eNaBLS

Education and NBS - bending the curve for biodiversity

DELIVERABLE D3.1

Seven Living Labs for Nature Based Solutions to Biodiversity Regeneration: Operational Model, Vision & Action Plans

Wageningen University & Research

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eNaBLS

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Document information

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Consortium

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Table of Abbreviations

Abbreviation	Description
AUTh	Aristotle University Thessaloniki
BD	Biodiversity
BHCR	Bioeast Hub - Czech Republic
BOKU	University of Natural Resources and Life Sciences - Austria
CEE	Central Eastern Europe
CERTH	Centre for Research and Techology Hellas - Greece
CoP	Community of Practice
D	Deliverable
ELS	Education and Learning Sciences (WUR Chairgroup)
eNaBLS	Education and Nature-Based Solutions: enable society to bend the curve for biodiversity
ES	Ecosystem Services
ESD	Education for Sustainable Development
EU	European Union
HE	Higher Education
HfWU	Hochschule für Wirtschaft und Umwelt Nürtingen-Geislingen
ICA	Association for European Life Sciences
ILEN	Institute of Landscape Development, Recreation and Conservation Planning
LL	Living Lab
LNL	Learn in Nature Lab
NBS	Nature Based Solution
NBT	Nature Based Thinking
NGO	Non-Governmental Organisation
NiE	Nature-inclusive Education
ReGeNL	Regenerative Growthfund project

RI	Research & Innovation
SBE	Society Based Education
SDG	Sustainable Development Goal
SME	Small & Medium Size Enterprise
T	Task
TLC	Teaching and Learning centre (WUR)
TVET	Technical and Vocational Education and Training
UBT	University of Bayreuth
UEF	University of Eastern Finland
UHOH	University of Hohenheim - Germany
US	University of Stuttgart
UT	University of Tübingen
VMU	Vytautas Magnus University – Lithuania
WP	Work Package
WUR	Wageningen University and Research – the Netherlands

1 Introduction to the eNaBLS Living Labs

1.1 A need for NBS education and skills development

Nature Based Solutions (NBS) comprise holistic approaches that leverage the power of nature to tackle environmental and societal challenges in a way that provides multiple benefits, including biodiversity gain (Sowińska-Świerkosz et al. 2022, European Commission 2025, IUCN 2020). Mainstreaming NBS therefore provides a promising pathway towards a sustainable future that is good for people and planet. As NBS per definition need to be adapted to local conditions, their implementation requires a systems approach and collaboration with multiple stakeholders (Wickenberg et al. 2021). Besides transferring knowledge, NBS training and education therefore need to include skills development allowing for tailoring that knowledge to the local context.

In WP1 of the eNaBLS project, online surveys and expert interviews were conducted to investigate 1) the current incorporation of NBS into higher education curricula in European universities, colleges and TVET schools and 2) collaboration between universities and TVET schools. Almost 60% of the respondents mentioned inclusion of some form of NBS concepts in their curricula. While the reasons to include NBS concepts in curricula varied among respondents and barriers to do so seemed to be region or country specific, insufficient resources were found to be a common hurdle to realizing the integration of NBS. A key finding from WP1 was that there is a need for practical teaching methods concerning NBS, and that student projects that provide hands-on experience have great potential for collaboration between higher education institutions and TVET schools. Additionally, it was found that there is an increasing demand for professionals with interdisciplinary environmental science skills (eNaBLS D1.1).

To accelerate training of academics and professionals in the implementation of NBS throughout Europe, the eNaBLS project aims to facilitate and promote the integration of NBS concepts and approaches into both academic and TVET education, as well as broader society. Living Labs (LL) provide a learning environment where knowledge institutes work on solutions to real-life societal problems through multi-stakeholder collaboration (AMS 2017). Through seven LLs in seven European countries, the eNaBLS project will experiment with NBS training and implementation in practical transdisciplinary projects embedded in the local context.

1.2 Towards a Living Lab way of working - the eNaBLS process

The LL approach was first introduced to most eNaBLS partners at the conceptualization phase of the project. To deepen understanding of the LL concept, the WUR team facilitated further familiarization for the partners with the nature and way of working of LLs in several steps. At the in-person kick-off meeting in Hohenheim in January 2024, WUR arranged an interactive session about the eNaBLS concepts Nature Based Solutions, Living Labs, and Skills & Competences. As there were still a lot of questions about LLs after this first meeting, WP3 lead Prof. Arjen Wals gave a presentation about LLs at the monthly online consortium meeting on 5th March. Another online meeting was organized on 12th June 2024 to discuss the LL Operational Framework that was being developed by WUR under task 2.1 to guide the development of the seven eNaBLS LLs. This was also the first moment the seven partners shared their initial ideas about their local LLs in break-out groups. The LL Operational Framework was delivered by the end of June, and to further guide the eNaBLS partners in the development of their LLs, several online tools designed by the AMS institute were shared.

To give individual support in ideation of each of the LLs, the WUR team held meetings with each LL team in August and September. In these meetings, it became clear that some ideas were further developed than others and the WUR team emphasized the importance of cocreation with stakeholders, urging the partners to connect to and meet with their prospective LL partners. Based on the insights from these individual sessions the WUR team formed buddy groups, matching eNaBLS LLs

with a similar approach or stage of development: the German LL was paired with the Czech LL, the Finnish LL with the Lithuanian LL, and the Austrian LL with the Greek LL. As the LL way of working is new to most partners, this buddy system is a way to ensure mutual learning and engagement as well strengthening relationships in the consortium. As the more experienced LL partner the WUR team does not have a fixed buddy LL, but assembles a team of individuals from all LLs as sparring partners.

At the in-person consortium meeting in Vienna in September, the LLs took the first steps towards their LL action plans using a few selected LL tools from the AMS institute. The 3s Research and Consulting team joined the Austrian LL team, and ICA partners divided themselves over different groups. After filling in these schematic questions about stakeholders, place and context, and the vision of their LL, the LL teams shared and discussed their ideas and plans first with their buddy group and then briefly presented their plan to all present. Finally, WUR presented their plan for a LL and the steps ahead towards the LL action plans and beyond.

Until then, most teams focused on deciding on NBS opportunities in the local context, and some partners were searching for ways to link to education. Therefore, an online meeting on student engagement and connecting the LLs to education was organized on 22nd October. Partners were asked to upload an update on progress in their LL development on the shared folder beforehand, and the last half hour of the meeting program was kept open to discuss progress and questions on the LL process or the LL action plan.

The WUR team provided a format for the LL action plans based on the Living Lab Roadmap designed by the AMS institute. All teams were asked to upload their draft LL action plans on 15th November, after which they were discussed in separate meetings with the buddy groups together with the WUR team. After these meetings the buddy groups were asked to send each other written feedback, and all received written feedback from WUR. Final action plans were submitted by 13th December, after which they were assembled as an operational model by WUR, and D3.1 was sent for final review to BHCR and UHOH partners.

1.3 Presenting: seven ENABLS Living labs

All ENABLS LLs incorporate the LL approach, working with multiple stakeholders on a real-life problem in the local context. Given these specificities of LLs, tailoring to local needs and ways of working, there are numerous differences between the seven ENABLS LLs, including topic, methods and approaches, and their ties to educational institutions. However, each of the LLs will create meaningful connections between local actors, raise awareness and understanding of NBS, and lay the basis for, or implement, integration of NBS concepts into TVET and higher education. ENABLS thus provides seven unique case studies for context-dependent NBS learning, acceptance and implementation. As the LLs come to life and mature following their own paths, inter-LL exchange will stimulate peer-to-peer learning among the partners, while between-LL comparisons will allow for the identification of success factors for NBS mainstreaming as well as the LL way of working.

Each of the ENABLS LLs set out from different starting points. Some partners build on an existing network or initiative, which they will use to create momentum for NBS. The LL in Czech Republic is using their network of partners built around introducing bioeconomy and sustainability concepts in Czech education to explore opportunities for NBS pilot testing in student projects. The Austrian LL also focuses on established partnerships, providing real-life cases in which students can develop the skills and competences required for balancing multi-stakeholder needs when taking a nature-based approach to land use planning. On the other hand, in the Netherlands the LL is used as a hub connecting existing and new initiatives around nature-based education to foster nature-based thinking across curricula in a whole institution approach. Other partners are finding their base in a local project or physical space that provides opportunities for NBS learning, and are connecting vested stakeholders around it in their LL. The Greek LL links to the current development of the Thessaloniki coast, the Finnish LL is finding opportunities for student projects in management of a local peatland and city

parks, and the Lithuanian LL is planning to use the campus as a showcase to introduce NBS to local stakeholders. The German LL is being built completely from scratch, bringing together stakeholders in a completely new endeavour that requires a lot of attention for relationship building and a shared vision.

The seven eNaBLS LLs cover a diversity of NBS-related themes, size and process. Clearly, there are differences in the pace at which the LLs can move forward. For instance, for many partners the living lab way of working is an experiment in itself and the concept of NBS is also rather new. In those cases, initial activities will focus on developing awareness and understanding of NBS before they can move to practical implementation in the local context. The Dutch LL is at the other end of the spectrum, connecting different initiatives around nature-based education, harnessing the existing momentum to ensure collective learning and development of joint activities.

Based in seven European countries, there are inevitably cultural differences and varying levels of familiarity with transdisciplinary working among the eNaBLS LLs. The Austrian LL will clearly benefit from their experience in working with local communities and policy makers using their landscape planning tool. Most eNaBLS LL partners are based in a university with varying involvement in education, while others (CZ, EL) are drawing in university partners. The integration of NBS in higher education will be tested in different forms through the eNaBLS LLs, ranging from student debates to project-based learning to embedding in existing courses.

The next chapters describe in detail the visions, plans and operational modes of action of each of the LLs, including the complex problems they will address, with whom, in which local context, and in which way it is interlinked with education. A summary of what the seven eNaBLS LLs aim to achieve is given in Table 1.1.

Table 1.1: The eNaBLS Living Labs in seven European countries: Austria (AT), Czech Republic (CZ), Germany (DE), Greece (EL), Finland (FI), Lithuania (LT), The Netherlands (NL).

Country	eNaBLS partners	Vision
AT	BOKU 3s	The Austrian Living Lab aims to address the complex socio-environmental challenges and land use conflicts in Austria. These conflicts arise from competing demands such as renewable energy expansion, biodiversity restoration, agriculture, tourism, and local recreation. The LL seeks to foster sustainable and inclusive solutions by equipping students with practical experience in navigating these competing interests. By integrating inter- and transdisciplinary approaches, stakeholder collaboration, and field-based learning, the Living Lab prepares students to visualize, analyse, and mediate conflicts, while ensuring the sustainable management of landscapes.
CZ	BHCR	The LL aims to address the lack of integration of NBS into Czech educational curricula. Due to the overall unfamiliarity with NBS in CZ initial focus will be on introducing the overall concept, before zooming in on a specific problem and NBS. The LL seeks to raise awareness, foster collaboration, and establish a multi-stakeholder network to embed NBS in education and promote sustainability and bioeconomy in the region. It involves hands-on learning, workshops, student-led projects, and interdisciplinary collaborations to raise awareness and build skills related to NBS.
DE	UHOH	The goal is to explore how NBS in the context of urbanization and biodiversity loss can be integrated into higher education. At the University of Hohenheim, the German LL will focus on testing the effectiveness of

		various teaching methods in transferring knowledge about NBS to halt the loss of biodiversity with students and, where possible, the general public. Teaching methods will include transdisciplinary interactions, outdoor learning activities, two-way knowledge exchange and opinion-forming through classroom debates, and the use of NBS case studies.
EL	CERTH IDEA FOCUS	Organised in the context of Thessaloniki's coastal regeneration initiative led by the Region of Central Macedonia, the Greek Living Lab will serve as a focal point for bringing together diverse stakeholders, including educators, professionals, community members, and policymakers, to discuss NBS and co-create sustainable solutions that enhance urban resilience and biodiversity. The Greek LL actively supports the ENABLS main goal of increasing the presence of NBS in VET and TVET by embedding NBS concepts within both vocational and lifelong learning frameworks.
FI	UEF	The Finnish LL aims to increase the skills and knowledge on (I) restoration of wetlands (peatlands in particular); and nature-positive actions (II) in forest ecosystems and (III) urban environments through transformative university-level education, targeted not only to degree students, but also outside academia by continuous learning and open university. The LL will produce multidisciplinary online education materials and training opportunities for UEF students, and has scaling potential through its Centre for Continuous Learning, and extensive national and international educational networks.
LT	VMU	The Lithuanian LL aims to address biodiversity restoration, promote NBS for climate change adaptation, soil protection, and community engagement making use of the VMU Agriculture Academy campus, including Arboretum collection, Dendropark, tree plantations, and tree nursery. It aims to embed NBS in university curricula and extracurricular activities, offering hands-on learning for students and fostering nature-based thinking through public workshops and vocational education programs.
NL	WUR	The Dutch LL focuses on NBW as nature-inclusive approaches to societal issues. They require a more nature-based mindset fostering new relationships with nature, reimagining governance and including active participation of communities. This living lab is about developing nature-inclusive educational approaches. Through a community of practice of teachers, students and other staff, such approaches will be co-created and tested in real-life course settings. The living lab will also include students in the process of research, evaluation and organisation of the living through course work, theses and internships.

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2 Action Plan Living Lab Austria: Landscapes4Future

2.1 Introduction - multifunctional landscapes

In Austria, as in much of Europe, the increasing use of land for various and often competing purposes is leading to significant land use conflicts. The slogan 'One landscape, many demands' aptly describes the challenges Austria faces when it comes to balancing the different interests of stakeholders in land use. In addition to the political goals for the expansion of renewable energies and the restoration of biodiversity, the demands of agriculture, tourism and local recreation must also be considered. These complex, often competing demands require comprehensive planning and cooperation between local communities, economic sectors, and policymakers. Addressing these complex challenges in landscape development requires an integrated planning approach to foster sustainable outcomes.

The Living Lab (LL) provides students with practical experience in managing land-use conflicts by combining interdisciplinary, collaborative, and nature-focused approaches. Through hands-on projects with real-world stakeholders, students gain a deeper understanding of sustainability and biodiversity, equipping them with the skills and insights needed to promote sustainable land-use practices in their future careers. At the same time, the lab fosters mutual learning by actively involving stakeholders such as local governments, conservation organizations, and community representatives. Stakeholders benefit from engaging with innovative tools and methods, gaining new perspectives and approaches to sustainable land management. They have also the opportunity to express their perspectives, which are integrated into the decision-making process, ensuring more inclusive and balanced outcomes. These partnerships, grounded in diverse rural and urban settings, not only facilitate fieldwork but also prepare students to navigate complex planning processes while empowering stakeholders to adopt and implement more effective, sustainable practices as well as fosters the mutual learning.

In the Landscapes4Future LL, students work on experiments and projects offered as part of courses. These experiments are carried out in collaboration with external partners and are based on challenges arising from planning practice and research. The students then work with the various stakeholders to develop solutions. For each project, students must assess the unique needs and conflicts of the studied landscape, consult with stakeholders, and work with stakeholders to develop actionable recommendations to ensure that the solutions are feasible and meet the needs of the community. Real-life-oriented learning and transdisciplinary approaches enhance student learning processes while fostering the development of soft skills that are essential for their careers after graduation.

The LL directly supports ENABLS goals by integrating Nature-based Solutions (NBS) concepts and biodiversity into the higher education curriculum. At the same time, however, events for a broader audience are also being organized in the context of the LL, in cooperation with non-university initiatives and groups. By tackling universal challenges — such as balancing biodiversity with energy needs or integrating climate adaptation measures with local land use — participants in the LL not only learn about NBS but also actively apply and discuss these solutions with real-world stakeholders. In addition, the LL incorporates nature-based thinking by encouraging students to consider the interconnectedness of natural systems and the benefits they provide. The LL also focuses on building skills to negotiate solutions with different stakeholders and to communicate different perspectives effectively. In this way, participants learn not only the basics of NBS, but also how to discuss and develop these solutions in dialogue with real-world stakeholders.

The approach developed in the Austrian context can also be applied to other countries and mountain regions facing similar land-use challenges, as it emphasizes interdisciplinary collaboration and community-driven solutions. This hands-on experience prepares students to implement effective, sustainable solutions in various global contexts, promoting biodiversity and climate resilience.

2.2 Brilliant idea or complex problem

2.2.1 Land-use conflicts: The complex, multidisciplinary and multistakeholder problem

In Austria, as in much of Europe, increasing land use for various and often competing purposes is leading to significant land-use conflicts. These conflicts arise from incompatible interests regarding land use, control, and management (Finietz et al., 2023). The consequences of these conflicts are becoming increasingly important, affecting both urban and rural areas. Given the limited amount of globally available land, conflicts over land use are inevitable and are likely to increase in both number and severity due to population growth, higher standards of living, and climate change reducing the amount of suitable land. Researchers propose comprehensive approaches focusing on anticipation and negotiation in the land-use planning process (Hersperger et al., 2015).

In Austria, 60% of farmland is classified as disadvantaged mountainous regions dominated by Alpine landscapes (Möhrs et al., 2013), highlighting the unique challenges of land use in the country. Rapid land consumption exacerbates these challenges, with urban expansion encroaching on limited agricultural land at a rate of 10 hectares per day in 2021 (UBA 2024). Austria's predominantly rural character is evident, with small municipal structures— 88% of all Austrian municipalities have less than 5,000 inhabitants (KDZ 2021). These rural areas hold significant potential for implementing NBS to meet the challenges of climate change and biodiversity loss. NBS are emerging as a key approach for integrating ecosystem services into both urban and rural planning and addressing societal challenges (Dushkova & Haase, 2020; Ronchi, 2020). Successful implementation of NBS requires overcoming challenges such as inadequate collaboration between actors, insufficient resources, and limited access to high-quality spatial data (Kuller et al., 2022). However, local spatial planning priorities, often influenced by financial pressures and short-term economic goals, frequently conflict with national or supra-local objectives for sustainable development (Getzner & Kadi, 2018). This conflict is compounded by limited resources for planning, knowledge transfer, and implementation of sustainable measures. Addressing these complex challenges requires an integrated planning approach that fosters sustainable outcomes through collaboration and innovation (Albert 2021). Poor spatial planning and improper implementation of nature-based solutions can diminish their functionality and cause issues such as inefficient resource use and environmental injustices (Wilson et al., 2008).

Planners play a critical role in mediating and negotiating land-use conflicts, necessitating technical expertise and emotional intelligence and strong communication skills. In this context, Education for Sustainable Development (ESD) is essential in equipping individuals with the knowledge, skills, and collaborative competencies needed to effectively tackle the intricate sustainability challenges of landscape development (Teff-Seker et al., 2019). Accordingly, our LL will focus on visualizing and discussing land-use conflicts, incorporating the diverse claims of different stakeholders in both rural and urban settings. Land-use conflicts in urban areas typically arise from the competing demands for limited space and resources, manifesting in various ways such as the tension between residential and commercial development, the preservation of green spaces versus urban expansion, the impact of infrastructure development on existing land uses, the social and economic tensions caused by gentrification, the conflicts between industrial and residential areas, the challenge of balancing historic preservation with modern development, the clash between public and private interests, the need for affordable housing versus profit-driven development, environmental concerns related to urban growth. In rural contexts, this will include topics such as managing multiple-use hedgerows, balancing forestry with agriculture, and reconciling photovoltaic installations or installing wind turbines with arable land. Based on previous research projects and interviews, as well as insights from planning and teaching practice, we recognize that gaining acceptance and ensuring successful implementation of NBS requires the involvement of various stakeholders and stakeholder groups such as landowners, citizens and maintenance staff. It is also crucial to have the skills to work effectively in inter- and transdisciplinary teams. The hypothesis is that multifunctional landscapes, managed sustainably, can meet multiple demands without compromising ecological integrity. Complexity arises from rapid

changes and diverse stakeholder perspectives. Planning challenge lies in reconciling differing views on land use: political goals for renewable energy and biodiversity restoration clash with economic, agricultural, and recreational priorities. Managing these demands requires integrated planning and compromise, often hindered by entrenched interests and varied visions of sustainable land use. Persistent socio-political conflicts and divergent stakeholder interests inhibit the smooth implementation of NBS. Stakeholders such as local governments, agricultural representatives, conservation groups, and tourism sectors often have conflicting goals, making it challenging to align on long-term strategies. Therefore, the potential solutions to the ongoing conflicts require sustainable and continuous analysis, reflection, and the integration of various types of knowledge, which will be the focus of our LL.

2.2.2 Living Lab Austria: Navigating land-use conflicts through collaborative spatial planning

The LL focuses on mutual learning in the field of spatial planning, which refers to a collaborative process where stakeholders—such as planners, government officials, community members, private sector representatives, and experts—exchange knowledge, experiences, and perspectives to improve planning outcomes. This approach emphasizes shared understanding and joint development of strategies for managing spatial resources, addressing societal challenges, and achieving sustainable development goals. In addition, the LL aims to train students to mediate these conflicts through stakeholder engagement, sustainable planning methods, and hands-on experience. By assessing landscapes and the mentioned conflicts with various methods like mapping, or stakeholder interviews, students learn to balance multiple interests. This approach equips students with the skills to navigate complex, real-world planning challenges and to integrate diverse perspectives into actionable NBS.

