholder groups. Outputs include value per site, value per hectare, value by ecosystem service, value by ecosystem type, value by beneficiary group, and comparison of value against investment.

FIEA			DP Implementation
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	The synthesis links ecosystem condition, service flows, beneficiaries and valuation results so that users can understand not only the total value estimated, but where it comes from, who benefits and how robust the evidence is. This step also consolidates limitations, data quality tiers and sensitivity results to support transparent interpretation. Positive impacts are evaluated and it is established which are most material, which stakeholder groups benefit most. Where the beneficiary is the company itself, ecosystem service value is treated as a dependency and interpreted accordingly. In this step DP14 distinguishes between different kinds of value: value to local communities, value to public authorities, value to global society, value to future generations and value to the company. This distinction reduces the risk of interpreting ecosystem service values as direct financial gains where they are actually broader societal benefits. Where company dependencies are identified, the results can support discussions on resilience, operational risk, avoided costs and integration of nature into business planning. Recommendations are developed from the results and tailored to the intended use of the assessment. Recommendation types include: • prioritising sites or interventions with high ecosystem service value or high value per hectare (scarce but valuable sites); • improving restoration or protection design to increase stakeholder benefits; • strengthening condition monitoring and data quality for priority services; • identifying opportunities for credible communication or reporting; • exploring carbon, nature or ecosystem service market options where relevant; • improving internal governance, data ownership and repeatability of the assessment process, incl. by using SEEA-EA as a formal data structure methodology; • preparing evidence packages for internal review or external assurance. Recommendations are linked to the evidence generated by the model and clearly separated from assumptions or speculative opportunities.
	Elaborate results stakeholder-specifically		Recommendations are developed from the results and tailored to the intended use of the assessment. Recommendation types include:

FIEA		DP Implementation
Share	Elaborate results stakeholder-specifically	• prioritising sites or interventions with high ecosystem service value or high value per hectare (scarce but valuable sites); • improving restoration or protection design to increase stakeholder benefits; • strengthening condition monitoring and data quality for priority services; • identifying opportunities for credible communication or reporting; • exploring carbon, nature or ecosystem service market options where relevant; • improving internal governance, data ownership and repeatability of the assessment process, incl. by using SEEA-EA as a formal data structure methodology; • preparing evidence packages for internal review or external assurance. Recommendations are linked to the evidence generated by the model and clearly separated from assumptions or speculative opportunities.
	Disseminate and communicate	Communication focuses on transparent presentation of results, assumptions, uncertainty and limitations. DP14 uses standard outputs such as dashboards, results tables, site comparisons, stakeholder value summaries, sensitivity analysis and data quality tiering. Auditability under ISAE 3000 is an intended output from the start of the assessment. DP14 aims to have conclusions and claims can be independently verified through clear documentation of inputs, sources, assumptions, calculation steps, data quality tiers, limitations and review evidence. The data tier concept is central to communication and assurance. It allows users and reviewers to see which results are based on primary data, which rely on locally relevant secondary data, and which depend on literature values or expert judgement. This supports internal challenge, management interpretation and credible external communication.
	Disclose	Assessment results are used in sustainability reports, nature-related disclosures, claims about restoration benefits, investor communication or other public materials. DP14 method supports disclosure by documenting data sources, assumptions, methods, quality tiers, sensitivity analysis and limitations. The approach is designed to support assurance readiness under the internationally recognized ISAE 3000 process. Standardised templates create an audit trail showing how each result was calculated and whether the evidence is sufficient for the intended claim.
Act	Adopt results (in public and private decision-making)	Assessment results can be adopted into corporate decision-making by informing prioritisation,

FIEA		DP Implementation
Act	Adopt results (in public and private decision-making)	investment planning, restoration strategy, sustainability reporting, stakeholder engagement, internal business cases and communication. EY may support clients in preparing outputs, but final adoption and public use of results remains the responsibility of the company. The most important adoption pathway is not simply reporting a total value, but using the results to compare options, understand beneficiaries, improve data quality and integrate nature-related value into practical business processes.
	Implement	Implementation is not normally part of the DP14 assessment itself. The method supports implementation indirectly by identifying priority sites, services, data gaps and management recommendations. Clients or implementation partners are responsible for carrying out restoration, protection, monitoring or management actions. EY may support follow-up work where needed, for example by refining implementation plans, designing monitoring approaches or updating valuation models as new data becomes available.
	Monitor and evaluate	Monitoring and evaluation are not normally implemented within the initial DP14 assessment, but the method provides a clear basis for future monitoring. The data quality tiering and model templates identify which inputs are most important and where better data would improve confidence. Recommended monitoring may include repeated ecosystem extent mapping, condition indicators, targeted field measurements, visitor or use data, stakeholder feedback, intervention cost tracking and documentation of partner contributions. Future iterations can then update the baseline, refine valuation assumptions and improve assurance readiness.

Framework for Integrated Ecosystem Assessment (FIEA)

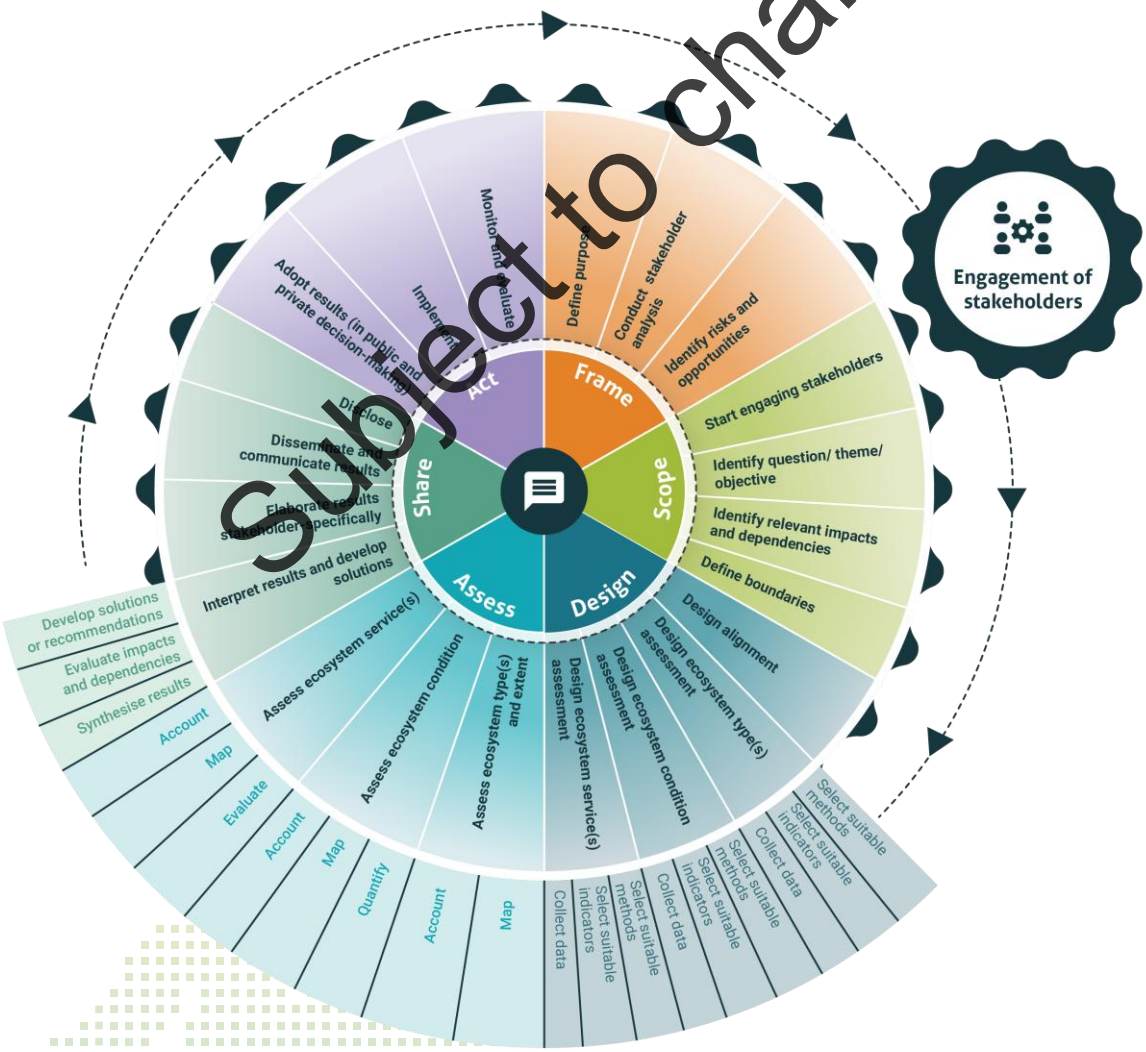
Implementation in

SELINA Demonstration Project (DP) 15

Valuing Nature in Construction: A Tool to Integrate Biodiversity Drivers and Ecosystem Services

Location The Netherlands | **Sector** Urban Planning & Construction

The project developed a practical, scientifically credible ES valuation tool that could demonstrate the tangible monetary value of nature-positive measures in infrastructure and real-estate projects, focusing on building a business case for nature and showing how ecosystem services contribute to corporate goals.