The underlying challenge of the LL is to address and mediate the complex land-use conflicts that arise from the competing demands for limited space and resources in both urban and rural areas of Austria. These conflicts are driven by incompatible interests regarding land use, control, and management, and are exacerbated by factors such as population growth, higher standards of living, and climate change, which reduce the amount of suitable land.

For municipalities, particularly smaller ones with limited resources, the challenge lies in balancing local spatial planning priorities with national objectives for sustainable development. These municipalities often face financial pressures and short-term economic goals that conflict with long-term sustainability efforts. The LL aims to provide these municipalities with the knowledge, skills, and collaborative competencies needed to effectively tackle these challenges through integrated planning and stakeholder engagement.

For planners, the challenge is to mediate and negotiate land-use conflicts while incorporating diverse stakeholder perspectives. This requires not only technical expertise but also emotional intelligence and strong communication skills. The LL will focus on equipping future planners with these essential skills to foster sustainable outcomes.

For stakeholders such as landowners, citizens, agricultural representatives, conservation groups, and the tourism sector, the challenge is to reconcile their often-conflicting goals and align on long-term strategies for sustainable land use. The LL will facilitate mutual learning and collaboration among these stakeholders to gain acceptance and ensure the successful implementation of NBS.

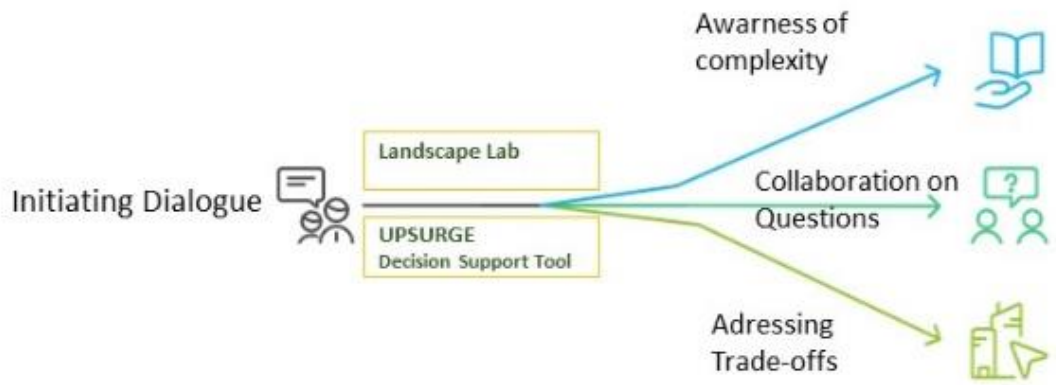

Figure 2.1: Initiating dialogue in the Landscapes4Future Living Lab using existing tools, including the LandscapeLab and UPSURGE Decision Support Tool

As visualised in Figure 2.1, existing tools such as the LandscapeLab and the UPSURGE Decision Support Tool, which have been developed in other research projects, can be used in the context of the LL to initiate a first dialogue with stakeholders. This aims to raise awareness of the complexity of spatial planning and subsequently work together on location-specific questions and trade-offs. Overall, the LL aims to address the complexity of land-use conflicts by fostering an environment of continuous analysis, reflection, and integration of various types of knowledge. By doing so, it seeks to create multifunctional landscapes that meet multiple demands without compromising ecological integrity, ultimately benefiting all involved parties.

2.3 Stakeholders and partners

The LL plays a significant role in capacity-building among stakeholders. Through workshops, training sessions, and collaborative experiments, participants can develop new skills and enhance their knowledge base. This capacity-building aspect is particularly important for empowering local communities and organizations, enabling them to take an active role in the innovation process. By equipping stakeholders with the necessary tools and resources, the LL contributes to the sustainability and resilience of communities.

One of the core facilities of the LL will be the **LandscapeLab**, serving as a physical space where mutual learning processes can be initiated and facilitated. LandscapeLab uses a playful digital VR-based approach for participation and joint learning to develop scenarios and visions for nature-based solutions. What is particularly important here is the low-threshold integration of computer interaction into group processes so as not to create barriers (e.g. for people with little computer knowledge or heterogeneous groups). The LandscapeLab uses therefore a system like a board game in which physical game tokens can be placed on an interactive map. These tokens are recognised by a camera system and translated into computer actions. In the case of nature-based solutions, however, precise demarcations in the form of areas and/or lines are often necessary (e.g. road-side measures, redesign of agricultural areas, renaturation of watercourses, etc.), which are to be implemented within the framework of ENABLS in order to realise a new approach for the joint planning and evaluation of NBS within the framework of a LL. In the LL, participants can apply the platform to learn how to develop nature-based and biodiversity-enhancing solutions through participatory, hands-on methods. The innovative tools of the LandscapeLab enable them to translate theoretical knowledge into practical applications, fostering sustainable land-use strategies through collaborative planning.

Building on the success of the Landscape Lab, the LL enriches its approach to sustainable land use and biodiversity, integrating research, education, and community involvement into a holistic framework for teaching and practical application.

To initiate mutual learning among the stakeholders from the **Biodiversity Platform at BOKU University** will play a central role. To integrate researchers from the Biodiversity Platform, we will host a session at BOKU Biodiversity Days. This session will map current teaching approaches to NBS and biodiversity, assess the competencies these aim to develop in students, and explore potential of collaboration within related, already established, courses. Additionally, we will discuss ways to better integrate NBS and biodiversity into the curriculum through new teaching formats, enabling deeper collaboration and innovation in education at BOKU.

Municipal politics and local government bodies will present on the one hand the current land-use challenges and potential conflicts of interest. On the other hand, they will receive insights into innovative solutions, best practices from other regions, and strategies for effective stakeholder engagement and conflict resolution. This exchange will enhance their capacity to address complex land-use issues collaboratively and sustainably. The involvement of local governments is crucial for aligning the LL's initiatives with local goals and addressing policy-related challenges in land use. Additionally, the local governments have established social networks, which we can leverage to engage with various landowners and stakeholders. We have already established collaborations from previous research projects and are currently assessing which municipalities and regions are in planning processes or phases suited for collaboration within the LL framework.

Schools and Non-Governmental Organisations. We aim to engage diverse citizen groups through established networks, including schoolchildren, via various activities such as those organized within the framework of **Lange Nacht der Forschung or Kinderuni** . Environmental NGOs, like Naturfreunde, and local community members are essential stakeholders in the Austrian LL. These groups play a crucial role in raising awareness and demonstrating how NBS can be practically integrated into land-use practices. In collaboration with the Volkshochschulen, we can design and offer workshops that foster environmental awareness, showing how biodiversity can thrive in private gardens and local ecosystems. The involvement of Naturfreunde is equally important, as their focus on sustainable tourism and environmental education supports the integration of NBS into leisure and tourism activities - a sector dependent on healthy ecosystems and facing societal challenges like climate change and disaster risk.

Practitioners: We will maintain regular contact with practice-oriented stakeholders, such as the **Austrian Society of Landscape Architecture / Österreichische Gesellschaft für Landschaftsarchitektur**, to ensure that students remain engaged with real-life challenges and develop the competencies needed to address current environmental and nature-based solutions challenges. This ongoing collaboration will bridge the gap between academic learning and practical application, preparing students to contribute effectively to sustainable solutions in their future careers.

2.4 Location and context

The LL is an interdisciplinary facility within BOKU University equipped with a dedicated space on campus where it supports collaborative, project-based work on a variety of environmental and spatial planning topics. It primarily serves BOKU courses, allowing students and teaching staff to use advanced tools such as the Landscape Lab 3D environment for hands-on learning and planning exercises. While the lab is available for on-campus sessions, an important goal is to take these interactive resources into regional settings and conduct hands-on workshops with local communities to teach and apply sustainable planning solutions.

The LL is primarily managed by BOKU ENABLS Team creating together with internal partners such as teaching staff from other institutes working on NBS and external experts (Naturfreunde, Leader Regions, Biosphere Parks, Mayors) to create a mutual learning environment. Teachers using the LL will

be continuously asked to reflect and, teachers can enhance their effectiveness in the classroom and better support student learning and growth. Students work in groups to address real-world challenges alongside communities, government agencies and/or conservation organisations. Using a variety of planning and management tools students apply their academic knowledge and innovative ideas directly to community projects. These projects are tailored to the focus of each course and address issues such as balancing biodiversity conservation with renewable energy development or integrating climate adaptation measures to enhance local biodiversity.

Through these interdisciplinary and transdisciplinary projects, students gain valuable experience in stakeholder engagement, understanding the complexities of land use and promoting biodiversity-friendly practices. The LL not only builds technical and analytical skills, but also fosters effective cross-disciplinary communication, preparing students to address pressing environmental issues collaboratively and holistically.

2.5 Reality check: experiments, location, context

In an urban and rural contexts such as a Lower Austria region, we can implement a series of experiments within the LL that integrate NBS and biodiversity concepts. This setup allows students to tackle real-world planning challenges while aiding the municipality in formulating a Spatial Development Concept ("Räumliches Entwicklungskonzept") that supports sustainable land use, ecological resilience, and community well-being. Below are potential real-life experimentations that can be embedded into the lab activities.

Experiments in Spatial Analysis and Biodiversity-Enhanced Development Strategy

The municipality aims to create a Spatial Development Concept that addresses sustainable growth while enhancing biodiversity. As part of this process, students will assess the municipality's "Ist-Situation" (current situation) by mapping areas with high ecological value (e.g., habitats, natural corridors) and identifying threats to biodiversity from current land-use patterns. They may explore how different development strategies—such as reducing isolated housing developments and creating green corridors—can mitigate environmental impacts. These findings will inform recommendations for preserving biodiversity while minimizing transportation emissions, fossil fuel dependence, and fragmentation of natural habitats.

Community and Stakeholder Engagement

Involving local stakeholders is critical to creating community-centered NBS and biodiversity strategies. Students will engage with residents, conservation groups, and local businesses to understand their perspectives on biodiversity and sustainable land use. Through interviews and community workshops, they will explore how NBS (e.g., creating green spaces, urban forests, or pollinator-friendly areas) can be integrated into planning. By discussing these ideas directly with the community, students gain insight into local biodiversity priorities and learn to incorporate community-supported solutions into planning.

Identifying Opportunities for NBS

The Spatial Development Concept will need to highlight areas for biodiversity conservation and NBS implementation. Students can analyze specific zones where NBS—such as natural flood management in low-lying areas, green roofs, or reforestation along urban edges—could mitigate risks like flooding, soil erosion, or biodiversity loss. By mapping these opportunities, students can propose a strategy that balances the need for economic growth with ecological integrity, highlighting areas where green infrastructure can strengthen the municipality's resilience to climate change and enhance biodiversity.

Simulating NBS-Integrated Development Scenarios Using GIS and VR Tools

Utilizing the LL 's interactive tools, such as the GIS-based "LandscapeLab," students can simulate planning scenarios that incorporate biodiversity and NBS. For example, they could model the effects

of green corridors on local species' movement or simulate the cooling effect of additional green spaces on urban areas. These simulations provide a tangible way for the community to visualize NBS benefits, from reduced heat islands to improved air quality. In public workshops, these visualizations can help communicate the impact of NBS, allowing stakeholders to see the ecological and social benefits of nature-based interventions.

2.5.1 Preliminary Timeline

Initiation phase where the topic is discussed initially, stakeholders are identified

August 2024: Mapping of NBS-related courses within the Department

Oktober 2024: Initial conversations with the Didactic Department, discussion of competences and skills of future LL teachers and planning students

November 2024: Conversation with 3s about TVET integration and with different teachers, about future collaboration within the LL

December 2024: LL project-plan is finished

Collaboration within Teaching

January 2025 – March 2024: Meeting teaching staff from other Institutes and stakeholders to discuss teaching collaborations for 2025

Co-creation phase

March – October 2025: Activities and courses to test tools, materials, approaches and collaborations, data collection

Monitoring and Evaluation Phase

April 2025 – June 2026: Monitoring and evaluation phase, where stakeholders reflect on progress or lack there-off to determine whether and how actions need to be adjusted.

2.6 Community involvement

In terms of participation, the Lab will involve different levels of citizen engagement (Figure 2.2), following the operational framework. Local residents and stakeholders will participate in co-design workshops and community feedback sessions to inform the development of green spaces and sustainable practices. Participation may also include on-the-ground citizen science activities, where community members help collect data or monitor local ecosystems, contributing directly to the outcomes of the NBS project. The overall learning that the LL includes:

Practical problem-solving skills: Students gain hands-on experience in addressing real-world land use and sustainability challenges through collaborative projects.

Stakeholder engagement competencies: Participants learn how to effectively involve and communicate with diverse stakeholders, including local residents, government officials, and industry representatives.

Interdisciplinary collaboration: The LL fosters the ability to work across disciplines, combining insights from environmental science, urban planning, social sciences, and other relevant fields.

Systems thinking: Participants develop a holistic understanding of complex sustainability issues and their interconnections.

Innovative solution development: The LL environment encourages creative approaches to developing nature-based solutions (NBS) and sustainable land use practices.

Technical skills: Students gain proficiency in using tools like GIS, VR, and data analysis for environmental planning.

Adaptive management: Participants learn to adjust strategies based on feedback and changing conditions in real-world settings.

Knowledge translation: The LL emphasizes the ability to communicate complex scientific concepts to diverse audiences and translate research into actionable recommendations.

Ethical considerations: Participants gain awareness of the social and environmental impacts of planning decisions.

Capacity building: The LL aims to empower local communities and organizations with the knowledge and skills to implement long-term sustainable practices.

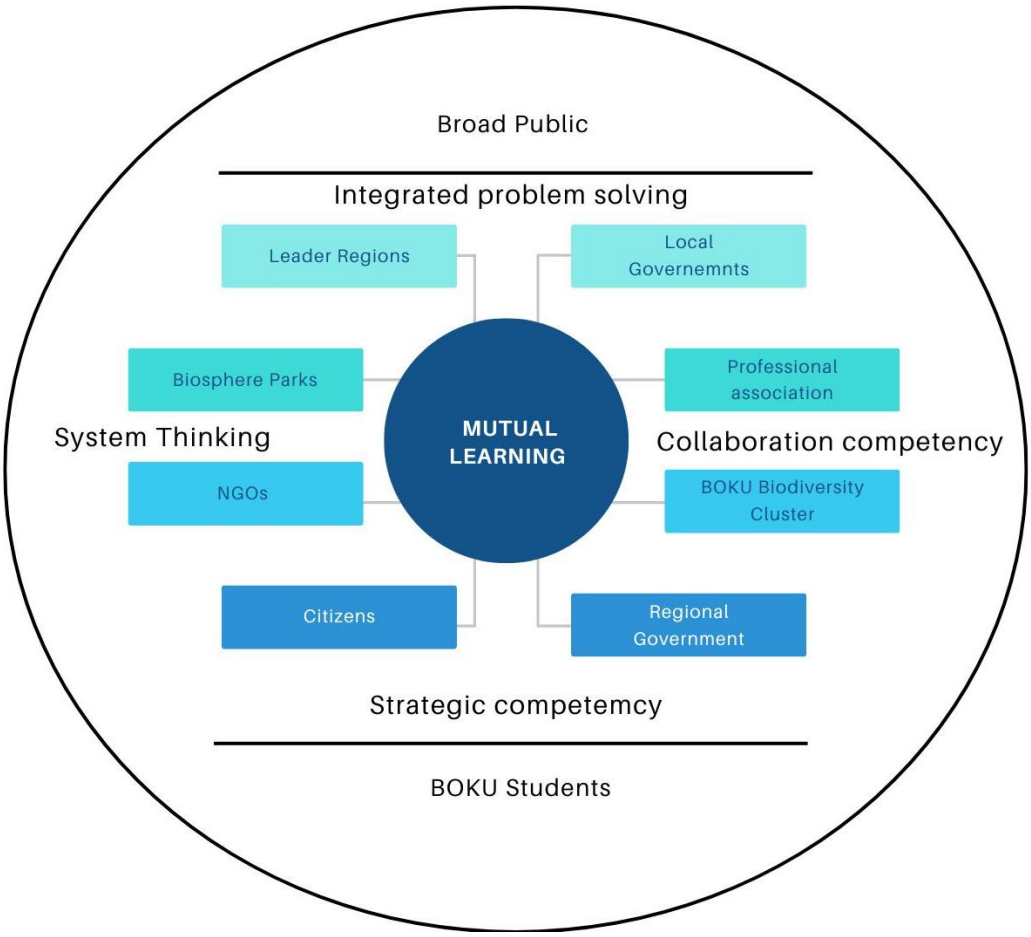

Figure 2.2: Visualization of the various actors participating in the Living Lab and skills to be developed as part of the experiments

To achieve the desired outcomes, various disciplines and expertise are essential in the lab and during the mutual learning process. Environmental science and ecology will play a key role in assessing biodiversity and ecosystems. Urban and regional planning experts will contribute to creating practical spatial solutions, while GIS specialists and data scientists will be vital for mapping, analysis, and visualizing data. Social scientists will guide stakeholder engagement efforts and ensure the social impact of NBS is thoroughly understood.

2.7 Process design

Living Lab coordinators: The LL is coordinated by the ENABLS Project Team within the Institute of Landscape Development, Recreation and Conservation Planning (ILEN) at BOKU University.

Data Processing within the Landscap Lab: The LL at BOKU University is organized to support an inter- and transdisciplinary approach to data processing, planning, and engagement with external partners. The Landscape Lab team handles data processing and technical operations, particularly for managing and visualizing spatial data within the 3D landscape environment. Course instructors are responsible for the organization, coordination, and communication with external partners. They set the framework for each project and guide students in contacting local associations, networks, and stakeholders relevant to their specific research questions. This setup also allows students to engage directly with local organizations, developing outreach and professional communication skills, especially in applied field settings.

External partners such as municipalities, local authorities, and conservation organizations, may contribute by providing data, case studies, and opportunities for students to engage in hands-on projects. Their involvement might also include in-kind support like access to local sites, participation in workshops, or offering expertise during planning phases.

Alignment of Tasks with Competencies: Roles and responsibilities align well with the competencies of each participant. The Landscape Lab team has the technical expertise required for data processing, while instructors bring pedagogical and organizational skills, ensuring smooth project facilitation. Students, with the guidance of instructors, develop targeted outreach and project management skills, directly engaging with stakeholders as appropriate for their course and project requirements.

2.8 The role of education in the Living Lab

Education for Sustainable Development (ESD) plays a crucial role in addressing global challenges, including natural resource conflicts and sustainable development (Leder, 2016; Niens & Bögeholz, 2021). Implementing ESD requires consideration of regional contexts and teacher perspectives (Niens & Bögeholz, 2021). Conflicts of interest are essential in ESD, as they drive dialogue and meaning making about the sustainability issues (Lundegård & Wickman, 2007).

The Austrian LL is dedicated to the eNaBLS goal 'Awareness of NBS in Higher Education'. We cooperate with the BOKU E-learning and Didactics Department to increase the awareness of teachers for NBS specific competences and skills. We will analyse the needs of different teachers and students at BOKU University and discuss which competences we want to promote in our teaching to address the current pressing challenges such as climate change adaptation and biodiversity loss with the help of NBS. In general, we will embed the LL and the NBS into the existing curricula and courses at BOKU, for this purpose we have mapped all courses that have a reference to NBS. We will contact the lecturers and look for future cooperation in the LL. This could also include vocational schools that are interested in integrating NBS concepts into their curricula and providing students with practical experience in sustainable land use and NBS implementation. Our educational activity will be integrated into existing curricula and courses by allowing students to participate in LL projects that emphasize NBS. We will involve educators from BOKU, external experts, and stakeholders in established courses who work with NBS in real-world contexts. This activity will also be open to interdisciplinary collaboration, allowing students from various fields to contribute.

As part of these courses, we will organize group projects that focus on solving real-world challenges in collaboration with communities, conservation organizations, and local stakeholders, as well as fieldwork where students work directly with local communities to carry out inventories, mapping, and stakeholder interviews. These experiences allow students to apply theoretical knowledge to practical, community-based projects, with faculty guiding them to think critically about the complexities and impact of their work.

Within the project timeframe, it is realistic to establish the initial course with BOKU Didactics, pilot several educational activities, and conduct a workshop with external stakeholders. After the project lifetime, we aim to expand the LL 's reach by incorporating more inter- and transdisciplinary courses and establishing partnerships with additional educational institutions, including vocational training

providers. By building a network of partners, the LL can continue to offer collaborative learning opportunities and practical NBS projects, encouraging ongoing engagement and knowledge-sharing in NBS beyond the university.

2.9 Reflexive monitoring, data management and reporting

To effectively organize monitoring, data management, and reporting for the LL, we will implement a comprehensive system that ensures accurate tracking of progress, efficient data handling, and clear communication of results. This system will be structured as follows:

- Integration of NBS and biodiversity into existing courses
- Development of new NBS and biodiversity focused programs or modules
- Increased student engagement in NBS projects
- Partnerships with local communities for real-world NBS applications
- Surveys to assess stakeholder perceptions of NBS before and after involvement
- Monitoring student interest in NBS-related courses and projects
- Evaluating the willingness of external partners to collaborate on NBS initiatives

By monitoring these aspects, the LL can demonstrate its impact on education, attitudes, and practices related to NBS, extending its influence beyond its immediate location and timeframe.