FIEA		DP Implementation
Frame	Define purpose	Purpose The assignment aimed to strengthen Heijmans' biodiversity credentials by demonstrating the tangible value of nature-positive measures. As a leading European construction services provider, Heijmans sought to align their strategy with CSRD/TNFD frameworks through four drivers: space for nature, species richness, environmental conditions, and nature as a resource. Success is measured across four pillars: inspiration, resilience, health, and production. Outcome The project delivered a practical, Excel-based tool primarily designed for the use of the sustainability team in Heijmans. Tailored to the Dutch national context using localized data and literature, the tool enables Heijmans to model scenarios for infrastructure and real estate projects. It provides evidence-based justifications for nature-inclusive investments, supporting both corporate sustainability and societal well-being, which can be used for the company's decisions in different project stages (design, construction) as well as for the company's strategy towards investors and tendering processes. Benefits and Applications The tool demonstrates that natural capital is a sound investment by quantifying ecological and economic value. Key applications include: • Strategic Planning: Integrating nature-inclusive measures during early design phases to maximize ecosystem services. • Competitive Advantage: Providing evidence of societal impact to strengthen bids during public and private tender processes. • Economic Analysis: Using Cost-Benefit Analysis (CBA) to compare "Business as Usual" against biodiversity-positive scenarios, determining the monetary impact for investors. • mpact Measurement: Tracking net changes in ecosystem services to validate project interventions and enhance brand reputation.
	Conduct stakeholder analysis	Targeted Expert Input While the formal partnership with Heijmans launched in early 2025, the project moved swiftly through a streamlined engagement process. It was therefore necessary to rely on our contacts from Heijmans to leverage the internal networks of Heijmans' ecologists, site managers, and procurement leads to ensure the tool was grounded in practical, on-site reality from day one. High-Level Strategic Alignment To ensure the project delivered immediate corporate value, we held a series of initial engagement consultations with the Head of Real Estate & Biodiversity and the Biodiversity Advisor.

	FIEA	DP Implementation
Frame	Conduct stakeholder analysis	. These sessions were instrumental in identifying critical pain points and defining a communication framework that prioritized clarity and action. Collaborative Objective Setting The tool's core objectives were developed with key executive stakeholders, including the Company Director and the Biodiversity Manager. By engaging leadership from both the Real Estate and Infrastructure divisions, we ensured the final output was not just a technical asset, but a strategic instrument aligned with Heijmans' overarching commercial and environmental goals.
	Identify risks and opportunities	Strategic & Legal Risks • Regulatory Compliance: Inadequate protection of nature or natural resources risks substantial fines and legal penalties • Market Access: As sustainability becomes a prerequisite for public and private tenders, a lack of robust biodiversity measures may result in the loss of major project opportunities to more nature-positive competitors. • Reputational damage: High-profile destruction of green spaces or loss of species can cause lasting damage to the brand and erode trust with clients, local communities, and potential employees. • Financial & Physical Risks • Climate & Flood Resilience: The loss of natural flood defences, such as tree cover and permeable soil, leads to increased runoff. • Capital Constraints: Without integrated biodiversity measures, securing "green finance" becomes increasingly difficult • Strategic Opportunities • Competitive Differentiation: Demonstrating measurable biodiversity gains provides a distinct advantage in the "green" construction market • Cost Efficiency through Nature-Based Solutions (NbS): Implementing nature-inclusive designs can reduce long-term capital expenditure on traditional drainage and cooling infrastructure. • Value Retention: Projects with high ecosystem service value such as improved air quality and "green" aesthetics often command higher real estate premiums and lower long-term insurance costs due to decreased hazard exposure. • Human Capital: A strong commitment to nature is a powerful tool for recruiting/retaining staff
Scope	Start engaging stakeholders	Only the key initially identified stakeholders were engaged since the beginning of the project. Goals and ambitions were developed with the Company Director and the Biodiversity Manager. Overall company's input for the development of the tool (data, validation of measures) was provided through Heijmans sustainability team.
	Identify question/ theme/ objective	In consultation with Heijmans, an overall objective was formulated. This was based upon Heijmans expressed desire to develop a tool that would present a monetary

FIEA		DP Implementation
Scope	Identify question/ theme/ objective	of ecosystems ervices at real estate and infrastructure construction projects. The objective was to strengthen biodiversity while using nature as a solution in the business operation and offering. The tool should help demonstrate that natural capital measures represent a sound investment for the client by adding ecological and potentially economic value. The assessment should be designed not merely to track compliance, but to inspire move beyond traditional "mitigation" (reducing harm) activities and 'business as usual' scenarios and help Heijmans go beyond regulatory requirements and peers. At this early stage, key ecosystem services were not identified or selected, as they would be location and project dependent.
	Identify relevant impacts and dependencies	To ensure the tool's outputs are both relevant and actionable, the assessment prioritised the highest impact impacts and dependencies between Heijmans' operations and the local environment. Land use change The most significant impact identified is Land Use Change. As a construction and infrastructure leader, Heijmans' primary footprint stems from the conversion of land for residential or civil use. Traditional development often results in the reduction of "space for nature" and the fragmentation of local habitats. By quantifying this impact, the tool enables project teams to design interventions such as green corridors or high-density vertical greenery that mitigate land-use pressure and restore ecological connectivity. Strategic Dependencies Heijmans' projects do not exist in isolation; they depend on healthy ecosystems for long-term viability and client satisfaction. Key dependencies integrated into the tool include: • Climate Regulation: Reliance on natural cooling (via vegetation) to mitigate the Urban Heat Island (UHI) effect in real estate developments. • Water Management: Dependency on soil permeability and natural drainage to manage runoff and prevent localized flooding on project sites.
	Define boundaries	The boundaries of this assessment were established to align with the core objective: providing a user-friendly, site-level valuation tool. 1. Geographic Scope: The assessment is strictly bounded by the legal and physical perimeters of the project sites provided by Heijmans. Focus remains on the footprint of real estate and infrastructure developments. While we recognize that ecosystems are interconnected and that interventions may influence adjacent areas (e.g., downstream water quality or local bird populations), these "spillover" effects were excluded due to resource constraints and based on the requirements of Heijmans. 2. Temporal Boundaries: To capture the true value of nature-inclusive measures, the tool employs a dual-layered temporal framework that looks at baseline and future level quantifications. This allows a comparison between different possible scenarios.

FIEA			DP Implementation
Scope	Define boundaries		3. Systemic Boundaries: The Direct Value Chain For the purposes of this tool, the boundary was set at the direct operational level. This meant the wider upstream value chain (e.g., the carbon footprint of raw material extraction) and downstream impacts beyond site handover were not included. This was agreed with Heijmans early in the project as it was decided this was not feasible within the constraints of the project and would not offer Heijmans sufficient value. 4. Biophysical & Social Context The boundaries were further refined to reflect the Dutch biophysical context. The tool focuses on ecosystem types relevant to the Netherlands, such as temperate grasslands, and urban forests
Design	Design alignment		The bridge between data generation and decision-making. The tool is designed to translate complex ecological metrics into a commercial language that supports Heijmans' nature ambitions. **1. Commercial & Operational use** • Financial Decision Support: Facilitating robust CBA and providing a clear ROI for NbS. • Strengthening tender submissions by quantifying the "Total Value" of a proposal, offering a significant competitive advantage over traditional bids • Risk Management: Potential to be used for informing site selection and design by identifying where nature-inclusive measures can best mitigate environmental risks **2. Users & scalability** • A primary objective was to ensure the tool's longevity and widespread adoption in company's decision making processes and strategies. Mainly staff from the sustainability department will be the ones running the tool and communicating its results to the Direction, project managers, procurement leads, and site developers. • 3. Strategic Alignment **3. Strategic Alignment** • The tool serves as the quantitative engine for Heijmans' overarching sustainability strategy, transforming "net-positive" ambitions into measurable results. • It provides the evidence base for Heijmans' commitment to ensuring every project delivers a net-positive contribution to nature. Furthermore, this positions Heijmans as a key contributor to national environmental goals, enhancing reputation with regulators and institutional investors.
	Design ecosystem type(s) assessment	• Select suitable methods • Collect data	We employed a multi-tiered methodology for ecosystem classification and accounting, integrating global and local frameworks and data sources.