2.10 Conclusions

The Austrian LL represents an innovative approach to addressing the complex challenges of land-use and biodiversity in Austria. By integrating NBS and biodiversity concepts and approaches into higher education and actively involving various stakeholders, it creates a unique mutual learning environment that effectively combines theory and practice.

Key aspects of the Landscapes4Future Living Lab are:

Interdisciplinary collaboration and real-world settings: Students from various disciplines work together on real-world projects, fostering a holistic understanding of sustainable land-use.

Hands-on experiences: Through work on concrete spatial planning concepts and the use of innovative tools such as the LandscapeLab, students acquire valuable practical skills.

Stakeholder engagement: The active involvement of municipalities, NGOs, and local actors enables fruitful exchange and promotes the feasibility of developed solutions.

Focus on NBS and biodiversity: The lab places special emphasis on integrating nature-based solutions and protecting biodiversity in spatial planning.

Technological innovation: The use of GIS and VR tools allows for the visualization and communication of complex planning scenarios.

Through this holistic approach, the LL contributes to training future professionals who are capable of sustainably and innovatively addressing the multi-faceted challenges of land-use in Austria. It promotes academic education and strengthens the connection between research, practice, and community, which can contribute to more sustainable and biodiversity-friendly spatial planning in Austria in the long term.

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3 Action Plan Living Lab Czech Republic

3.1 Introduction

3.1.1 Shared vision developed with stakeholders

The core challenge is the lack of policy-driven integration of Nature Based Solutions (NBS) into curricula and the educational sector's slow adaptation to sustainability themes. While broader themes like sustainability and climate change are present in policy documents, NBS-specific content is absent.

The lack of policy interest in NBS is reflected in low awareness and minimal coverage in educational curricula, similar to the initial situation with Bioeconomy in the Czech Republic. Since 2020, BIOEAST HUB CR (BHCR) has coordinated efforts to promote Bioeconomy education in Central and Eastern Europe. BHCR will apply the same approach to establish a Living Lab (LL) as a dynamic multi-stakeholder network to address the challenges of nature-based solutions and Bioeconomy education. Given the Czech Republic's particular context, the limited awareness and lack of interest, the LL will adapt itself to this specific framework and work toward embedding NBS into its entire educational model.

3.1.2 Why a Living lab?

The Living Lab (LL) is necessary to provide a collaborative space for stakeholders to co-create and pilot innovative educational models that bring practical NBS and bioeconomy-focused projects into curricula. By engaging educators, students, NGOs, and industry professionals, the LL ensures that these models are tailored to local needs and challenges. It bridges the gap between theoretical knowledge and real-world application, enabling hands-on activities such as urban greening, biodiversity monitoring, and renewable energy integration.

Through relatable examples and practical demonstrations, the LL raises awareness and makes NBS more accessible to educators and policymakers. This dynamic approach not only enhances understanding but also fosters acceptance of NBS in educational strategies. By supporting capacity-building activities and aligning with the BIOEAST framework, the LL ensures its outputs are sustainable and scalable, contributing to the systemic integration of NBS into education.

3.1.3 How will the Living Lab make an impact?

The LL will detect specific needs and requirements in its target groups and address them through the prism of NBS. It will enhance public interest and participation, foster interactions among diverse public groups, and connect with other Living Labs within the eNaBlS network. The LL will provide practical insights and region-specific practices that can contribute to achieving the broader objectives of eNaBlS.

The LL will make an impact by implementing its outcomes into common activities and actions, detecting and improving good practices, and contributing to addressing global challenges such as climate change, environmental balance, and biodiversity, which also significantly affect the region.

The LL will function as an open school, fostering interaction and dialogue through focus groups, seminars, workshops, site visits to dedicated fields and locations, and various dissemination activities.

Meetings will occur on a bi-monthly basis, alternating between online and in-person formats to accommodate diverse stakeholder needs. Activities will be **coordinated and supported** through a dedicated committee composed of representatives from key stakeholders, including educational institutions, industry partners, and the BIOEAST HUB CR. This committee will oversee the planning and execution of activities, ensuring alignment with the Living Lab's objectives.

The LL is also planning to hold **focus groups** and **seminars** perhaps quarterly, offering opportunities for stakeholders to share insights and discuss challenges related to NBS. Dissemination activities, such as newsletters produced by BHCR, online platforms and social media, and public forums, will ensure consistent communication and broader outreach.

To enhance collaboration, a centralized coordination folder (in a form of Gdrive) will be implemented, allowing participants to share updates, materials, and progress reports in real time. **The combination of frequent meetings, structured activities, and robust coordination mechanisms will ensure the LL remains dynamic, inclusive, and impactful.**

3.2 Brilliant idea or complex problem

3.2.1 The complex, multidisciplinary problem the Living Lab tries to solve or the idea the LL wants to realize and why that is challenging

The LL in the Czech Republic addresses the **lack of integration of NBS** in educational curricula, a challenge stemming from limited awareness, policy focus, and practical implementation across institutions.

The absence of NBS in Czech curricula is caused by **limited policy support**, insufficient inter-ministerial collaboration, and a lack of awareness among educational institutions regarding the potential of NBS. This issue is based on the fact that no **direct references to NBS** are found in key educational policy documents like the "*Guidelines for Education Policy of the Czech Republic 2030+*". This is further evidenced by feedback from educational institutions showing a lack of NBS integration in curricula. The complexity arises from the multidisciplinary nature of NBS, which involves **education, environmental policy, and cross-sector collaboration**. Additionally, a gap exists between theoretical learning and practical application, making it harder to align with existing curricula. The current situation is mainly due to a **lack of specific policies addressing** NBS in education. Moreover, institutions prioritize research and employability, which can limit collaboration between universities and vocational institutions.

Additionally, we observed a **lack of cooperation between universities and Technical and Vocational Education and Training** (TVET) institutions, despite the fact that such collaboration seems promising based on the responses we received. The key obstacles identified are that universities often prioritize research and theoretical knowledge, while TVET institutions focus on employability and practical skills, leading to differing priorities. Another significant obstacle hindering collaboration between universities and TVET institutions for integrating NBS into higher education curricula is the difficulty in securing funding.

In the Czech Republic, educational trends emphasize the **integration of modern technologies and interactive methods to enhance learning effectiveness** (Borusiak et al. 2024). Traditional teaching approaches are being supplemented with tools like Pearson's eLearning platforms, aiming to foster student engagement through discussions and applied projects. There is a growing recognition that active **learning techniques—like project-based learning and practical application—significantly improve knowledge retention compared to passive listening.** Additionally, the shift towards technology-driven education aligns with the global movement towards digitalization in learning.

Nevertheless, despite the lack of information regarding NBS, the **majority of institutions are willing to learn more about them and increase the number of cooperative projects addressing NBS** and biodiversity loss. Additionally, we see significant interest from some institutions in including NBS and biodiversity loss in their curricula. A clear pattern emerges here: faculties more closely related to the sciences are more willing to incorporate NBS and biodiversity solutions into their curricula than those focused on the humanities. This disparity exists because the latter faculties believe that NBS are not aligned with their field of study.

There were two empirical studies conducted to assess awareness and perception of Bioeconomy and environmental concern in the Czech Republic:

Perception and Awareness of Bioeconomy (Pink et al. 2024):

- Conducted a questionnaire survey in 2023 involving 127 respondents from the Czech Republic, including both students and academic teachers. The survey focused on knowledge, awareness, and integration of Bioeconomy topics in higher education curricula.
- The study found limited awareness of Bioeconomy among participants, particularly concerning its socio-economic aspects, and a lack of practical implementation in educational programs.

Exploring Factors Shaping Business Students' Environmental Concern (Borusiak et al. 2024):

- In 2021, a survey was conducted among 588 business students in the Czech Republic as part of a larger study across six countries. The survey examined predictors of environmental concern using structural equation modeling.
- Results showed that awareness of consequences and a sense of responsibility are significant predictors of environmental concern, but the level of practical environmental education remains low.

The link between **NBS and the bioeconomy lies in their shared emphasis on sustainability, resource efficiency,** and the use of biological resources to address societal problems. In particular[1]:

- NBS **harnesses natural processes and ecosystems**, such as wetlands for water purification or forests for carbon sequestration, to deliver environmental, social, and economic benefits. Similarly, the bioeconomy focuses on utilizing renewable biological resources (e.g., plants, microorganisms, and biomass) in a sustainable way to produce goods, energy, and services. Both approaches emphasize sustainable resource use to reduce environmental degradation and reliance on non-renewable resources.
- NBS are contributing to climate resilience by restoring ecosystems, enhancing biodiversity, and regulating water and carbon cycles. The bioeconomy complements this by promoting innovations like bio-based products, sustainable agriculture, and renewable energy, all of which reduce greenhouse gas emissions.
- Both NBS and bioeconomy support circular and local economies, create opportunities for local job creation and entrepreneurship in sectors such as eco-tourism, bio-based industries,
- Both NBS and the bioeconomy drive innovation by integrating traditional ecological knowledge with cutting-edge technologies. For instance, bioeconomy initiatives that produce biofuels or biodegradable materials can be paired with NBS that maintain the natural ecosystems supplying the raw materials.

Our LL can **help bridge the awareness gap by offering practical, hands-on exposure to the Bioeconomy** and its applications by integrating real-life projects focusing on bio-based practices, the LL can help students experience the economic relevance of Bioeconomy. Workshops, lectures, and field experiments can increase awareness, making Bioeconomy more relatable and understandable from a socio-economic perspective.

Our LL will **involve multi-stakeholder collaboration and advance upon the existing network of BHCR** such as bringing in bioeconomy practitioners from industries and NGOs (existing members of the BHCR) to explain real-world applications and impact. This can also foster stronger ties between

[1] BHCR is not categorized as a research organization, and the presented text adopts a more explanatory rather than a strictly scientific approach

educational institutions and local industries, highlighting the economic benefits and employment opportunities in the Bioeconomy.

Our LL will also serve as a **platform to pilot and test educational models that bring practical NBS and Bioeconomy-focused projects into the curricula. BHCR experienced several demands on providing educational materials and have some practice from the national ERDF projects (inovacezvt.cz, bioenergetikazvt.cz)** It provides an environment where students and educators can collaborate on applied bioeconomy projects such as developing sustainable agricultural techniques, utilizing bio-based materials, or studying resource efficiency.

3.2.2 The actual (underlying) challenge of the Living Lab

The integration of NBS into Czech educational curricula faces several interconnected challenges. Despite the presence of broader sustainability and climate change themes in policy documents, NBS-specific content is notably absent, reflecting limited policy support and a lack of inter-ministerial collaboration. This gap is further exacerbated by the educational sector's slow adaptation to sustainability topics and insufficient awareness among institutions about the potential of NBS. Additionally, there is minimal cooperation between universities and Technical and Vocational Education and Training (TVET) institutions, hindering the development of multidisciplinary approaches that bridge theoretical and practical learning. Although institutions have expressed a willingness to incorporate NBS and biodiversity loss into their programs, the low level of practical environmental education limits students' ability to connect awareness of environmental consequences with a sense of responsibility. **Addressing these challenges requires coordinated efforts to enhance awareness, foster collaboration, and promote policy-driven inclusion of NBS in education**.

Lack of policy interest in NBS is reflected in low awareness and almost zero coverage in the curricula. It does resemble the story of Bioeconomy in the Czech Republic. BHCR achieved that Bioeconomy became a topic of the RIS3 strategy, BHCR national thematic working group prepared a proper translation of Bioeconomy that was accepted by the official translation office for the EU policies. Since its establishment in 2020 BHCR has gained some experience in facilitating the discussion about Bioeconomy, the inter-ministerial dialogue launched by the Agri Ministry has been facilitated by the BHCR, both the Ministry of Industry and Trade, Ministry of Environment and the Ministry of Education. The latter supported the establishment of the network of Bioeconomy universities in the BIOEAST macro-region the BIOEAST UniNet as a structural part of the BIOEAST Thematic Working Group (hereinafter referred as "TWG") Bioeconomy Education that BHCR is coordinating that is facilitating policy expert discussion in CEE to promote Bioeconomy education. [2]

BHCR will take the same approach to overcome the above-mentioned issues and establish a LL as a dynamic **multi-stakeholder network of experts as structural part of the national Thematic Working Group bioeconomy education that will facilitate**:

1. **Transdisciplinary Dialogue** and launch discussions focused on NBS together with diverse stakeholders from academia (Technical University Ostrava*[3], Business Chamber of the Moravian Silesian Region*, SMEs*, NGOs (ZERA Regional agriculture agency)*, this multi-actor approach and quadruple helix participation is essential for developing inclusive NBS and promoting this topic to be included in the curricula.
2. **Co-Creation and Collective Action**: the Living Labs will actively involve participants from a wide spectrum and support co-creating and implementing actions that contribute to address the

[2] The BIOEAST Iniative is a political initiative established in 2016 and operating since then, the BIOEAST Thematic working groups are macro-regional working tools, the first Forestry was established in 2016, Bioeconomy Education in 2020.
[3] * BIOEAST HUB CR members

above mentioned challenges, i.e. increase policy interest, increase awareness of natural based solutions and enhance involvement of education institutions in this topic.

3. **Integrate good practice**: By showcasing successful NBS implementations and methodologies, universities and vocational education and training (VET) institutions will be encouraged to embed NBS concepts into their curricula and institutional practices, fostering a culture of sustainability and innovation.
4. **Capacity Building and Engagement**: LL members will have opportunities to participate in capacity-building activities and stakeholder engagement events organized within the framework of the eNABLS project. These efforts aim to empower participants with the knowledge and skills needed to advocate for and implement NBS effectively.
5. **Policy Influence**: the inclusion of policy representatives and strategic connections to the interministerial discussion in the Czech Republic will facilitate discussions and advocacy for policies that promote and support the adoption of NBS across various sectors, reinforcing their importance in sustainable development agendas.
6. **Sustainability**: The connection to BIOEAST Thematic Working Groups secures the long-lasting activities and outputs of the LL.

Economic hurdles include funding limitations, while behavioral challenges stem from institutions prioritizing research over practical collaboration. Politically, there's a lack of interministerial cooperation in advancing NBS policies. Main stakeholders include educational institutions, government ministries (Ministry of Education, Ministry of Agriculture), NGOs, and regional bodies like BIOEAST HUB Czech Republic Regional Departments . The challenge is also present in other Central European countries, but this LL addresses the specific gaps within Czech education and policy.

3.3 Partners and stakeholders

Core partners include the Technical University of Ostrava, Secondary School Matiční, and the **Biotechnology Lyceum in Brno,** which is part of the **Secondary School of Chemistry.** Together, these institutions form a foundational knowledge base and provide the educational context necessary for successfully integrating NBS. **However, their current understanding of NBS is partial, primarily focused on specific aspects or isolated applications rather than a comprehensive, system-level perspective**. Despite this, they have shown a strong willingness and enthusiasm to deepen their expertise and broaden their approach to NBS, signaling a commitment to advancing their capacities in this innovative field.

The **Technical University of Ostrava** not only offers a physical location for the Living Lab but also **access to its extensive research networks, advanced laboratories, and academic resources.** With a strong focus on technology and applied sciences, the university is an ideal partner for fostering innovation and aligning NBS with practical, technological solutions. Its commitment to multidisciplinary research ensures the integration of NBS into diverse academic and societal contexts. The Technical University of Ostrava **has been actively integrating innovative educational methods, particularly leveraging eLearning technologies**. Historically, the university utilized platforms like LMS Moodle and others, but recent advancements include the adoption of tools such as Pearson Higher Education for course innovation (Dvoroková and Kulhánek, 2017). These new methods aim to shift teaching dynamics from traditional lectures to interactive learning, emphasizing student engagement through discussions, projects, and applied knowledge. The approach recognizes that modern technology can make learning more efficient and appealing, enhancing retention and understanding by fostering active participation. The **Biotechnology Lyceum in Brno**, part of the Secondary School of Chemistry, offers a specialized curriculum focused on **natural sciences, biotechnology,** and environmental studies. This program equips students with a deep understanding of biological processes, sustainability, and ecological practices. By incorporating cutting-edge topics such as biotechnology and environmental stewardship, the lyceum fosters the next generation of professionals capable of implementing NBS in various fields. The school's **emphasis on both theoretical knowledge and practical application makes it a valuable**

contributor to the Living Lab, particularly in raising awareness and engaging young minds in sustainable practices. Together with the **Secondary School Matiční**, which has a strong focus on vocational and technical education, these partners provide a comprehensive educational framework. Their collaboration within the Living Lab ensures a multidisciplinary approach, integrating technological expertise, academic research, and practical skills to advance NBS implementation and education. This partnership exemplifies the critical role of education in promoting sustainable development and addressing environmental challenges through innovative solutions.

There were two key events taking place in the autumn 2024 related to Living Lab members On September 2, 2024, **Prime Minister Petr Fiala, along with Minister of Education Mikuláš Bek and Minister of the Environment Petr Hladík, inaugurated a new science-focused Biotechnology Lyceum in Brno**, The content framework of the science-oriented gymnasium was developed in collaboration with company representatives, rectors from three Brno universities, and other members of the academic community. The ribbon-cutting ceremony was attended by the Prime Minister, Minister of Education Mikuláš Bek, Minister of the Environment Petr Hladík, the Governor of the South Moravian Region Jan Grolich, and other distinguished guests. Jan Nedělník, Coordinator of BIOEAST HUB CR, attended the event as a member of the Advisory Board for the Biotechnology Lyceum in Brno. He has been actively involved with the Secondary School of Chemistry in Brno, which played a key role in establishing the lyceum. One of the pivotal projects that strengthened the collaboration between the Secondary School of Chemistry in Brno and BHCR, as well as their interest in participating in the Living Lab initiative, was the Bioenergy project. This initiative provided a comprehensive tutorial and one-pages on teaching selected Bioeconomy topics, further embedding Bioeconomy principles into the school's curriculum and fostering their alignment with the goals of BIOEAST HUB CR.

The meeting of the Living Lab took place on 19th November at the Technical University of Ostrava, with approximately **40 participants from academia and industry.** VŠB-TUO delivered a presentation exploring the potential of energy and technological systems in shaping the future development of society and during the meeting the LL idea was discussed.

The following industries were in particular interested in further cooperation. Ostax, Lamella and SDO Technika **OSTAX**, established in 1992, specializes in **producing ecological wood products**, including briquettes, pellets, pallets, shingles, firewood, and kindling sticks. They manufacture construction and carpentry lumber using automated cutting lines and offer drying services in chamber hot air dryers. Additionally, OSTAX provides heat treatment for pallets and packaging materials per IPPC certification standards. The company also engages in custom metal production, crafting machined parts based on client specifications. OSTAX ensures domestic delivery of its products through its own truck transport services. **Lamella CZ, s.r.o.**, established in 2014 and based in Ostrava, Czech Republic, is an **engineering and contracting company specializing in energy conservation**. The company offers services in robotics and automation, infrastructure for transport systems, and represents FitCraft Energy s.r.o. in production management and electricity flow control. Since 2017, Lamella CZ has expanded its portfolio to include photovoltaic systems and the design of electrical storage systems. SDO Technika s.r.o., established in 2012, is based in Šenov u Nového Jičína, Czech Republic specializes in the sale and **service of forestry, municipal, agricultural, and gardening equipment.** Their product range includes composters, wood chippers, sweepers, and garden machinery. **SDO Technika** represents brands such as AL-KO, MTD, BCS, Fiskars, Stocker, JRK, Atmos, Lamborghini, Yanmar, Belarus, Nilfisk, and Michelin. The company operates an e-shop and provides professional tools for hobby gardeners, municipal services, and professional horticulturists.

These three companies share a **strong commitment to sustainability, innovation, and circular economy principles**, making them ideal participants in collaborative initiatives - Living Lab focused on NBS. **Sustainability and Ecological Solutions** are central to their operations. OSTAX specializes in producing ecological wood products and adopts sustainable manufacturing practices, while Lamella CZ focuses on energy conservation and the integration of renewable energy systems like photovoltaics. Similarly, SDO Technika provides equipment that supports sustainable land and forestry management,

including composters and wood chippers. All three companies have a **connection to natural resources**, as they either work with or support industries reliant on resources like wood, energy, and agriculture. This shared focus positions them to contribute meaningfully to projects aimed at optimizing natural resource use. Their emphasis on **innovation and technology** further strengthens their compatibility. Lamella CZ employs advanced technologies such as robotics, automation, and energy storage systems, while OSTAX integrates modern drying and heat treatment techniques in its production processes. SDO Technika enhances efficiency in municipal and agricultural practices through advanced tools and equipment. Finally, all three align with **circular economy principles**. OSTAX repurposes wood into briquettes and pellets, minimizing waste and promoting bio-based products. Lamella CZ enhances energy efficiency and advances renewable energy solutions, contributing to sustainable systems. SDO Technika supports recycling and composting efforts with its equipment, furthering the circular economy agenda.

During discussions with stakeholders, the potential benefits of participating in the LL were outlined, and the companies expressed interest in exploring the opportunities. They recognized the potential for **enhancing business opportunities** through participation, exploring new markets focused on sustainability, biodiversity, and ecosystem restoration, creating pathways for growth in emerging sectors. Participation in the LL also offers a chance to **contribute to broader environmental goals**, showcasing their commitment to corporate responsibility. This aligns their operations with objectives such as carbon reduction, resource conservation, and sustainable development. The **knowledge-sharing and networking** opportunities provided by the LL were also highlighted as a significant benefit. Stakeholders appreciated the chance to exchange expertise, technologies, and methodologies across sectors, fostering synergies among forestry, energy, and agriculture. In addition, the companies recognized their role in **scaling NBS**. With their expertise and product portfolios, they are well-positioned to contribute to NBS by advancing sustainable wood-based energy systems that support carbon sequestration and biodiversity preservation, developing renewable energy solutions that integrate ecosystem services such as watershed protection and habitat restoration, and designing eco-efficient land management tools that enhance soil health, promote agroforestry, and support climate adaptation efforts

Finally, engaging in NBS initiatives through the Living Lab could **align their activities with policies on sustainability**, potentially unlocking funding opportunities or innovation incentives.

3.4 Location and context

Core partners include the Technical University of Ostrava, Secondary School Matiční, and the Biotechnology Lyceum in Brno. These institutions collectively provide a robust knowledge base and educational framework essential for integrating Nature-Based Solutions (NBS).

The **Technical University of Ostrava** offers not only a physical location for the Living Lab but also access to extensive research networks, advanced laboratories, and academic resources. With a strong focus on technology and applied sciences, the university is well-positioned to advance the mission of integrating NBS into educational and practical contexts, leveraging its expertise in innovation and applied research. The **Biotechnology Lyceum in Brno**, part of the Secondary School of Chemistry located at Vranovská 65, 614 00 Brno-Husovice, provides a comprehensive educational environment tailored to preparing students for careers in science and technology. The school is equipped with specialized laboratories for practical instruction in various branches of chemistry, enabling hands-on learning that complements theoretical studies. Its modern classrooms and computer labs ensure students receive a well-rounded educational experience. The campus also includes amenities such as a library, study areas, and spaces for extracurricular activities, fostering both academic and personal growth. This infrastructure supports a holistic approach to education, preparing students for future endeavors in scientific and technological fields. The **Secondary School Matiční** in Ostrava, known as Matiční gymnázium Ostrava, is a reputable educational institution offering a range of study programs. The school provides a conducive learning environment with well-equipped classrooms, science

laboratories, and facilities that support both academic and extracurricular activities. Its commitment to fostering critical thinking and innovation among students aligns with the objectives of integrating NBS into educational curricula.

BH CR acts as a leader and manager of the LL, ensuring a supportive environment for the project's objectives. This involvement allows for smoother access to university resources and facilities and enables tighter integration of NBS topics into academic curricula.

Core partners include Technical University Ostrava, Secondary School Matiční Ostrava, and the Biotechnology Lyceum in Brno. Collectively, these partners form a strong foundation for the Living Lab, combining technological expertise, advanced facilities, and a commitment to fostering the next generation of professionals equipped to implement NBS in diverse contexts.

The Just Transition Fund (JTF) is a European Union initiative designed to support regions and communities most affected by the transition towards a climate-neutral economy. In the Czech Republic, the Operational Program Just Transition (OPJT) 2021–2027 allocates approximately €1.64 billion to assist the Karlovy Vary, **Moravian-Silesian**, and Ústí nad Labem regions in addressing the social, economic, and environmental impacts of phasing out coal and other high-emission industries. The program focuses on economic diversification, job creation, retraining of workers, and environmental rehabilitation to ensure a balanced and inclusive transition.

The Moravian-Silesian Region has historically grappled with educational challenges, including a workforce predominantly trained for traditional industries like mining and heavy manufacturing, leading to a skills mismatch in the evolving job market. The Just Transition Fund (JTF) addresses these issues by financing initiatives that promote education and skill development aligned with emerging economic sectors. This includes support for retraining programs, enhancement of educational infrastructure, and fostering partnerships between educational institutions and businesses to ensure curricula meet current labor market demands. By investing in human capital, the JTF aims to facilitate a smoother transition for workers from declining industries to new opportunities, thereby contributing to the region's sustainable economic transformation. It is a great opportunity for the LL, both Technical University Ostrava and Matiční Secondary school are located in the Moravian Silesian Region.

3.5 Reality check: experiments / location / context

As it has been described above, the real issue in the Czech Republic is the very low awareness of NBS, not only the use of their methodology in solving problems but even the understanding of the overall concept. For this purpose we have decided that an initial step is to raise the awareness and enhance the interest of the target audience before going to practices. This step is perhaps not needed in other regions but in the Czech Republic is mandatory. Therefore the methodology will be to promote existing material of good practices from other regions, in forms of presentations, videos and seminars, to discuss the cases with the audience and then together to detect existing issues in the region and to propose solutions.

3.6 Community involvement

The success of the Living Lab depends on **the active and meaningful participation of a diverse range of stakeholders**. This ensures that the project not only delivers academic impact but also creates tangible benefits for the wider community. This section highlights the key stakeholder groups, their expected contributions and benefits, and the mechanisms for their engagement.

The Living Lab embraces a broad spectrum of stakeholders beyond its core partners to ensure diversity, representation, and inclusivity. **Key educational institutions, such as the Technical University of Ostrava, the Secondary School Matiční, and the Biotechnology Lyceum in Brno, play pivotal roles in providing foundational knowledge and fostering innovation.**

Small and medium-sized enterprises (SMEs), including OSTAX, Lamella CZ, and SDO Technika, bring valuable expertise in ecological products, energy conservation, and sustainable land management. Their involvement strengthens the practical and applied aspects of the LL, bridging academic research with real-world solutions.

This inclusive approach ensures that the LL becomes a collaborative platform for innovation, knowledge-sharing, and community impact.

Key stakeholders & affected groups

Local Educational Institutions

- Secondary Schools: Including students and educators from schools like the Secondary School Matiční and the Biotechnology Lyceum in Brno, which are keen on integrating nature-based solutions (NBS) into their curricula.
- Universities & Vocational Education and Training (VET) Institutions: The Technical University Ostrava and other nearby universities will play a pivotal role in aligning the project with academic and vocational standards.

Expected Benefits: Enhanced curricula, development of innovative educational materials, expanded opportunities for hands-on learning experiences, and strengthened connections with the local community.

Local Government Authorities

- Municipal Departments: Particularly those engaged in environmental planning, sustainability initiatives, and urban development projects.
- Regional Policy Makers: Representatives from the Ministry of Environment and the Ministry of Education, tasked with scaling successful NBS initiatives across the region.

Expected Benefits: Increased capacity for implementing NBS policies, evidence-based case studies to inform urban planning, and improved opportunities for collaborative, cross-departmental policymaking.

Environmental NGOs and Local Activists

- Non-Profits: Organizations like the ZERA Regional Agriculture Agency and other environmental NGOs that offer technical expertise, resources, and outreach capabilities.
- Citizen Groups: Community-based organizations advocating for green infrastructure and sustainability, such as neighborhood associations and local environmental advocacy groups.

Expected Benefits: Broader visibility for NBS initiatives, access to extended networks, hands-on implementation experience, and a stronger voice in shaping local environmental policies.

Industry Partners and Local Businesses

- Green Technology Companies: Enterprises specializing in sustainable solutions, green construction, and resource-efficient technologies.
- Agricultural Cooperatives & Bio-based Industries: Local agricultural entities and cooperatives committed to sustainable farming practices and bio-based industrial processes.

Expected Benefits: Opportunities for collaboration on pilot projects, potential for market expansion of sustainable products and services, enhanced reputation for corporate social responsibility, and access to cutting-edge research and data for innovation.

Defined groups of citizens, consumers, and the general public

This group encompasses residents, consumers, and community members who stand to benefit directly or indirectly from the implementation of NBS. These individuals include:

- Urban Residents: Who will enjoy improved air quality, reduced urban heat, and enhanced public spaces.
- Consumers: Gaining access to sustainable products and services fostered by the project.
- General Public: Experiencing increased environmental awareness and involvement opportunities through public workshops, consultations, and participatory activities.

Expected Benefits: Enhanced quality of life through greener urban environments, increased engagement in sustainability efforts, better access to locally grown or bio-based products, and a stronger sense of community ownership over environmental solutions.

By actively engaging these diverse stakeholder groups, the LL aims to foster inclusive participation, ensuring the success and scalability of nature-based solutions across the region

3.7 Process design

The successful operation of the Living Lab requires clear roles and responsibilities to ensure effective knowledge transfer, implementation, and outreach. The following key stakeholders play essential roles in the LL:

1. **Technical University Ostrava**

   As the main provider of technical expertise and knowledge, the Technical University Ostrava plays a pivotal role in the LL. It develops educational materials to support the integration of NBS into curricula, provides technical and scientific expertise to guide innovative practices, and serves as a resource hub for cutting-edge research and methodologies related to NBS.

2. **Secondary School Matiční Ostrava**

   The Secondary School Matiční Ostrava acts as a key institution for implementing and practically applying knowledge within the LL. It embeds NBS-focused educational content into its school programs, engages students and educators in hands-on activities and demonstrations, and serves as a model institution showcasing how NBS concepts can be integrated at the secondary education level.

3. **Biotechnology Lyceum in Brno**

   The Biotechnology Lyceum in Brno serves as a partner institution for applying knowledge and involving students in the LL. It integrates NBS knowledge into its educational practices, facilitates student-led projects and activities aligned with the LL's goals, and promotes cross-disciplinary collaboration to expand the scope of NBS applications in education.

4. **BIOEAST Hub CR**

   BHCR acts as the organizational and coordination lead for the LL. It oversees the organizational structure and ensures smooth coordination among stakeholders. Additionally, it leads dissemination activities to raise awareness about the LL's initiatives and outcomes while facilitating communication among partners to align efforts with the broader objectives of the BIOEAST Thematic Working Group Bioeconomy Education and BIOEAST Uni Net.

By clearly defining these roles and responsibilities, the LL can function as a cohesive platform for innovation, collaboration, and knowledge dissemination. Each stakeholder's contribution is vital to achieving the Living Lab's overarching goal of integrating nature-based solutions into education, community practices, and regional development strategies.

3.8 The role of education in the Living Lab

Education will be based on seminars, and interactive sessions. We are planning to invite experts on a case by case basis (especially for the online workshops) who will provide seminars on the use of NBS in solving problems in a wide spectrum of domains. Emphasis will be given to the participation of the audience therefore most sessions will comprise a strong interactivity and participation.

3.8.1 Addressing the ENABLS goal to bring more attention for NBS in higher education

The LL aligns with the ENABLS goal by integrating NBS topics into existing curricula at partner educational institutions, ranging from technical universities to vocational schools. These curricula will focus on both the theoretical underpinnings of NBS and the practical application of these solutions to real-world challenges. Additionally, the LL will engage students in real-world projects that demonstrate the relevance and impact of NBS in local and regional contexts. The lab will also raise awareness of NBS through workshops, field experiments, and interactive educational activities that showcase the importance of sustainable, nature-based approaches.

To connect with vocational education, the LL will partner with Technical and Vocational Education and Training (TVET) institutions to provide hands-on learning experiences. Collaborations will focus on the practical aspects of implementing NBS in urban planning, agriculture, and water management. The LL will offer apprenticeships or internships where students can participate directly in the lab's activities, gaining practical skills and insights into NBS application.

3.8.2 Educational activities

The LL will create modules and courses focused on NBS that can be embedded into existing environmental science, agriculture, and engineering programs. These educational modules will cover the theory behind NBS as well as case studies based on the lab's experiments. In addition to academic courses, the LL will develop extracurricular projects that allow students to tackle real challenges, such as designing sustainable urban spaces or evaluating specific NBS interventions. These projects will be connected to existing networks, such as BIOEAST UniNet, to ensure wider visibility and knowledge exchange. The LL will also organize educational workshops and seminars involving guest speakers from industries, government agencies, and NGOs, offering students a broader perspective on the value and implementation of NBS.

Real-life learning within the LL will include field experiments where students participate in practical trials on biodiversity enhancement, sustainable agriculture, or water retention solutions. Project-based learning will allow students to work in interdisciplinary teams to develop prototypes and assess the effectiveness of their solutions. Service-learning opportunities will engage students in community-based projects, where they contribute to local NBS initiatives, gaining firsthand experience and building a sense of civic responsibility.

To incorporate reflection and consideration of different interpretations of NBS, the LL will organize reflection sessions where students and stakeholders discuss the effectiveness, challenges, and broader implications of NBS. These sessions will be essential for exploring diverse perspectives on NBS, including ecological benefits, social impacts, and how these solutions can be applied to various fields beyond environmental science. Nature-Based Thinking will be emphasized by focusing on the systemic benefits of NBS, such as resilience, sustainability, and biodiversity.

3.8.3 What is realistic within the timeframe of this project?

Within the project's timeframe, the LL aims to develop and pilot NBS modules that can be integrated into educational curricula, conduct workshops and field trips to engage students from diverse disciplines, and launch student-led projects related to NBS that will provide concrete data for future analysis.

After the project concludes, the educational effort can grow by scaling the developed modules to other institutions, both within and outside the Czech Republic. The LL will create a repository of case studies and best practices that can serve as a resource for other regions interested in integrating NBS into education. A network of LL alumni, including students, educators, and partners, will continue collaborative NBS initiatives, fostering long-term community engagement in sustainable practices. Through this approach, the LL aims to not only increase attention to NBS within higher education but also build a culture of sustainability that extends far beyond the classroom.

3.9 Reflexive monitoring, data management and reporting

3.9.1 Monitoring

Monitoring will focus on assessing key aspects of public and stakeholder involvement to ensure meaningful engagement and progress toward objectives. The following elements will be observed and analyzed:

- Understanding of NBS;
- Levels of awareness and interest;
- Participation and engagement in activities;
- Perceptions and attitudes toward NBS;
- Reflective actions stemming from involvement.

3.9.2 Data management

Data will be collected through a variety of methods, including surveys, interviews, and focus groups, ensuring a comprehensive understanding of stakeholder perspectives and behaviors.

Collected data will be organized using:

- Standardized templates.
- Data sheets and infographics for visual representation.
- Secure and appropriate storage solutions.

Analysis will be conducted using quantitative, qualitative, and comparative approaches to derive meaningful insights.

To ensure compliance with data protection standards:

- Anonymity will be maintained for all participants.
- Sensitive data will be encrypted to prevent unauthorized access.

3.9.3 Reporting

Reporting will adhere to the guidelines established in the ENABLS Grant Agreement (GA). Customized reports will be prepared for key stakeholders, such as educational institutions, government agencies, and community organizations. These reports will summarize findings, provide insights into NBS integration, and offer practical recommendations to guide future actions.

3.10 Conclusions

The LL's success relies on the collaboration and defined responsibilities of its core partners. The **Technical University Ostrava** serves as the primary knowledge provider, developing cutting-edge educational materials and offering scientific expertise to guide innovative practices. As a resource hub,

it provides research networks, laboratories, and methodologies for implementing Nature-Based Solutions (NBS). The **Secondary School Matiční Ostrava** and the **Biotechnology Lyceum in Brno** play critical roles in assimilating and applying this knowledge within their curricula, engaging students and educators in hands-on learning activities. These institutions act as model schools, showcasing the integration of NBS concepts at the secondary education level.

The **BHCR** coordinates and manages the LL, overseeing dissemination activities to raise awareness and ensure alignment with broader educational and policy objectives. It facilitates communication among stakeholders, ensuring smooth collaboration and efficient resource use. The LL will promote co-creation through cross-disciplinary projects and workshops, integrating NBS into education and community practices. It will support capacity-building events that empower stakeholders to adopt and scale NBS effectively.

This collaborative framework bridges gaps between theory and practice, engaging students, policymakers, and industry partners in meaningful activities. SMEs like **OSTAX**, **Lamella CZ**, and **SDO Technika** add industry expertise, focusing on sustainable land management, energy conservation, and green technologies. Their participation ensures real-world relevance and opportunities for market-driven innovation. The Living Lab fosters public involvement through workshops and field projects, engaging communities in environmental education.

Together, these roles create a dynamic platform to address educational, policy, and sustainability challenges, driving the integration of NBS into curricula and fostering long-term regional development. The Living Lab will not only enhance knowledge and skills but also inspire action and collaboration for a sustainable future.

3.11 References

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4 Action Plan Living Lab Germany: Learn in Nature Lab

4.1 Introduction

4.1.1 Learn in Nature Lab

The scientific method employed in Living Labs (LL) emphasizes "learning by doing". At the University of Hohenheim, the LL will focus on testing various teaching methods to effectively exchange knowledge about nature-based solutions (NBS) to halt the loss of biodiversity with students and, where possible, the general public.

The goal is to explore how NBS can be integrated into higher education. Based on research from Task 1.1 and initial brainstorming sessions with stakeholders, several learning methods have been identified for testing. These include transdisciplinary interactions, outdoor learning activities, two-way knowledge exchange and opinion-forming through classroom debates, and the use of case studies. It should also give opportunity for teachers to evaluate the effectiveness of learning methods at NBS. Therefore, our LL is closely connected to the teaching and learning of the NBS concepts and education is at the core of the LL.

These methods will be tested in what we call the "Learn in Nature Lab" (LNL), with activities conducted in and around the University of Hohenheim (UHOH) campus. At the moment of creating this action plan we have finished the steps presented in Figure 4.1.

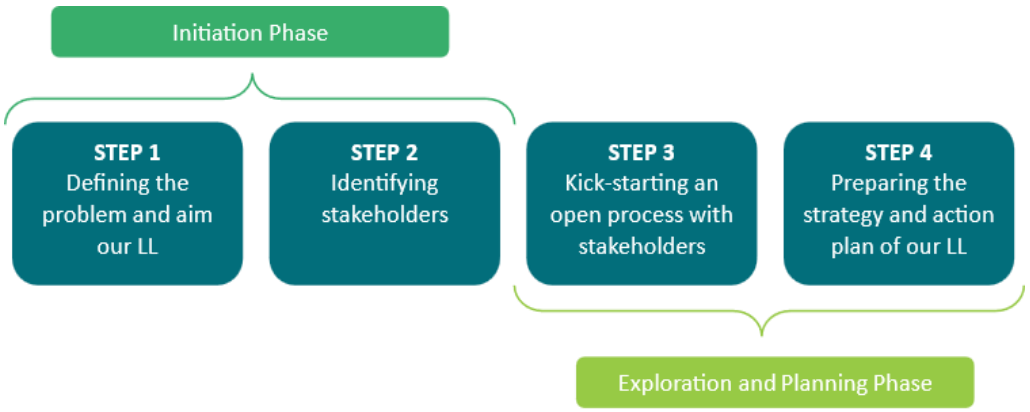

Figure 4.1: Initiation, exploration and planning phases of Learn in Nature Lab

The key working mechanism of our LL will completely depend on the common ground we find with our stakeholders. The expected impact of our LL will be changing or at least creating an impact on the current teaching and learning practices that generally lack connection with nature and real-world approach in conveying NBS education. The outcomes of our LL can have an impact on the city of Stuttgart in general, or maybe even spread to the neighboring cities. But we aim to start small within our network at first and mainly collaborate with other higher education and TVET institutions in our city, e.g. University of Stuttgart and the Staatliche Gartenbauschule to test our initial ideas and its potential.

Since our first steps will be taken together with the students and experts at UHOH, there is a huge potential to integrate NBS concept within the education of our university. The interest and willingness of our stakeholders, as well as the resources available for our LL will shape the path we need to take.

4.1.2 Urbanization, NBS and permaculture

Urbanization is one of the biggest challenges faced globally which doesn't affect only the land cover but also the climate and biodiversity in the cities. Stuttgart is one of the largely populated cities in Germany and it is crucial to keep the city green to protect the health and well-being of not only the residents but also the other species. Although Hohenheim is not located in the center of Stuttgart, it can play a significant role in educating future teachers, politicians and citizens in protecting the biodiversity mainly through NBS.

As one of the potential NBS to urban sustainability challenges, permaculture can emphasize sustainable land use, community engagement and biodiversity (Yassein and Ebrahiem, 2024). Moreover, permaculture can create functional redundancy and provide a greater share of ecosystem services by combining multiple practices (Hirschfeld and Van Acker, 2021). With its principle "work with nature rather than against" (as cited in Taylor Aiken, 2017), we consider permaculture as one of the learning topics to include in our LL.

Our aim is to prepare our LL to raise awareness on the challenges that the Stuttgart city faces such as urbanization and correspondingly biodiversity loss and to create a movement to find solutions to these challenges by introducing the concept of NBS. For this, our plan is to start within our network, mainly with students and academics, to find a common ground and establish our LL at the campus of our university, which later on can be expanded with the involvement of other stakeholders, such as start-ups, businesses, Stuttgart municipality and more.

4.2 Brilliant idea or complex problem

4.2.1 Demand for practical NBS learning

Our research for Task 1.1, along with discussions with stakeholders, revealed that while NBS are sometimes included in higher education and vocational training programs, they are primarily taught through theoretical approaches. Our investigation highlighted a significant demand for practical, hands-on learning methods to teach NBS effectively. Both students and educators, such as professors and teaching staff, expressed a preference for experiential learning over purely theoretical instruction.