FIEA			DP Implementation
Design	Design ecosystem type(s) assessment	• Select suitable methods • Collect data	• We looked at the possibility of implementing the SEEA-EA tiered approach to provide a structured pathway for ecosystem evaluation, ensuring that our accounting follows international natural capital standards. It was decided that Tier 3 was beyond the possibilities for this project, but was something that could be looked at and integrated later on. • ESVD & i-Tree Integration: To calculate the specific benefits of green assets (such as urban cooling and air filtration), we integrated values from the Ecosystem Service Value database and i-Tree coefficients. This allowed for a "Benefit Transfer" approach, where results from established ecological studies are applied to the specific parameters of Heijmans' project sites. • We used public data from the CBS (Centraal Bureau voor de Statistiek) and other national environmental databases to ensure the valuation coefficients reflect the Dutch socio-economic and biophysical reality Custom Ecosystem Classification • A cricital first step was to translate the raw and land cover data from Heijmans' on-site ecological assessments, reclassify it, and then map it onto CBS land-use classifications. This alignment was essential for "scaling" the tool, as it ensures that the data generated at the project level can be easily integrated into broader national environmental accounts or corporate-level sustainability reporting. There are notable assumptions made here and certain ecosystems were grouped together in broader categories when more specific categories would have allowed more accurate results. Some spatial data was made available from Heijmans in addition to the raw data on land-use/ecosystem change provided by their evaluating ecologists. Surface Area (m^2/ha): The primary indicator for spatial extent, categorized by ecosystem type (e.g., urban green, open water, forest). A scale was also developed for assessing the land cover in more detail for the real esytate tool. This was based on a BAF weighting scale that assigns ratings (0.0-1.0) for ecological integrity. This helped to improve overall accuracy of our assessment tool. Rankings based partially on permeability but also ecological/biodiversity value Site data (ecosystem/LUC) was acquired from Heijmans and provided the basis for ecosystem valuations. Supplementary data was acquired from public databases and other literature (ESVD, CBS, TEEB Stad Tool, iTree)
	Design ecosystem condition assessment	• Select suitable methods • Select suitable variables • Collect data	N/A

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Design	Design ecosystem service(s) assessment	• Select suitable methods • Select suitable indicators • Collect data	**Methodology: Tiered Approach** To balance precision with practicality, the tool aimed to use a tiered assessment framework: **Tier 1** Using "Benefit Transfer" methods, applying generalized Dutch valuation coefficients from sources like the TEEB Stad Tool and CBS to project sites based on land-use types. **Tier 2** (Condition-Adjusted Valuation): Incorporates a performance weighting scale. This allows for a more nuanced valuation by adjusting the "standard" value based on the quality or condition of the land type. This was used for adjusting ecological integrity of different ecosystem types when using the STAD tool and assessing healthcare benefits (e.g.high-quality mixed forest is weighted significantly higher for ecological integrity than arable land, meaning ecosystem service values reflected are higher). **Tier 3** (Site-Specific Modeling): For high-priority projects, the tool can integrate direct biophysical data. This was not included in the project, but is suggested as further work to consider for more accurate results Indicators were chosen that reflected both the biophysical capacity of the ecosystem and its socio-economic impact. Carbon sequestration, air pollution removal, pollination, green living environment - using national statistical data and valuations from literature and publicly available tools such as TEEB Stad tool, CBS, and the ESVD. Scenario development is a key aspect of the tool and allows Heijmans to ascertain the benefits of implementing different combinations of measures or land-use change options. *Collect data: Same as for ecosystem type(s) assessment*
Assess	Assess ecosystem type(s) and extent	• Map • Account	Data for land use type and ecosystem extent provided by Heijmans. Spatial data (GIS files) were provided by Heijmans for infrastructure project example, however, the key data extracted was the land cover in hecatres for each ecosystem/habitat type. Habitat location and connectivity were not assessed in the assignment.
	Assess ecosystem condition	• Quantify • Map • Account	N/A
	Assess ecosystem service(s)	• Evaluate • Map • Account	The tool integrates specific biophysical and monetary data across four core service categories: **Carbon Sequestration:** • Logic: Calculations are based on sequestration rates (tC/ha/year) for various Dutch land types, including orchards, urban green, and mixed forests.