The key issue identified is twofold: first, NBS concepts are not comprehensively integrated into curricula; second, appropriate learning methods to effectively convey these concepts are lacking. To ensure that the knowledge gained is applied to real-world problem-solving, education systems need to adopt more practical and engaging learning methods.

Our interviews and surveys confirmed that hands-on approaches are considered the most effective for embedding NBS concepts across diverse fields. However, questions remain about how to implement these methods effectively:

- Can university systems adapt quickly to include practical learning methods?
- How challenging is it to integrate these approaches into existing curricula?
- Are these methods as effective as anticipated by both educators and students?

These questions must be addressed to fully realize the potential of NBS education in fostering real-world solutions.

We consider this problem complex because it requires willingness of the teachers to change the way they teach, support and motivation of students to change the way they learn, acceptance by the administrators in academia to adapt these changes to the curricula, as well as the willingness of external stakeholders to be open for knowledge sharing.

The chronological development of our idea is illustrated in Figure 4.2. The methods used in our LL are designed to allow flexibility and adaptation based on ongoing learnings. Initially, we identified two

areas within university education to introduce NBS topics: curricular activities and extracurricular activities.

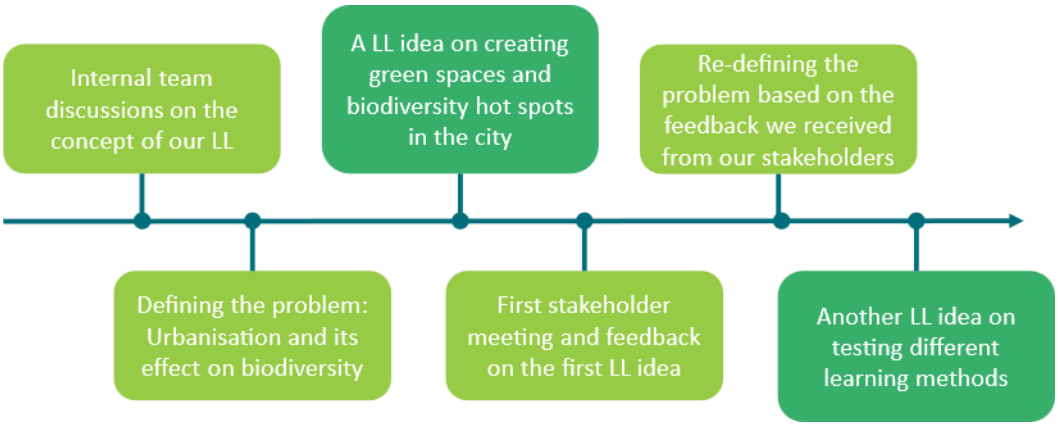

Figure 4.2: A chronological overview of the development of LNL idea

4.2.2 Extra-curricular learning activities

Three different extra-curricular activities are planned to test in our LNL together with our students, teachers and other stakeholders: i. field trips/excursions, ii. expert invitations, iii. debate club (Figure 4.3).

Figure 4.3: Learning methods that will be tested in LNL

As mentioned by experts participated in our interviews, real-world approach and outdoor learning methods play a crucial role in teaching NBS and biodiversity loss concepts. In our LNL, we will be able to test the effectiveness of these methods not only considering perspective of the teachers, but also the students. Figure 4.3 shows the learning methods that will be tested in our LNL according to the integration of these methods into the curricula.

Extra-curricular activities, as the term suggests, fall outside the formal curriculum of an educational program. Academic credits are not automatically earned through these activities, they are not listed in transcripts or official graduation certificates. As such, they remain outside the formal educational framework. In some cases, the efforts could be honored in portfolio modules at some study programs.

Figure 4.3 illustrates an extra-curricular activity planned for the upcoming semester: a science debate promoting two-way knowledge transfer on Nature-Based Solutions (NBS). Researchers, teaching staff from the University of Hohenheim, and stakeholders from other educational institutions or industries will present lectures on their research or concepts related to NBS. These sessions will either take the form of a science debate, where the audience engages directly with the speaker, or include a questions and answer session to foster dialogue between the speaker and the participants.

This interactive format encourages a two-way exchange of knowledge, making the lectures highly engaging. The LNL will handle promotion, organize lecture venues, and evaluate the teaching methods and learning experience using anonymous feedback forms at the end of the series. This approach aims to test and enhance interactive learning methods for conveying NBS concepts effectively.

Field trips and expert visits can also be categorized as extra-curricular activities. These initiatives, facilitated by the LNL, may be offered either as part of the curriculum or as extracurricular learning opportunities, depending on feasibility.

If the teaching staff or educators at the University of Hohenheim wish to organize a field trip or invite an expert or external stakeholder to a lecture, the LNL will handle the arrangements. However, such activities must align with and convey Nature-Based Solutions (NBS). This approach aims to enhance both teaching and learning by exposing students to real-world applications of NBS (Outdoor Learning).

The decision to integrate these activities into the curriculum or treat them as extra-curricular remains at the discretion of the teaching staff.

4.2.3 Curricular learning activities

Two credit-based learning activities have been planned under LNL at UHOH (Figure 4.4). While both activities share a similar structure, their target audiences differ:

1. **Humboldt reloaded project**:
    - **Target audience**: Bachelor's students at the University of Hohenheim.
    - **Focus**: Connecting students with external stakeholders to identify problems and collaboratively develop nature-based solutions with experts, including researchers at the university.
2. **Case study module (7.5 ECTS)**:
    - **Target audience**: Master's students in educational programs at the University of Hohenheim.
    - **Focus**: Similar to the first activity, but tailored to a more advanced audience, emphasizing transdisciplinary integration and collaboration.

Activity structure

Both activities are designed as case studies, using a transdisciplinary, hands-on approach. Students will engage in collaborative tasks to develop practical applications for NBS. Current collaboration involves permaculture experts addressing urban green space challenges and biodiversity promotion. Students are encouraged to independently explore specific aspects of permaculture.

Evaluation and collaboration

- **Evaluation**: Teaching and learning experiences are regularly assessed through anonymous feedback forms throughout the activity.
- **Collaboration**: The activities involve teaching and research staff from Hohenheim and nearby institutions, as well as experts from non-academic organizations

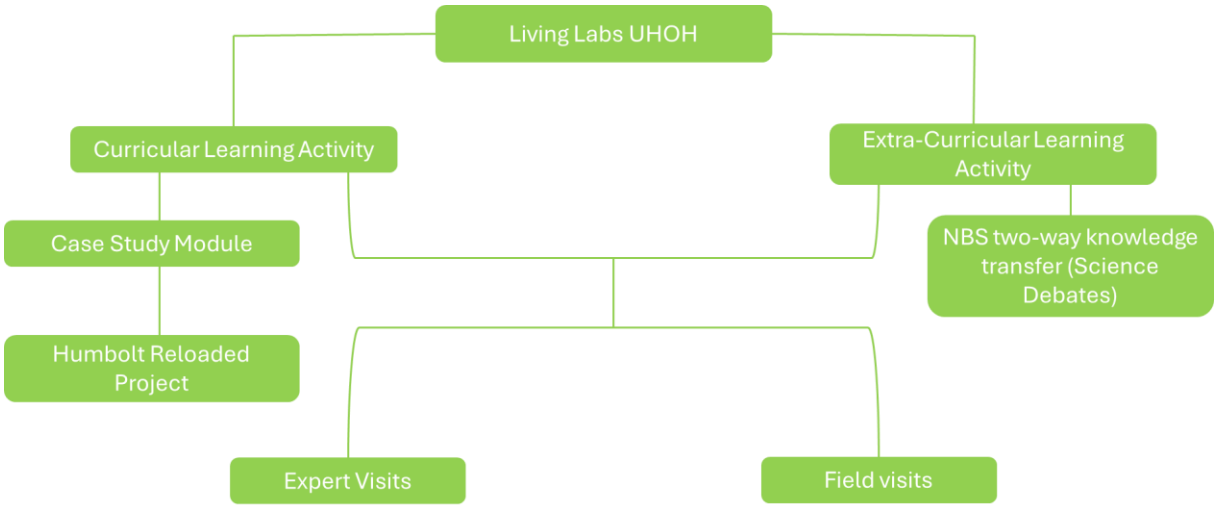

Figure 4.4: Structure of planned activities at LNL Hohenheim

4.2.4 Sustainability themes

Since the concept of NBS is related to many of the sustainability themes, it is difficult to identify the ones that will be shaping our LNL. However, our main goal is to test different methods to understand their effectiveness in learning NBS. Therefore, education, biodiversity and environment can be mentioned as closely related sustainability themes to our LNL. The following Sustainable Development Goals (SDG) are touched with our LNL: SDG 4 – quality education, SDG 11 – sustainable cities and communities, SDG 15 – life on land, among others aiming on halting loss of biodiversity.

4.2.5 Economic, behavioural and political hurdle

As mentioned earlier, the problem we define is complex because it requires action from multiple stakeholders, including students, teachers and administrators. Therefore, there are some foreseen economic, behavioural and political hurdles that we need to overcome in our LNL.

From economical point, we will need financial resources to organise field trips, to invite experts to the lectures, to prepare an open platform for debates and to provide support for students' case studies. From behavioural perspective, the attitude of the stakeholders involved in our LNL will also play a critical role in changing the curricula and transforming the education system. Their willingness and support will be required. If the stakeholders are not open for knowledge exchange, it will also affect the activities we do in our LL. Here the role of teachers is especially crucial. From political point of view, integrating NBS into the curricula will require adapting the current policies in our university. Moreover, several agreements with external stakeholders needs to be done before taking action to test the learning methods. These are main hurdles we can foresee that we need to overcome with clear communication and collaboration between our partners and stakeholders.

4.3 Partners and stakeholders

4.3.1 Core partners

We, as the team of Center for Biodiversity and Integrative Taxonomy (KomBioTa) will be the founding partner of our LNL, together with other internal and external partners we have identified such as Natural History Museum Stuttgart, the team of Humboldt-Reloaded and the permaculture expert from Rette Garten Eden. We expect to have more partners joining our LNL, such as student and employer

initiatives at our university, some of which are mentioned in the following section as our potential stakeholders.

4.3.2 Potential stakeholders

The following groups are identified as potential stakeholders who can participate in our LNL. Invitations to these groups are sent to join our LNL and to our first stakeholder meeting.

Student initiatives

- Greening Hohenheim
- FRESH
- AKN – Arbeitskreis Nachhaltigkeit
- AKÖ - Arbeitskreis Ökologischer Landbau
- ASTA-Kulturgruppe
- Bunte Wiese

Employer initiative

- Greenoffice
- Ökologischer Campus

Internal stakeholders at UHOH

- Humboldt reloaded team
- Coordinator of Bachelor in Sustainability and Change
- Educators at UHOH

External stakeholders

- Staatschule für Gartenbau
- Pedagogical staff trained in environmental education
- Permaculture expert from Rette Garten Eden

4.3.3 Stakeholder meetings

As we aim at strongly engaging stakeholders in our LL activities, frequent meetings with our target groups are planned throughout the LL project at the University of Hohenheim. The purpose of these meetings is to establish a platform for discussions, planning, and feedback to ensure continuous development and updates for the LL. These sessions may take the form of organized discussions, feedback meetings, or workshops.

The first meeting was held on November 25 between 1 pm and 4 pm, involving participants from diverse groups, including student representatives, educators, members of the *Humboldt Reloaded* project (https://humboldt-reloaded.uni-hohenheim.de/), and external stakeholders. This session featured multiple discussion rounds (Figure 4.5) and provided valuable insights.

Key outcomes of the meeting included:

1. Deepening our understanding of challenges at the University of Hohenheim, specifically identifying how, where, and when to incorporate teaching on NBS.
2. Strengthening our prior research on preferred learning methods, ensuring they align with the needs of both students and educators for effective knowledge delivery on NBS.

More results are presented in Figure 4.6.

Stakeholders represented (for explanations we refer to the links in chapter 3.2):

- Greening Hohenheim
- FRESH

- AKN – Arbeitskreis Nachhaltigkeit
- Expert from KomBioTa at UHOH
- Representatives of the Humboldt Reloaded at UHOH
- Expert from Department of Integrative Taxonomy at UHOH
- Alumni of UHOH
- External experts on environmental pedagogy and permaculture
- Students of the University of Stuttgart

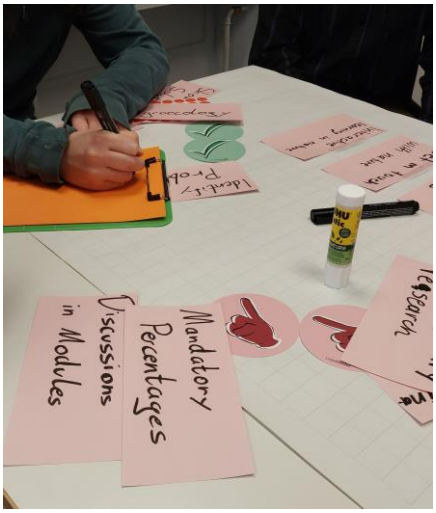

Figure 4.5: Group discussions in the first stakeholder meeting

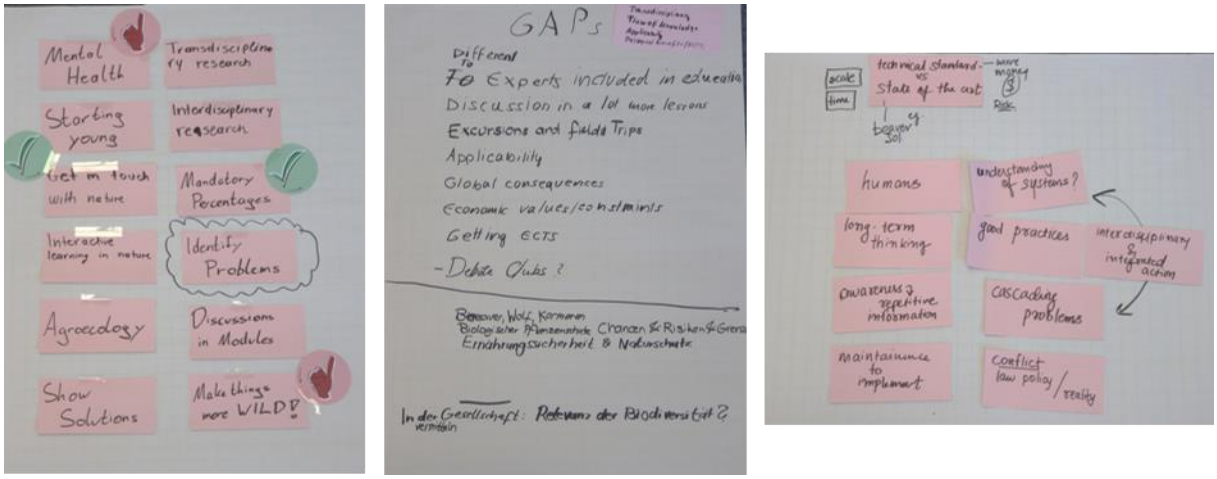

Figure 4.6: Posters prepared by the groups in the first stakeholder meeting

Future stakeholder meetings are foreseen to co-create ideas and realise the LNL activities.

4.4 Location and context

The main location of the Learn in Nature Lab will be the campus of the University of Hohenheim (Figure 4.7). The University of Hohenheim is equipped with abundant infrastructure such as Lecture Halls, Event Halls, Open Spaces for meetings and many technical equipment. These facilities are available for our access and with prior planning. Some such spaces are mentioned below.

Figure 4.7: Location of University of Hohenheim and KomBioTa (Center for Biodiversity and Integrative Taxonomy) in Stuttgart; Source: Google (n.d.). [Google Maps Location of University of Hohenheim]. Retrieved December 2024.

Open Space at Hohenheim Campus

An open space located at the University of Hohenheim Campus could be used for several activities, such as planting, observation of species morphology and diversity, holding discussions in open air etc. Necessary paper work and registration processes should be done duly as the LNL demands for it.

Lecture Halls at the University of Hohenheim

The lecture halls at the University are available for our use and can be booked according to the facilities in demand. The lecture halls come with diverse capacities and technical equipment.

KomBioTa Office

The open space at the KomBioTa office is used from time to time to hold meetings and can host up to 15 attendees. The office is equipped with all the basic equipment for group meetings, teaching kit and also several microscopes. The first stakeholder meeting on the 25th of November 2024 was held at this Office space (Figure 4.8).

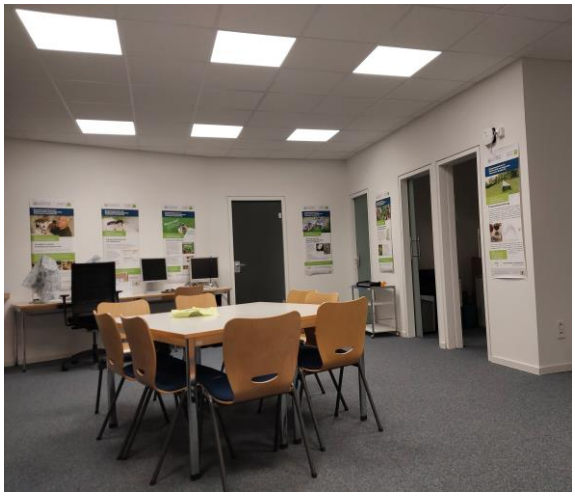

Figure 4.8: KomBioTa office as potential area for discussions in our LL

Educational garden of Agriculture Sciences at Hohenheim

There is a self-study garden for our students at the campus to do exercises and allow them to have lecture-accompanying visits. Agricultural crops can be investigated by the interested visitors.

Museum of Natural History Stuttgart

As one of the partners of the LNL, Natural History Museum Stuttgart can offer place to hold our discussions or excursions. The exhibition buildings of the museum can also help us to plan some of the activities in our LNL.

Places to meet external experts

These places will depend on which experts we would visit with our stakeholders, one example might be the Federsee research station, where we could exchange with an expert in species conservation.

4.5 Reality check: experiments in learning

In the LNL, the following real experiments and projects are envisioned:

- to have case studies conducted by students,
- to organise excursions to showcase the examples of NBS in real world settings,
- to invite experts to lectures,
- to prepare a debate club where the stakeholders can share their knowledge and experiences on NBS.

It is also envisioned that activities will be organised based on the demand by our stakeholders. These activities together with the ones mentioned above will be the experiments to conduct in our LNL to understand how effective they are in learning the concept of NBS from the perspectives of different stakeholders.

4.5.1 Case study projects developed by students

As part of the learning methods to test in our LNL, students will participate in a case study module to design their own case study with NBS related subjects. For this activity, we plan to prepare a module that will be integrated into the curricula either as portfolio module or as Humboldt-Reloaded project. Students who are willing to conduct their own case study will get support from their teachers as part of their course activity. We will also be assisting the students in developing their cases. The effectiveness of this learning method will be evaluated based on examination (Presentations, reports and debates). Students will receive ECTS by successfully completing this activity. Therefore, this experiment is planned as a curricular activity.

4.5.2 Experiments in learning through field trips

The departments at the University of Hohenheim will be reached out to identify interested teaching staff who are closely working on NBS concept and would like to organise field trips together with their students as extra-curricular activity. We will also identify external stakeholders who are willing to host such a trip for students, teachers and other volunteers to learn the concept of NBS in real-world settings. Before and after each trip, the participants will be asked to share their experiences and learning outcomes. This will be one of the experiments to conduct in our LL to understand if and how field trips affected the learning experiences. This experiment is planned as extra-curricular activity.

4.5.3 Experiments in learning from experts

As another experiment we will conduct in our LL, experts from different disciplines who have experience and interest in NBS concept will be invited to the lectures. For this activity, similar to the field trips, we will contact the teaching staff at our university who are interested in inviting experts to their classroom to talk about real-world examples/cases/applications of NBS. Before and after the sessions, evaluation forms will be used to understand the effectiveness of this learning method. It is expected to get feedback not only from the students and teachers but also the experts invited to the lectures. This experiment is planned as extra-curricular activity.

4.5.4 Experiments with transdisciplinary discussions

Another experiment that will be conducted in our LNL will be providing an open space for stakeholders to discuss NBS related topics with an inter- and transdisciplinary approach. For this activity, we will book available rooms at the UHOH campus and prepare invitations for all the interested stakeholders to participate. Before and after the discussion rounds, the participants will fill out evaluation forms to share their experience in learning NBS concept. This experiment is planned as extra-curricular activity.

4.6 Community involvement: stakeholders, users and citizens

4.6.1 Open exploratory approach & participation

As mentioned previously, together with our stakeholders, we aim to have an open exploratory approach to decide on our LL activities. To achieve this, our plan is to have regular meetings with our partners to get their feedback in conducted activities in our LL and methods to improve them. The very first stakeholder meeting allowed us to identify the needs of students, teachers and experts to learn about NBS concept and to integrate it into the curricula. Similarly, the planned meeting with our stakeholders in future will allow us to improve our communication and learn from our experiences. Moreover, evaluation forms and feedback we will receive after each event will help us to shape the development of our LNL. For this, it is crucial for us to follow “Engagement by doing” approach to involve our stakeholders in our LL.

To reach out our stakeholders, we are planning to use several communication channels which includes social media, newsletters of UHOH, flyers and posters (printed in minimal number to reduce waste), emails, website and newsletter of the KomBioTa. Since the activities will involve mostly the students, we also think that using social media effectively will allow us to disseminate and communicate our activities and to motivate them to participate in our LNL.

4.6.2 Potentially affected stakeholders

Depending on the experiments we conduct in our LNL, the affected stakeholders will vary. However, based on the four learning methods we plan to test, we identified the following stakeholders:

Case study: students enrolled in bachelor’s or master’s programs at UHOH (and potentially at US), teaching staff – including PhDs, administrative staff including examination department

Debates: students, teaching staff, experts in different fields such as ecological agriculture, citizens, stakeholders from business and government

Excursions: students, teaching staff, administrative staff, experts in different fields such as taxonomists in SMNS, permaculture, stakeholders from other universities in Germany including University of Stuttgart, University of Bayreuth (UBT) and University of Tübingen (UT), Hochschule für Wirtschaft und Umwelt Nürtingen-Geisenheim (HfWU) stakeholders from business and government

Experts to invite: students, teaching staff, administrative staff, experts to be invited from different fields and universities such as US, UBT, UT, HfWU.

4.6.3 Social issues to consider

In order to provide equal opportunities for all the stakeholders participating in our LNL and to be inclusive, we identified the following points to consider and apply throughout the lifetime of our LL.

Gender equality: we will consider gender equality in each stages of our LL activities. It is important for us to ensure all stakeholders, especially the students, can participate in our LL regardless of their sexual orientation and gender identity.

Cultural differences and social inclusion: we aim to be inclusive not only to ensure gender equality but also to ensure that the persons with disabilities are not excluded from our LNL activities and learning opportunities. Our mission is also to ensure that regardless of the cultural background of the stakeholders, all the activities, discussions and communication platforms are open for all the participants. Considering the international students enrolled in several programmes not only at UHOH but also in other universities, it is important for us to be open and inclusive to successfully conduct our experiments and run our LNL.

Language barrier: considering different stakeholders with different language skills involved in our LL activities, we aim to hold our main discussions in English, instead of German or other languages. This will allow us to eliminate potential communication problems. However, this decision will also depend on the demand by our stakeholders and the language they feel confident to communicate.

Subjectivity: we are aware that different stakeholders can have different world-views. Therefore, we aim to ensure that all the voices are raised and everyone can openly share their opinions, especially in discussion sessions.

4.7 Process design: roles and responsibilities

4.7.1 Potential contributions from the partners

As we have identified several potential stakeholders who could participate in our LNL, we also foresee their potential contribution to our activities. For example, it is expected that we have knowledge sharing between the students, teachers, experts, citizens and other stakeholders from business and government. We also expect that these stakeholders will dedicate their time to our LL activities, which plays a crucial role especially in curricular activities to be awarded ECTS points. With potential collaborations, we also expect financial support from different stakeholders. All these resources and contribution of the stakeholders will be determined with the future activities that will take place in our LNL, starting with the second stakeholder meeting at the beginning of 2025.

4.7.2 Competences and responsibilities

There are several roles identified that can influence the innovative work in LLs (Nyström et al., 2014). To ensure an effective collaboration, we also think the responsibilities should be shared according to the competences of our stakeholders. However, we are at the very early stage of the development of our LL, therefore only the following roles are identified based on Nyström et al. (2024) at this stage – which obviously will extend with the participation of other stakeholders.

- Webbers who decide on potential actors
- Gatekeepers who processes resources
- Messengers who distribute information
- Planners who participate in the development process

Although these main roles are identified, no person has been assigned to these roles yet. With the planned stakeholder meetings we will have in the future, we aim to finalise the decision on who will take what role based on the open discussions.

4.7.3 Structure of communication

It is planned to have KomBioTa as the core partner to be the main contact point. Our stakeholders will be able to contact us via several communication channels including our email address dedicated to ENABLS project: enabls@uni-hohenheim.de.

Depending on the stakeholders' roles, the Webbers and Messengers (not limited to these roles) are expected to foster the communication between internal and external partners, invite potential stakeholders, and disseminate our LL activities.

4.8 The role of education in the Living Lab

The LNL is based in and around the University of Hohenheim, focusing primarily on integrating NBS into education in the most effective way. The lab fosters collaboration among students, educators, researchers, and interdisciplinary stakeholders. Its reach extends beyond University of Hohenheim students, encompassing students from TVET organizations, the University of Stuttgart, and even the general public, depending on feasibility.

The lab operates like a "spider-web" model of higher education, emphasizing interconnectedness and a strong focus on education at all levels. Activities are structured around the university's semester system, ensuring projects and initiatives are planned before the start of each semester and during semester breaks.

Regular feedback sessions and discussions with stakeholders play a crucial role in refining and improving the lab's activities. Lessons learned from one semester are integrated into the next, fostering continuous development.

At the outset, the lab adopts an open and flexible approach to integrating NBS into education. Over time, collaborations with existing university modules are expected, allowing NBS concepts to be incorporated into course content. The timing and specifics of these integrations remain flexible, adapting to ongoing developments.

Future activities will be planned progressively, ensuring adaptability and responsiveness to evolving needs. This approach aims to foster the continuous growth of NBS concepts, not only at the University of Hohenheim but also at collaborating TVET institutions and potentially adult education centers in the region.

4.9 Reflexive monitoring, data management and reporting

4.9.1 Organization of monitoring, data management and reporting

All activities will be regularly evaluated using feedback and evaluation forms to assess both the learning and teaching experiences. The collected data will be activity-specific, anonymized, and frequently updated in an Excel sheet for analysis. This process enables a deeper understanding of outcomes and helps refine future learning activities in a continuous cycle.

The data will be securely stored on the BW Sync&Share file hosting platform alongside other project files. Regular monitoring is also expected to expand stakeholder networks and inspire new ideas for LNL initiatives.

Evaluation forms

With the aim of monitoring the effectiveness of learning methods, evaluation forms will be used before and after each activity in our LL. They will be in line with the feedback process developed under T3.3 in our project. This will help us to understand whether and how the debate session, excursion, case study module and the lectures where the experts are invited affected the understanding of NBS concept. The following figure 4.9 demonstrates the use of evaluation forms in our LL and their critical role in determining and planning our future activities and education at other universities and TVET institutions, which might be inspired by our experiences.

Figure 4.9: Evaluation forms to be used in organising future activities in our LNL

Self-reflection

Not only the feedback of our stakeholders on LL activities but also the feedback within our KomBioTa team plays crucial role in ensuring an effective collaboration and successful design of our LL. Therefore, we will also have regular meetings within our internal team to reflect on our achievements, mistakes, learning and experiences. Similarly, self-reflection sessions can be organised with the interested parties to identify potential risks and to avoid or eliminate them in time.

Data management and reporting

The data collected in our LL will be in line with our university policies and procedures as well as our ENABLS project data management plan and the EU data protection regulations. To ensure the confidentiality, no personal data will be collected as we use anonymized evaluation forms. However, collecting some of personal data is unavoidable since emails and social media channels will be used for communication. Any personal data collected in our LL will be stored in our local secure folders either on paper or electronically.

4.9.2 Impact of the Learn in Nature Lab

To have an impact beyond the time or area of the lab location our LNL activities we aim to include the existing student groups in our extra-curricular activities, which will be active after ENABLS end. We plan to implement the developed LNL case study module on NBS in the study programs of UHOH and can supervise Humboldt reloaded projects beyond the ENABLS duration.

We will observe the results of our LL activities according to the evaluation forms and experiences and extract what could be learnt for others. The insights would be published in accordance to our open science understanding at least on our webpage as an informative article.

4.10 Conclusions

The interviews and surveys earlier conducted on NBS and biodiversity in higher education curricula in the ENABLS project highlighted that teaching staff favour experimental learning for effectively integrating NBS into education. These insights have guided the development of the LL activities.

Collaborative planning with stakeholders has reinforced these ideas, resulting in LL activities focused on hands-on learning and promoting inter- and transdisciplinary learning methods.

Our Living in Nature Lab aims to test various approaches for effectively teaching the NBS concept in a co-designed setup. The target audience includes students, teachers, experts, and societal stakeholders such as business partners and government authorities. By adopting an "engagement by doing" approach, stakeholder input will shape future activities.

This action plan outlines activities, roles, responsibilities, partners, and potential stakeholders, which will be further refined according to our upcoming activities and meetings within the LL.

4.11 References

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5 Action Plan Living Lab Greece: Advancing Urban Coastal Transformation through NBS Skills Development and Capacity Building

5.1 Introduction: shared vison

The Greek Living Lab (LL) needs to be established to address a crucial gap in the integration of Nature-Based Solutions (NBS) into educational and professional practices, particularly in the context of Thessaloniki's coastal regeneration initiative led by the Region of Central Macedonia. The LL will serve as a focal point for bringing together diverse stakeholders, including educators, professionals, community members, and policymakers, to co-create sustainable solutions that enhance urban resilience and biodiversity. Its establishment is pivotal in transitioning theoretical knowledge into practical applications that can directly influence urban planning and community living standards.

The Greek LL aims to make a significant impact by demonstrating how NBS can be effectively implemented in urban, peri-urban and coastal settings to address complex challenges such as climate change, biodiversity loss, and urban sprawl. By developing and disseminating new knowledge and practical solutions, the LL will serve as a model for other regions and cities. The good practices gathered can enhance ecological, social, and economic resilience, providing a blueprint for sustainable development that can be replicated and adapted worldwide.

To realize its mission, the Greek LL requires:

1. **Collaborative Partnerships.** Strong partnerships with local universities and TVET centers, government bodies, NGOs, and industry stakeholders to ensure a multidisciplinary approach to problem-solving.
2. **Community Engagement**. Active involvement of the community to ensure that the solutions developed are practical and meet the real needs of the local population.
3. **Policy Support**. Engagement with policymakers to ensure that the findings and good practices can influence local and regional policies related to urban planning and environmental sustainability.

The Greek LL will operate through a series of interconnected processes:

- **Workshops and Training Sessions.** Regular workshops to train stakeholders on NBS and gather input on local needs and challenges.
- **Lecture series.** A series of lectures delivered by experts in the field of HE and TVET in terms of Educational Policy and NBS integration. Other experts of all sciences/fields of knowledge related to NBS will be invited in order to achieve a multidisciplinary approach. It is suggested that from all 11 Faculties of Aristotle University of Thessaloniki (AUTh) one member will be invited
- **Panel discussions for stakeholder engagement**: HE Faculty Members from AUTh and other HE institutions from RCM, TVET institutes, public authorities (i.e. representatives of local municipalities), Associations (e.g. Technical Chamber of Greece) and environmental NGOs in the area of Central Macedonia and Municipality of Thessaloniki will be invited to debate and explore possibilities for introducing and/or NBS educational and training curricula. These deliberations will support the adoption of the material developed through the project.
- **Field visits** to showcase NBS and discuss their application potential in similar settings.
- **Feedback and Iteration.** Continuous collection of feedback from all stakeholders to better understand the needs and extend of each stakeholders' involvement and how the LL has affected the mindset towards NBS.
- **Dissemination and Advocacy.** Active dissemination of results and advocacy to promote the adoption of successful strategies and solutions beyond the LL.

The outcomes of the Greek LL will extend beyond Thessaloniki through structured exchange and collaboration activities, particularly under Task 3.4 of the eNaBLS project. This approach operates on two primary levels: interaction within the eNaBLS network of LLs and engagement with external LLs and relevant projects. Both levels are designed to maximize the transferability and impact of the LL's outcomes across diverse locations, contexts, and challenges.

5.1.1 Interaction and Exchange within eNaBLS Living Labs

Through structured interactions with other LLs in the eNaBLS network, the Greek LL will contribute its insights, educational resources, and findings on NBS in vocational education and coastal resilience. These exchanges will be organized as regular online meetings, workshops, and collaborative sessions where each LL shares its unique challenges, methodologies, and results. This internal exchange will allow the Greek LL to both benefit from and contribute to a shared repository of knowledge, which will be accessible to other eNaBLS LLs implementing NBS in diverse geographic and urban contexts. The specific focus of the Greek LL on vocational training and coastal zone management provides a distinct perspective that can inform other labs working on similar themes, such as urban resilience, biodiversity enhancement, and community engagement.

5.1.2 Collaboration with External Living Labs and Relevant Projects

The Greek LL will also engage with external LLs and related projects, such as CARDIMED, which operates demonstration sites and has partners both in Greece and other countries. This level of interaction aims to facilitate knowledge transfer and leverage the collective expertise of projects working in areas aligned with NBS and environmental education. Potential activities include joint workshops, online exchanges, and demonstration site visits, which will be organized to allow in-depth discussions on best practices, technical solutions, and engagement strategies.

5.1.3 Contribution to eNaBLS aims

The Greek LL actively supports eNaBLS's main goal of increasing attention to NBS in VET and TVET by bringing together stakeholders from diverse educational levels and background to explore the adoption and inclusion of NBS curricula related to coastal restoration. Through the collaboration between the Technical Chamber of Greece (TEE) and CERTH, the LL provides targeted training for engineers, emphasizing NBS within a lifelong learning context to support continual professional development. This partnership ensures that practicing engineers gain practical, updated knowledge of sustainable solutions, enhancing their capacity to apply NBS principles in real-world projects. Meanwhile, IDEA, as a key LL partner, is instrumental in extending NBS awareness and skills into the TVET sphere, reaching young professionals and unprivileged social groups who are new to the field. Together, these efforts foster a generation of professionals equipped with both foundational and advanced knowledge, driving the broader integration of NBS in technical fields and aligning with eNaBLS 's overarching educational mission.

The Greek LL is positioned at the core of the NBS definition by focusing on solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. It not only aims to address ecological and social challenges through these solutions but also promotes nature-based thinking among stakeholders. This involves encouraging stakeholders to consider natural processes and ecosystems in decision-making, which is essential for the sustainable planning and development of urban areas. The Greek LL fosters a mindset that values nature as a central component of urban development, which is critical for the long-term sustainability of cities.

5.2 Brilliant idea or complex problem

The Greek LL aims to address the intricate challenge of integrating NBS into VET/TVET and also HE within the context of the planned coastal unification initiative in the Greater Thessaloniki Area. This initiative seeks to unify the coastal front from Kalochori to Aggelochori (Figure 5.1), spanning approximately 40 kilometers, to enhance urban resilience, biodiversity, and sustainable development.

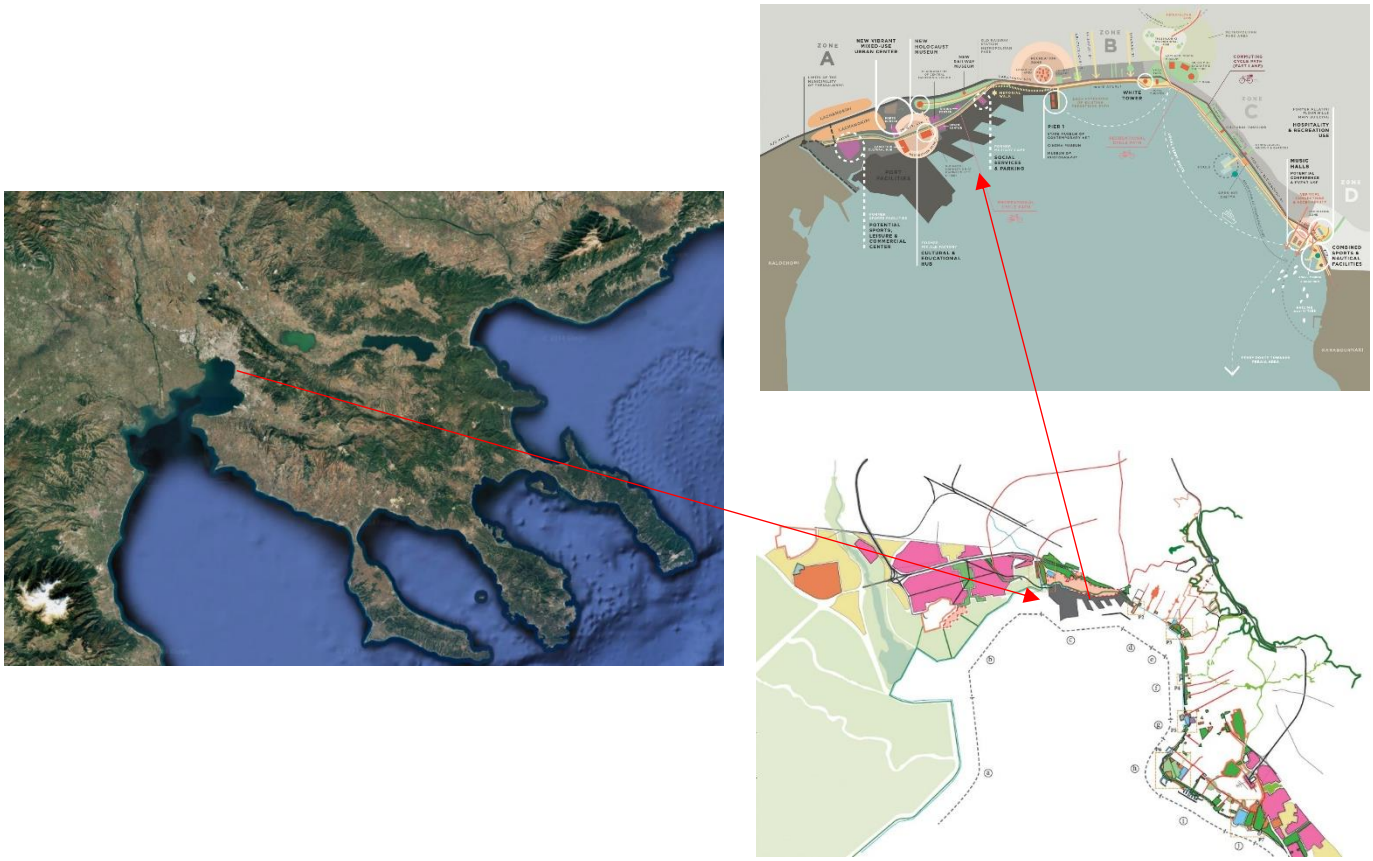

Figure 5.1: Map of the planned coastal zone unification

- The challenge requires the convergence of environmental science, urban planning, education, and policy-making. Aligning these diverse fields necessitates coordinated efforts among various stakeholders, including educational institutions, local authorities, environmental organizations, and the community. The way the Greek LL is planning to tackle this challenge was also demonstrated during the 1st gathering of the involved stakeholders in Thessaloniki, were a diverse group of actors throughout the quadraple helix was introduced to the Greek LL concept.
- Incorporating NBS into VET and TVET curricula involves updating educational content, training educators, and developing practical modules that reflect the latest advancements in sustainable practices. This process demands significant resources, time, and a shift in traditional educational paradigms. The involvement of a diverse range of educators and educational institutions (HE through universities, technical lifelong learning through the Technical Chamber of Greece, VET/TVET through IDEA Training) demonstrates our way of addressing this.
- Implementing NBS within the coastal unification project requires navigating complex legal and regulatory landscapes. Existing policies may not fully support or recognize NBS, posing

challenges in approval processes and funding allocations. Bringing in all levels of regional and local stakeholders (Region of Central Macedonia, Municipal and intermunicipal development agencies and the Natural Environment & Climate Change Agency of Greece) marks the way the Greek LL is addressing this challenge.

Gaining the support, acceptance and active participation of local communities is crucial. However, varying levels of awareness and interest in environmental initiatives can hinder collective action and the successful implementation of NBS.

The concept of integrating NBS into VET and TVET emerged from the recognition that sustainable urban development requires a workforce equipped with practical skills in environmental stewardship. The coastal unification initiative in Thessaloniki presents an opportunity to embed these principles into educational frameworks, ensuring that future professionals can effectively contribute to and sustain such projects:

- Thessaloniki's coastal areas face challenges such as erosion, pollution, and loss of biodiversity. NBS offer sustainable solutions to mitigate these issues by enhancing natural habitats and promoting ecological balance.
- Current VET/TVET and technical lifelong learning programs (that can also be applied directly during the development of a project and provide ready to use skills to the trainees) in most cases lack comprehensive modules on NBS, leading to a skills gap in the workforce. Addressing this gap is essential for the successful implementation and maintenance of sustainable projects.
- Integrating NBS into urban development can provide economic advantages, such as job creation and tourism, while improving the quality of life for residents through enhanced green spaces and resilience to climate change.

What makes the problem complex:

- Developing and integrating new educational content and training programs require substantial investment, which may be limited.
- Educational institutions and policy frameworks often exhibit resistance to change, slowing the adoption of innovative approaches like NBS.
- A lack of awareness or understanding of the benefits of NBS among stakeholders can lead to reluctance in embracing these solutions.
- Effective implementation necessitates collaboration across multiple sectors and disciplines, which can be difficult to achieve due to differing priorities and communication barriers.

5.3 The underlying challenge of the Greek LL

The fundamental challenge for the Greek LL is to integrate NBS into the VET and TVET systems within the context of the coastal unification project in Thessaloniki. The underlying challenge is multifaceted and affects a range of stakeholders:

- For educational institutions, the challenge lies in adapting curricula to incorporate NBS, requiring updates to course content, educator training, and resource allocation.
- For local communities and professionals, it involves raising awareness and developing practical skills to engage with and implement NBS in real-world projects.
- For policymakers and local authorities, it's about developing supportive policies and navigating regulatory frameworks to enable and sustain these environmental initiatives.