FIEA			DP Implementation
Assess	Assess ecosystem service(s)	• Evaluate • Map • Account	• Source: Data is derived from Robinson et al. (2022) on the economic valuation of North Brabant landscapes and Remme et al. (2014) regarding carbon sequestration in Limburg. • Values are adjusted for inflation **Air Filtration (Air Pollution Removal):** • Models the removal of pollutants by different vegetation types, such as coniferous and broad-leaved forests. • Source: Uses estimations from Horlings et al. (2020) regarding the contribution of ecosystems to air filtration and the associated avoided health and mortality costs in the Netherlands. **Pollination:** • Assessed via a suitability index based on floral resources and nesting habitats. • Source: Horlings et al. (2020) and model that calculates pollination abundance as a relationship to nesting and foraging distances. **Green Living Environment & Real Estate:** • Evaluates the cultural and amenity value of green spaces, specifically looking at how proximity to parks, lakes, or "green views" increases property values. • Sources: Incorporates data from the TEEB Stad Tool and relevant literature **Inflation Adjustment**: All monetary values are inflation-adjusted using CBS (Statistics Netherlands) data (e.g., 2023 at 3.8%, 2024 at 3.2%) to provide present-value figures. **Discount Rates:** Discount rates are applied for future projections of ecosystem service valuations. These are related to the discount rates suggested in relevant literature or tools used.
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	Ongoing use of the tool by Heijmans to project different scenarios for projects. This will be used in future procurement and tender processes to demonstrate the value of including ecological measures and nature-inclusive building practices in projects. Early analysis of the real estate tool by Heijmans revealed surprise at the level of value derived from an increase in house prices due to green space in/nearby the sites. However, due to the small areas of habitat involved in these projects, cultural ecosystem services are understood to be of high importance, and house price increases over time reflect this. Analysis of how land-use cover has changed as a result of Heijmans' acitivites, with monetary valuations quantifying the differences in ecosystem service provision in baseline and alternative scenarios. Through using the tool to project different scenarios, Heijmans is able to assess the impact of projects and how the decisions they make during planning can have real-world ecological and monetary impacts in the future. This kmnowledge can be linked to project goals.

FIEA			DP Implementation
Share	Interpret results and develop solutions	• Synthesise results • Evaluate impacts and dependencies • Develop solutions or recommendations	This kmnowledge can be linked to project goals. For example, increasing house prices and valuations due to nature-inclusive design measures will be influential in getting stakeholders on board. Tool facilitates the development of multiple scenarios and its results can be used by stakeholders across the business (i.e. ecological consultants, finance directors, procurement teams) to assess trade-offs and cost-benefits of implementing certain ecological measures or offsets. Results are used to present the benefits to Heijmans, residents, and for wider society from integrating nature-inclusive measures and biodiversity into projects. Given small areas of land that can be given to nature across infrastructure and real estate projects, Heijmans can use the tool to assess the value of obtaining land to compensate further the negative impacts of the projects they undertake, therefore contributing to their wider goal of ensuring projects are nature positive. The tool can allow Heijmans to value the ecosystem service benefits of purchasing an additional hectare of land. This could be further enhanced by analysing the location and connectivity of the land in respect of other landscapes.
	Elaborate results stakeholder-specifically		**Use of results by Shareholders:** Results are framed in a language of Return on Investment (ROI) and natural capital appreciation, which can support the investor narrative. The tool demonstrates how these measures represent a sound investment by adding both ecological and potentially economic value over a 30-year term. **Use of results in Tendering processes:** The tool generates evidence of wider societal good, which is pivotal during public and private project proposals to gain a competitive advantage over rivals.
	Disseminate and communicate		Both internal and external dissemination of information. Internal company updates and training will allow employees to use the results of the tool within their own departments. Heijmans has a positive reputation externally when it comes to biodiversity, and communication of the tool fits into the wider narrative surrounding the company and its committment to nature positive construction
	Disclose		Potential for Heijmans to communicate involvement in project and work on biodiversity valuations as part of the annual sustainability report.
Act	Adopt results (in public and private decision-making)		N/A
	Implement		N/A
	Monitor and evaluate		N/A