Several sustainability themes are central to the Greek LL's work:

- Ecological Resilience. Enhancing biodiversity along Thessaloniki's coastal front and improving its resilience to environmental stressors like climate change and pollution.
- Urban Regeneration. Using NBS to revitalize urban spaces, creating green infrastructure that supports public health, well-being, and quality of life.
- Environmental Education. Building a skilled workforce equipped to develop and maintain sustainable urban ecosystems.
- Community Engagement. Fostering a culture of sustainability by actively involving local communities in NBS projects.

Economic Hurdles

- The financial resources needed to develop and implement NBS-based curricula and training programs are substantial, and securing funding for these efforts remains a persistent challenge.
- There may be initial economic resistance from sectors that do not yet recognize the value of NBS, and aligning the job market with NBS-oriented training could take time.

Behavioral Hurdles

- Shifting educational paradigms to prioritize sustainability requires significant changes in mindset among educators, students, and professionals.
- Many community members and stakeholders may have limited understanding or motivation to engage with NBS, necessitating sustained awareness campaigns and training.

Political Hurdles

- The introduction of NBS within the urban planning framework of Thessaloniki requires alignment with existing policies and regulatory structures, which may not yet support or prioritize NBS.
- Policymakers may face pressure to prioritize short-term economic gains over long-term environmental goals, complicating efforts to gain political support for NBS initiatives.

This challenge is not unique to Thessaloniki; many urban areas worldwide face the dual challenge of revitalizing their urban landscapes while addressing climate resilience and biodiversity loss. Integrating NBS into educational and professional training systems is a challenge echoed in cities globally, particularly those with vulnerable coastal or urban ecosystems.

The Greek LL focuses specifically on bridging the gap between NBS concepts and practical, vocational education and training, aiming to:

- By integrating NBS into VET and TVET curricula, the LL will seek to set the frame for the development of a generation of skilled professionals capable of implementing and maintaining sustainable solutions.
- Collaborating with policymakers to develop frameworks that support NBS initiatives in the context of Thessaloniki's coastal regeneration.
- Engaging local residents through workshops and training to cultivate a collective sense of environmental stewardship and active involvement in the coastal unification project.

5.4 Partners and stakeholders

5.4.1 Stakeholders and partners that are involved in the Greek LL

The following Table 5.1 summarizes the role, expected benefits and level of participation for the core partners and stakeholders to the Greek LL.

Table 5.1: Core ENABLS Greek LL partners and stakeholders

	Role	Stake/Benefit	Level of participation
CERTH	Lead partner managing the overall coordination, funding, and strategic direction of the LL.	CERTH aims to advance applied research on NBS, showcasing practical solutions for urban sustainability and biodiversity. CERTH benefits from reinforcing its role as a research leader in sustainable urban transformation and aligning with regional policy priorities.	CERTH is leading operations, providing technical expertise, and ensuring outcomes align with the overarching goals of the ENABLS project.
IDEA Training	Educational partner adopting VET and TVET-specific NBS training materials and leading skill-building workshops	IDEA seeks to enhance the curriculum with NBS modules, aiming to build capacity in the workforce by equipping professionals with sustainable practices knowledge. The organization benefits from expanding its educational offerings and strengthening its relevance in green vocational training.	IDEA participates through the creation and implementation of educational content, hands-on training, and facilitating workshops, supporting both technical and pedagogical dimensions
FOCUS	Key partner responsible for stakeholder engagement, community outreach, and dissemination of outcomes	FOCUS has a vested interest in promoting community engagement in sustainability practices and enhancing public awareness of NBS. The organization benefits from strengthened local networks and elevated public awareness of environmental issues	FOCUS contributes through organizing public forums, managing communications, and capturing community feedback, playing an essential role in engagement and reflexive monitoring

Region of Central Macedonia	The Region of Central Macedonia provides official support and legitimacy, placing the LL under its auspices, which elevates its standing and connects it with broader regional strategies	RCM aims to position the region as a leader in sustainable development, supporting innovative projects like the LL to enhance regional resilience and biodiversity. This partnership allows the LL to influence regional policy and planning directly	RCM will support regulatory alignment, resource mobilization, and networking, playing an instrumental role in guiding policy-related aspects of the LL.
Technical Chamber of Greece/Section of Central Macedonia (TCG/SCM)	TCG/SCM will act as a bridge to the technical and engineering community, facilitating access to technical expertise and engaging professionals in training on NBS	TCG/SCM is invested in promoting sustainable practices within the engineering field, helping its members gain critical skills and knowledge in NBS and sustainability. This partnership broadens the impact of the LL by ensuring that trained professionals integrate sustainable practices into urban projects across Central Macedonia.	TCG/SCM will contribute by providing infrastructure for training sessions, facilitating access to a network of engineers, and supporting the dissemination of NBS knowledge within the technical sector.

5.4.2 What other stakeholders could / should be involved? How are you going to approach them? What are potential conflicts of interest?

In addition to the core partners, the LL involves several other critical stakeholders:

- Municipality of Thessaloniki: To align LL activities with urban planning goals and ensure integration into municipal projects.
- Aristotle University of Thessaloniki: To contribute research insights and facilitate student involvement.
- Regional Development Agencies (e.g., MATh A.E., Anatoliki S.A., and Regional Development Fund of Central Macedonia): These agencies will provide regional planning support and resource allocation.

These stakeholders will be invited during all LL engagement activities, such as workshops, public meetings, and collaborative planning sessions. Differences in policy preferences or regulatory approaches, especially concerning urban development or economic goals may arise. Also, divergent views on environmental interventions and their implications for local businesses and residents are expected. To address these, clear communication/collaboration channels (accessible meeting minutes, shared online repository area) and regular online and physical meetings will be established, ensuring transparent decision-making and conflict resolution.

5.5 Location and context

5.5.1 Greek LL physical space

The Greek LL is strategically situated within the premises of IDEA Training in Thessaloniki, with supplementary activities hosted at the Technical Chamber of Greece / Section of Central Macedonia (TCG/SCM).

5.5.2 Location, ownership, size and facilities

Primary Location: IDEA Training's facilities are located at Christou Pipsou 9, Thessaloniki 546 27, in the second (B) municipal district of Thessaloniki that is the northern and western part of the Municipality of Thessaloniki (Figure 5.2). With a population of 28.792 people this area serves as the gateway to the centre of Thessaloniki.

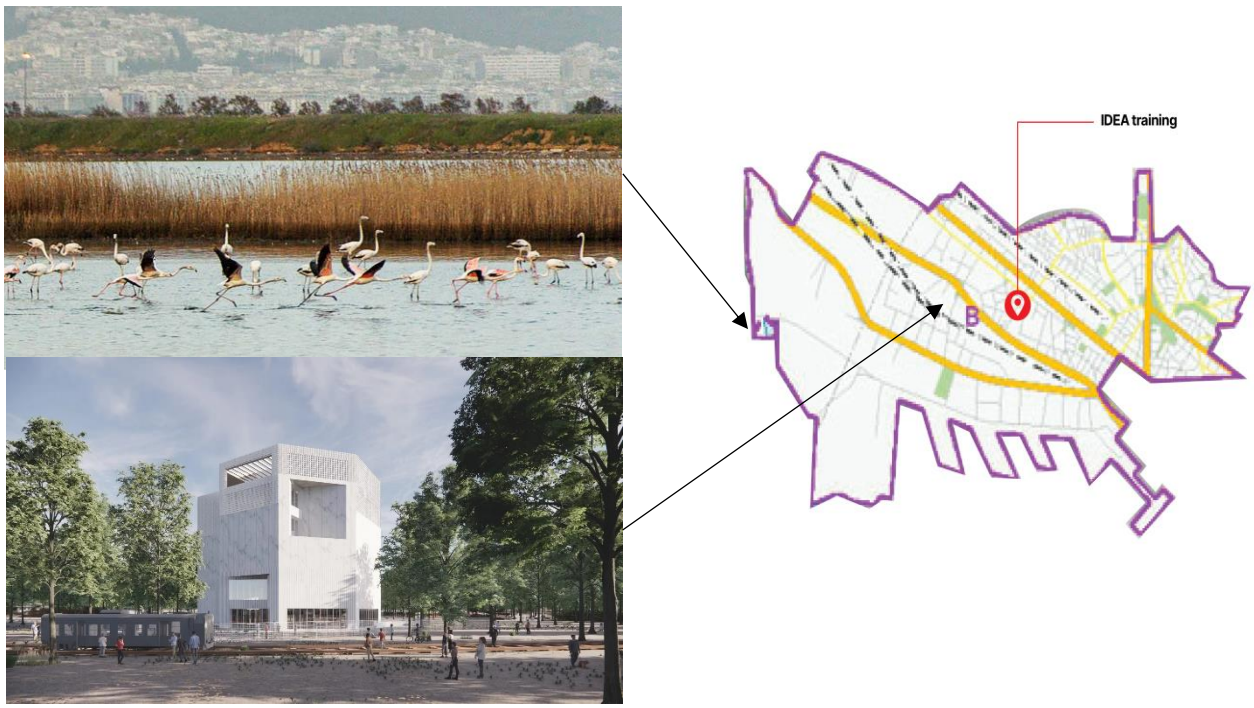

Figure 5.2: Map of the Greek LL primary location and surrounding landmarks.

On the wider northwestern side of the city the New Railway Station, the commercial and passenger port of the city, the Old Railway Station of Thessaloniki, the central building complex of the Region of Central Macedonia can be found, as well as the Holocaust Museum, which is under construction. This is a very critical point for the future of the area with such a construction a number of challenges will emerge. The construction is expected to be completed in 2026 and the flow of tourists, spatial planning, construction works and their effects in the natural habitat are some of the key challenges to be addressed even after its completion due to the overall added value that it will bring in the area. It is also important to mention that IDEA training's facilities are within a walking distance from the seafront, the harbor and the building of the Region of Central Macedonia, where the major urban planning decisions are being taken.

In the harbor area many hotels and several old listed industrial buildings are nowadays renovated and operate as multicultural venues. There are also important buildings of the Byzantine period of the city, part of the Byzantine walls and scattered recreational areas, urban gardens, parks and squares.

IDEA's facilities encompass a total area of 700 square meters, featuring modern offices, classrooms, and IT labs spread across the 1st and 3rd floors (Figure 5.3). The facilities include:

- Classrooms with a certified capacity of 100 people
- 4 modern digital labs with 100 computer stations
- Multimodal classroom with a capacity of 60 people
- Educational Research Innovation Lab with AI, VR & AR infrastructure (IQ LL)
- Open workspaces
- Break and relaxation rooms
- Library – Study space and Print Centre
- Modern administrative facilities
- Modern videoconferencing rooms

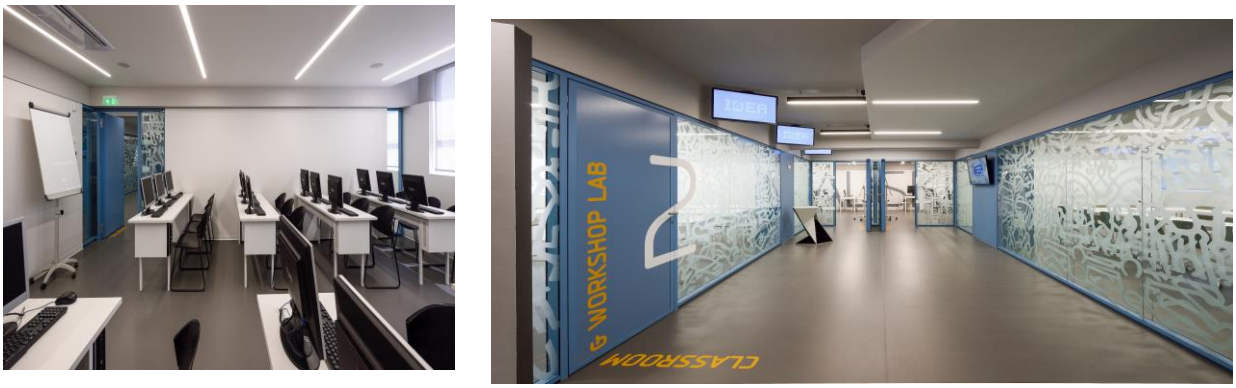

Figure 5.3: IDEA Training facilities

Within IDEA training premises, the horizontal and vertical, independent and safe access for people with disabilities or handicapped persons has been ensured, as well as their service in all exterior and interior areas of the buildings in accordance with the Design Guidelines of the Ministry of Environment and Energy "Designing for All".

In particular, accessibility is ensured by horizontal and vertical routes starting from the level of the pavement and extending to the lift door and the interior and exterior of the building, consisting of elements of appropriate standards such as ramps, lifts, special entrance doors without thresholds, both in the secretarial area and in the classrooms. Accessibility is also assured by protected accessible waiting areas in case of emergency on each floor in the ratio of one space with one wheelchair position.

In addition, the design of sanitary facilities for people with disabilities or handicapped persons on each floor with educational use and relaxation areas of appropriate dimensions has been planned. As far as the classrooms are concerned, the necessary dimensions have been studied and applied to the corridors and the distances between the mobile equipment so that all points are accessible. The lockers are designed to be accessible and easy to use for people with disabilities and the rooms have the necessary soundproofing for the visually impaired.

Following a sustainable approach, IDEA training's facilities are at the moment going through a bioclimatic renovation, expanding the floors of the buildings. The renovation will be completed in the following months before the launch of the Greek LL, offering 3 more classrooms and many more possibilities.

Supplementary Location: The Technical Chamber of Greece / Section of Central Macedonia is situated at M. Alexandrou 49, 54643 Thessaloniki. TCG/SCM operates autonomously with its own

administrative and operational structure. In their premises regular training workshops, as well as conferences and large-scale events are held.

Primary location is managed by eNaBLS partner IDEA, actively involved in the LL, ensuring seamless collaboration and alignment with the LL's objectives. TCG/SCM facilities are publicly available to engineers and CERTH maintains very close and long-term collaboration with them.

5.5.3 Alignment with mission and challenges

Both IDEA Training and TCG/SCM are committed to advancing vocational education and training (VET) and technical vocational education and training (TVET) in Greece. Their missions align with the LL's goal of integrating Nature-Based Solutions (NBS) into educational frameworks, addressing challenges related to environmental sustainability and urban resilience. The existing infrastructure at both locations is well-suited for the LL's activities, including workshops, training sessions, and collaborative projects. Minimal interventions are needed, primarily involving the integration of NBS-specific materials and resources into the existing educational setups. **IDEA Training** serves a diverse group of learners, including unemployed individuals and employees seeking to enhance their skills through various training programs, while **TCG/SCM,** as the regional branch of the Technical Chamber of Greece, represents over 17,000 qualified engineers of all specialties, indicating a significant professional community engaged in its activities. Both locations are situated in Thessaloniki, providing easy access for local participants and stakeholders. Both facilities are equipped with modern IT infrastructure, supporting digital learning and collaboration essential for the LL's operations.

5.6 Reality check: experiments, location, context

The Greek LL focuses on integrating NBS into VET and TVET to address key knowledge and skills gaps among present and future professionals. At this stage, the LL is centered around adopting educational curricula, hosting training workshops, and engaging relevant stakeholders, rather than implementing hands-on experimental projects. This approach allows the LL to establish a strong foundation in NBS concepts and technical competencies, ensuring that students and professionals are well-prepared to apply these principles across various sectors.

The main activities of the Greek LL are dedicated to educational, training and capacity building efforts. These include curriculum development and technical training that introduce NBS concepts and practical applications, specifically tailored to urban and coastal contexts. In this initial phase, the LL will be covering the thematic areas of ecological resilience, sustainable urban planning, and environmental management, all closely aligned with the planned coastal zone unification in Thessaloniki. In addition to curriculum adoption, workshops focused on coastal zone NBS will provide immersive learning experiences for participants, discussing both theoretical foundations and real-life case studies. These workshops expose students and professionals to current NBS strategies in urban and coastal resilience, helping them connect these approaches to the local environmental challenges of Thessaloniki's waterfront area. Already from the first gathering of the LL, expert presentation of Dr. Stefanakis has provided the participating stakeholders with valuable baseline information on NBS.

While no experimental activities are expected in this foundational phase, the Greek LL's connection to Thessaloniki's coastal zone unification opens up promising opportunities for future hands-on activities. These may include field visits to coastal sites where participants can observe ecosystem conditions and discuss NBS potential directly on-site. Such visits would allow participants to see how NBS can address specific environmental challenges and integrate into urban landscapes. There is also potential for pilot projects in collaboration with local authorities, where small-scale NBS interventions could be tested, such as native vegetation for shoreline stabilization or rain gardens for water management. These pilot projects would give students and professionals hands-on experience with NBS installation and maintenance, while assessing the feasibility of these solutions for coastal resilience in Thessaloniki. Additionally, as the LL evolves, community-involved projects may be organized to engage local

residents in the installation or care of green infrastructure, like small green spaces along the coast or community gardens. These hands-on, community-focused activities could foster a deeper understanding of NBS, increasing public awareness and community ownership of sustainable practices.

5.7 Community involvement

The Greek LL aims to foster collaboration among a diverse array of stakeholders, users, and citizens to develop and implement NBS effectively.

Beyond the core partners—CERTH/IBO, IDEA Training, and FOCUS—the LL plans to engage the following entities:

- **Academic Institutions**: The Department of Spatial Planning and Development at Aristotle University of Thessaloniki (Τμήμα Χωροταξίας ΑΠΘ) will contribute research expertise and facilitate student involvement.
- **Local Government**: The Municipality of Thessaloniki (Δήμος Θεσσαλονίκης) will provide insights into urban planning and community needs, ensuring that NBS initiatives align with municipal strategies.
- **Regional Development Agencies**: Organizations such as MATh A.E., Anatoliki S.A. (Ανατολική Αναπτυξιακή), and the Regional Development Fund of Central Macedonia (ΠΤΑ ΠΚΜ) will offer support in regional planning and resource allocation.
- **Environmental Authorities**: The Natural Environment and Climate Change Agency (ΟΦΥΠΕΚΑ) will provide guidance on environmental regulations and sustainability practices.
- **Community Organizations**: Groups like Friends of the New Waterfront (Φίλοι Νέας Παραλίας) and local organizations like Εχεδώρου Φύσις (Echedorou Fysis – locate in the Axios-Aliakmonas Delta natural reserve) will represent citizen interests and assist in community engagement efforts.
- **Private Sector**: Companies such as Incommon will bring industry perspectives and potential technological solutions to the table.

Expected benefits:

- Fostering partnerships across sectors will lead to more comprehensive and effective NBS curriculum implementations.
- Pooling resources and expertise will improve efficiency and reduce redundancy in project efforts.
- Active citizen participation will ensure that solutions are tailored to local needs, increasing public support and sustainability.
- Collaboration with governmental bodies will facilitate the integration of NBS into existing policy frameworks, promoting long-term adoption.

The LL will require expertise from various disciplines, including:

- Environmental Science
- Urban Planning
- Social Sciences
- Art & Humanities
- Economics

- Engineering

Citizen involvement will be structured across several levels, as outlined in the OECD Guidelines for Citizen Participation Processes:

- **Information**: Providing citizens with accessible information about NBS projects through public meetings, brochures, and online platforms.
- **Consultation**: Gathering feedback from the community via surveys, focus groups, and public forums to inform decision-making on the development of the LL amongst ENABLS Greek partners.
- **Active Participation**: Involving citizens directly in the co-creation and implementation of small-scale NBS initiatives, such as through participatory workshops and volunteer programs.

To ensure inclusivity and address social issues, the Greek LL will proactively engage marginalized communities, including low-income residents, minorities, and individuals with disabilities, to ensure their perspectives are considered. Moreover, the LL will adopt good NBS practices that provide benefits across all societal segments, aiming to reduce disparities in environmental quality and access to green spaces. Finally, the LL will offer training and educational opportunities to empower citizens with the knowledge and skills to participate effectively.

5.8 Process design

5.8.1 Roles and responsibilities

The Greek LL is led by the CERTH, with active participation from IDEA Training and FOCUS. Each partner brings distinct expertise and resources to ensure the LL's success. CERTH serves as the lead organization, overseeing the LL's strategic direction, budget management, and coordination of all activities. Additionally, CERTH facilitates communication with stakeholders and external partners. CERTH also plays a key role in capturing feedback for reflexive monitoring and ensuring community needs are addressed. IDEA focuses on adapting and implementing VET and TVET content related to NBS. Their tasks involve adapting educational materials, designing hands-on training modules, and leading workshops that align with the LL's objectives to meet local training needs, providing training infrastructure, including classrooms and technical equipment, and supporting outreach to students and professionals. FOCUS is responsible for stakeholder engagement and dissemination of the LL's outputs. FOCUS manages relationships with regional partners, coordinates with local government, and organizes events to raise awareness of the LL's initiatives.

The responsibilities assigned to each partner align closely with their expertise and resources. CERTH/IBO's specialization in project management and coordination makes it suitable for overseeing complex, multi-partner activities. IDEA Training's strong foundation in education positions fits well for curriculum development and hands-on training. FOCUS's skills in stakeholder engagement are critical for community involvement and feedback collection.

5.8.2 Organizational structure and communication

The LL employs a decentralized yet structured approach to organization and communication. Regular core team meetings between CERTH, IDEA, and FOCUS are held to discuss progress, share updates, and resolve any issues. FOCUS manages external communications, ensuring timely and consistent updates to stakeholders, local authorities, and the community. A structured reflexive monitoring process allows stakeholders to provide feedback on all activities, enabling the LL to adapt to emerging needs and challenges.

5.9 The role of education in the Living Lab

Our LL will address the central goal of ENABLS, to bring more attention for NBS in higher education, **by enhancing collaboration between the local TVET & HE stakeholders and especially curriculum designers and policy makers.** Thus, our LL's purpose will focus on providing a safe, interdisciplinary and creative space for HE and TVET policy makers and practitioners to work on practical issues of raising awareness regarding NBS integration in HE and VET sector at a local and regional level.

In a more practical way, our LL will address the central ENABLS goal by aiming to deliver ***a sustainable model (a set of principles and foundations)*** of coping with NBS topics horizontally in HE and TVET curricula.

Our LL will be mainly developed in the premises of IDEA VET center in collaboration with various other VET Centers of Thessaloniki. With the participation of TVET and HE stakeholders, IDEA VET center will play a key role in engaging trainers and trainees in pilot activities regarding the integration of NBS in hands-on training. For this purpose, IDEA VET center has designed a variety of workshops that will include:

- Integration of ENABLS LL Projects into VET Curricula
- Collaboration on Real-World Problem Solving
- Collaborative Learning Environment
- Real-World Testing Grounds for our VET Students
- Interdisciplinary Education

This safe and interdisciplinary space will be the IDEA VET center itself which will host the workshops and panels for the joint activities of HE and TVET stakeholders, along with activities that will happen in the premises of the Technical Chamber of Greece. Discussions and liaising have been developing since M6 during the T.1.1 and T.1.4 activities where all participants were informally invited to join our LL.

By connecting a LL with a VET center and a stakeholder such as Technical Chamber of Greece, we create a dynamic ecosystem where real-world innovation and practical vocational training intersect. During these sessions all participants will hopefully be engaged in Advocacy and Policy Work under a twofold purpose:

- on one hand to advocate for policy changes: That is to work with educational, technical and environmental policymakers to create incentives for incorporating NBS into HE and VET.
- on the other hand, we aim to engage LL participants in policy forums: that is create a network where they can be invited to participate in regional or national dialogues on sustainable development, where they can advocate for the inclusion of NBS in educational frameworks and training systems.

We intend to do so by creating ***a constant dialogue*** between HE and TVET stakeholders in the context of integrating NBS into existing curricula. This dialogue will focus on two interconnected experiments.

Experiment 1

Cross-curricular integration of NBS: we plan to work with curriculum developers to integrate NBS concepts into various academic disciplines, not just environmental science. NBS can be applied in fields such as architecture, urban planning, agriculture, engineering, social sciences, Art & Humanities.

Experiment 2

Develop novel courses: we plan on offering ideas and models for specialized programs in NBS-related fields, such as sustainable urban planning, climate-resilient agriculture, or eco-design and eco-feminist

practices. This could attract students who are interested in making an impact on sustainability through their career choices. **This way, our objectives of the Greek LL will be:**

- to promote interdisciplinary dialogue regarding the creation of a model framework/guidelines for NBS in HE and VET curricula by engaging stakeholders from a wide spectrum of disciplines and walks of life (Humanities, Performance Arts, Biology, Cultural Studies, Geography, Physical Education, Life Sciences)
- to create materials/PRODUCTS for interdisciplinary incorporation of NBS in HE and VET curricula (materials can be: objects, services, technology, applications, processes, systems etc.)
- to provide training for HE & VET educators that want to integrate NBS concepts and materials in their teaching

5.9.1 Project-based, real-life learning

We plan to set up an educational activity by integrating Project Based Learning (PBL) principles for TVET learners. The idea is that we will blend eNaBLS LL with Existing Courses and Curricula in order to potentially design Collaborative Learning Modules. The method we estimate that we will follow is **Project-based Learning (PBL)**. We plan to make use of the eNaBLS LLs as a base for project-based learning modules located around the 2nd municipal district where the Holocaust Museum is currently being constructed (Figure 5.4).

Figure 5.4: Construction site of the Holocaust Museum in Thessaloniki

For example, a course on sustainable urban design could include a real-world project where students work with the eNaBLS LL team, and especially with stakeholders from TEE, in order to design and implement an eco-friendly green space or ways to incorporate NBS in construction management. In this construction-related PBL, students are tasked with working on a **real-world construction project** (in our case the Holocaust Museum). The projects should span multiple stages of the construction process, integrating a variety of subjects and skills, such as:

- **Design and Planning**: Architectural design, structural engineering, project management.
- **Sustainability**: Green construction, energy efficiency, NBS, circular economy.
- **Building Technologies:** Modern construction methods, materials science, and smart construction technologies.

This PBL activity will also provide a genuinely interdisciplinary approach regarding two aspects:

Aspect 1. Cross-Disciplinary Courses: we will offer courses that involve students from different programs in both TVET and HE sector (e.g., engineering, design, environmental science, finances, cultural management, sociology) working together on LL projects. These cross-disciplinary modules will allow students to experience the collaborative nature of real-world problem-solving.

Aspect 2. Fieldwork Integration: Students can undertake fieldwork as part of their coursework in the LL, where they collect data, analyze results, and contribute to ongoing research or development efforts. This could include environmental monitoring, energy audits, or social surveys to understand the impact of NBS on the local community of the 2nd municipal district of Thessaloniki.

5.9.2 Reflection on the different interpretations of NBSL foresight studies

We plan to integrate Foresight Studies Seminars in our eNaBLS Greek LL in the sense that they will allow participants to reflect not only on the past and present but also on the future(s) of their hands-on-training. That means that all participants will be trained in order to study the urban environment of the construction site in its LL implementation period (Summer of 2025-Summer 2026) and project their insights on the future of the whole area.

Foresight Studies Seminars in the context of eNaBLS Greek LL are an excellent tool for helping TVET and HE students understand the potential of Nature-Based Solutions (NBS), as they provide a structured framework for exploring future scenarios, challenges, and opportunities. Foresight methodologies encourage students to think long-term, creatively, and critically about how NBS can address complex environmental, societal, and urban challenges. In this sense, Foresight Studies Seminars can specifically help students grasp the potential of NBS and potentially begin their reflection on how to:

Simulate Future Scenarios with NBS

- **Visioning Workshops**: Students can participate in visioning workshops where they imagine multiple futures, considering both the opportunities and challenges that may arise in different scenarios. For example, they may explore a future where cities rely on NBS to combat extreme weather events, and contrast this with a scenario where cities fail to adopt NBS, leading to worse outcomes like urban heat islands, increased flooding, and loss of biodiversity.
- **Backcasting**: Students can also use backcasting to identify the steps needed to achieve a desirable future where NBS are fully integrated into urban planning and land management. For example, backcasting could help students map out the steps required to integrate green infrastructure, like rain gardens and permeable pavements, into city planning policies by 2030 or 2050.

Evaluate the Impact of NBS

- **Cost-Benefit Analysis**: Students can use foresight methodologies to conduct cost-benefit analyses of implementing NBS in different contexts. For example, they might evaluate the long-term benefits of urban parks in terms of carbon sequestration, health improvements, and stormwater management, compared to the initial investment.
- **Monitoring and Adaptation**: Foresight seminars encourage students to consider how NBS solutions can be monitored and adapted over time to ensure they remain effective in changing environmental conditions. For example, students might look at how adaptive management practices can ensure that urban forests or wetlands continue to provide flood protection and biodiversity benefits under future climate scenarios.

5.9.3 Translating foresight into action for NBS

- **Policy Recommendations**: After engaging with future scenarios, students can be asked to develop policy recommendations for integrating NBS into urban or rural planning. They may explore how public policies can incentivize the adoption of NBS and how to overcome barriers such as lack of funding, regulation, or public awareness.
- **Community Engagement Strategies**: Foresight studies also help students design **community engagement strategies** for promoting NBS. Students might propose ways to raise awareness about the benefits of NBS among local residents or suggest community-driven projects that use NBS to enhance local resilience to climate change.

All the above can be understood in the context of a real - life setting which our area can provide, situated only a few meters away from the construction site of the Holocaust Museum.

The model for integrating NBS in HE and TVET curricula is realistic within the timeframe of the project.

5.10 Reflexive monitoring, data management and reporting

To achieve its goal of increasing awareness and the uptake of NBS concepts and practices in higher education, the Greek LL will implement a structured approach to monitoring, data management, and reporting. This approach is designed to capture quantitative and qualitative data that reflects the LL's impact on stakeholders, educational systems, and local communities, ultimately providing a foundation for long-term adoption and integration of NBS beyond the lab's timeframe and location.

5.10.1 Monitoring Approach

Table 5.2: Critical elements of the monitoring process

	What to Monitor	How to Measure
Awareness and Attitude Shifts	Changes in awareness, understanding, and attitudes toward NBS among educational institutions, students, professionals, and local authorities. Surveys, interviews, and focus group discussions will be conducted with these stakeholders periodically	Baseline surveys will be conducted at the beginning of the LL's operations to assess initial knowledge and attitudes. Follow-up surveys and discussions will be held at key intervals to measure shifts over time, evaluating the effectiveness of educational materials, training sessions, and awareness campaigns
Uptake of NBS in Curricula	Integration of NBS concepts into VET and TVET curricula at IDEA Training and other involved educational institutions.	Monitor the number and quality of NBS-related modules, course materials, and workshops introduced. This includes tracking student enrollment and feedback in NBS-focused courses and the adoption of these materials by educational staff
Barriers and Opportunities for NBS in Education	What to Monitor: Identification of barriers (e.g., resource constraints, regulatory challenges) and opportunities (e.g., stakeholder enthusiasm,	Through stakeholder interviews, workshops, and community feedback, data on the barriers and facilitators for NBS adoption will be collected and analyzed to inform

	policy support) for integrating NBS into education.	recommendations for overcoming obstacles.
Stakeholder Engagement and Participation	Levels of engagement and collaboration among stakeholders, including attendance at LL events, feedback on sessions, and willingness to participate in future NBS activities.	Attendance records, engagement metrics (e.g., questions asked, ideas contributed), and post-event surveys will assess the degree of active participation and commitment to NBS goals among stakeholders.
Impact on Local Policy and Community Practices	Policy changes, local authority actions, and community practices influenced by LL activities.	Document any policy adjustments, government initiatives, or community-driven NBS projects that emerge from the LL's influence. Interviews with local authorities and community leaders will help track these changes over time.

5.10.2 Data management

Data will be gathered through digital surveys, recorded interviews, focus group notes, and event attendance logs. Each partner will use standardized data collection templates to ensure consistency. Data will be securely stored in a centralized, encrypted digital platform accessible to LL partners. Sensitive data will be anonymized to protect participant privacy, in compliance with data protection regulations. Qualitative data from interviews and focus groups will be analyzed thematically, identifying patterns in stakeholder attitudes and perceived barriers. Quantitative data will be analyzed using descriptive and comparative statistical methods to track changes over time.

5.10.3 Reporting

Reports will be compiled according to the eNaBLS GA. Customized reports for key stakeholders, including educational institutions, government agencies, and community organizations, could summarize relevant findings, share insights on NBS integration, and offer practical recommendations. At the end of the project, a comprehensive impact report will be produced (WP4), summarizing overall findings, key outcomes, and recommendations for sustaining NBS integration beyond the LL's timeframe and area.

5.10.4 Long-Term Impact Beyond the LL Location and Duration

The Greek LL aims to have a sustained impact beyond its physical and temporal boundaries by embedding NBS principles into educational systems and influencing local policies. By adopting NBS-focused curricula, providing practical training, and engaging stakeholders, the LL creates a foundation for continuous NBS adoption. The partnerships with local government and regional agencies also pave the way for integrating NBS into future urban development and environmental initiatives.

5.11 Conclusions

The Greek LL is poised to make significant contributions to integrating NBS into vocational and technical education frameworks while addressing the challenges of urban and coastal regeneration.

By establishing a collaborative and inclusive platform, the LL aligns with the broader goals of the ENABLS project to raise awareness and foster the implementation of NBS in higher education and professional training. This action plan outlines a comprehensive approach to tackling interdisciplinary challenges, engaging diverse stakeholders, and ensuring the sustainability and scalability of its outcomes.

The LL's focus on the Greater Thessaloniki Area, particularly in the context of the coastal zone unification initiative, underscores its commitment to addressing real-world environmental and urban challenges. Through its educational and training initiatives, the LL seeks to bridge the gap between theoretical NBS concepts and their practical application. This involves equipping current and future professionals, particularly engineers and technical experts, with the skills and knowledge needed to implement sustainable and innovative solutions in their respective fields.

Collaboration lies at the heart of the LL's methodology. The active involvement of ENABLS partners CERTH, IDEA Training and FOCUS, and key stakeholders as the Region of Central Macedonia, and the Technical Chamber of Greece ensures a multidisciplinary approach that integrates expertise in research, education, stakeholder engagement, and policy advocacy. The LL also incorporates input from local authorities, academic institutions, and community organizations, reflecting its commitment to inclusivity and co-creation. The LL emphasizes a dynamic and iterative process through reflexive monitoring, allowing for continuous feedback and adaptation. This ensures that its activities remain responsive to emerging challenges and opportunities, fostering an environment of ongoing improvement and innovation.

6 Action Plan Living Lab Finland

6.1 Introduction - Shared vision developed with key stakeholders

A "hub" for BD and NBS learning

The Living Lab (LL) led by Eastern University of Finland (UEF) will create a "hub" for our students, staff and stakeholders to interact and learn together about biodiversity (BD) and NBS (Nature Based Solutions) concepts and applications, focusing on (I) restoration of wetlands (peatlands in particular); and nature-positive actions in (II) forest ecosystems and (III) urban environments, which are key issues in our area (Ketola et al. 2021; Peura et al. 2022; Oksanen et al. 2024). Our aim is to increase the skills and knowledge of society in these actions through transformative university-level education, targeted not only for degree students, but also outside academia by continuous learning and open university. In a broader sense, UEF LL will generate positive interactions for renewable processes and practices for increasing biodiversity and NBS. We aim to enhance the shift from static targets to dynamic improvement in the environment, from linear thinking to systems thinking, and from compliance-orientation to value-based orientation (Paulomäki et al. 2023).

To realize the mission of our LL, it is essential to effectively engage students, university staff and key partners by communicating the benefits of participation. Therefore, our LL will organize events and communication channels that bring students and other stakeholders together, fostering connections and collaboration on local problems relating to biodiversity and NBS. While students possess the knowledge, enthusiasm and energy to support these actors, many of them face challenges in getting involved. Our partners, in turn, can offer students valuable tools, spaces, and real-life examples for developing solutions for restoration and biodiversity challenges mentioned above.

Research-based knowledge

In Eastern Finland, the desiccation and degradation of wetlands (in particular peatlands) pose a significant environmental challenge. Additionally, loss of biodiversity both in forest and urban environments in the region requires more attention. At UEF, we have extensive research expertise in all these study fields, combined with excellent research environment and infrastructure. Our multidisciplinary Research Communities (RCs) on Forest and Bioecomy (FOBI), Sustainable Co-management of Water Resources and Aquatic Environments (WATER) and Climate Forcing, Ecosystems and Health (CLEHE) produce the latest scientific knowledge on these topics, providing research-based courses and training possibilities for the students. All of our education materials are being produced in collaboration with researchers from different fields of science enhancing the multidisciplinary aspects of the courses and training. While teachers and researchers are responsible for the research-based learning materials, the students with different backgrounds are key players in transfer-of-knowledge from the university to society. Feedback and ideas from the students are an essential part of the course development. For practical training and actions, we need stakeholders, companies, industry and surrounding society, including campus cities.

Learning modules on BD and NBS

Our study modules on BD and NBS are forming the core of our LL. We have produced up-to-date online courses on BD (Biodiversity.now A, both in English and Finnish) (Biodiversity.now online course) and hybrid courses (Biodiversity.now B, both in English and Finnish) where students from all disciplines can learn together how to solve actual problems in the field and work together with the stakeholders and companies, locally or internationally. Additionally, we are developing a basic course on NBS to educate students about innovative ideas and advantages of NBS. This course will also highlight successful examples and introduce students to key actors working in the field of NBS. All these multidisciplinary courses are based on the latest scientific knowledge in the field and have been done by the best experts not only at UEF but also our partner universities and stakeholders. The courses on BD and NBS belong

to Sustainable Future program at UEF and national Sustainability Studies Network targeted to all students of the university and aiming at transformative change in education.

Continuous learning and education networks

Our strength is the Centre for Continuous Learning, that is efficient in marketing and sharing the courses outside the academia through the Open University portal. Extensive national and international networking in education can multiply our students and facilitate the scaling of LL outcomes to wider area. We have established the national biodiversity education network Biodiversity Education Network (BEN), offering biodiversity-related courses to all Master degree students in the partner universities in Finland according to the cross-institutional agreement. In this way, the partner universities can focus on their special expertise in biology (e.g. forest ecology, peatland ecology, marine biology, ornithology) and the students can select high-quality courses according to their interests. We are also partners in Climate University, UArctic, YUFE and EBU, all promoting education in sustainable development.

Scalability and impact

While our initial focus will be on wetlands, forest ecosystems and urban biodiversity, the core concept of our LL can be adapted to address various contexts and challenges. Through the LL, we aim to make NBS a more prominent aspect of our university's activities and integrate them into the curriculum. The planned NBS course will play a pivotal role in introducing Nature-Based Thinking, with the goal of influencing decision-making processes both within and beyond the university.

The following prerequisites are required for UEF LL:

- **Educational materials and activities:** Up-to-date basic, online and/or hybrid courses on BD and NBS, available for all university students of UEF and lifelong learners through Open University, national and international education networks. Courses on BD and NBS will be integrated to all teaching programs at UEF through Sustainable Future -program and flexible online or hybrid courses that are available every study year both in Finnish and English.
- **Student and teacher engagement**: Collaboration with the UEF four faculties and administration in study program work and marketing of the courses, multidisciplinary courses made in collaboration with teachers from different disciplines.
- **Research and experiments:** Continue ongoing experiments in peatland restoration and forest ecosystems, with increasing collaboration with researchers (e.g. from geography and social science) and stakeholders, new collaboration in urban green projects with campus cities, create new research ideas and collaboration relating to biodiversity and NBS.
- **Stakeholder engagement:** Continuous collaboration with local cities, environmental agencies, forest management and research institutes, determining research needs and possible funding sources. Meetings and webinars with stakeholders, accompanied by site visits (e.g. city walks).

6.2 The complex and multidisciplinary problem

6.2.1 Background

Biodiversity has decreased dramatically in Finland, even though we imagine living in the middle of nature. In general, “biodiversity loss” has not been properly highlighted in the teaching programs although biodiversity is a key component in biology and ecology courses. We believe that UEF and universities in general should be pioneers in incorporating BD and related NBS in all study programs. At UEF we educate schoolteachers, biologists, environmental scientists and other experts that have key positioning in making transformative change in the society. In addition, we share information about biodiversity, forestry and sustainability –related topics to professionals and public through the Open University.

Our LL focuses on three complex problems, i.e. restoration of wetlands (peatlands), and biodiversity loss in forest ecosystems and urban environments, which are all affected by human activities, biological and geographical factors and changing climate (Ketola et al. 2021; Peura et al. 2022). Extensive and multidisciplinary collaboration between environmental and forest managers, engineers, city planners, land- and forest owners, citizens and educators are essential in resolving these problems.

Peatlands

The need for the restoration of peatlands has been growing over several years. More than half of our natural 10 million ha peatland area has been drained for forestry, agriculture, and peat production since 1950's. Many of these forest management actions have failed and the financial support from the government for drainage has now ended. Peat production has been also an important source for bioenergy and peat industry in Finland. Peat extraction, i.e. the peeling of *Sphagnum* moss from the surface of the mire during has caused serious damage to peatland ecosystem. Deterioration of natural wetlands and peatlands has resulted also in severe biodiversity loss in these habitats. It has been estimated that about 11% (total of 120 species) are endangered in peatland habitats, with a high risk of disappearing. In addition, extensive drainage both in peat production sites and forested areas has resulted in disturbed water fluxes, reduction of carbon stocks from peatlands, browning of lakes due to humus accumulation, and impaired ecosystem services. Increasing environmental regulation, guidance and the implementation of the EU restoration law requires rewetting of peatlands but the restoring of their natural state usually takes several years or even decades. (Ketola et al. 2021)

Although restoration promotes carbon accumulation in the peat layer, increasing water level of the area tends to promote methane emissions at the beginning of the restoration process. Methane is a strong greenhouse gas with harmful impact on climate for decades. After 10 to 20 years, however, methane emissions start to decline. The disadvantages and benefits of restoration process depend strongly on the type and wetness of the peatland. For example, eutrophic mires, rich in minerals and nutrients, can be restored to carbon sinks rather quickly, but in the first years there is a high risk for nutrient pollution of water bodies. In the long-term, the restored peatlands act as a stabilizer for the water fluxes of the catchment area. Besides their high recreational value, peatlands offer new exciting possibilities for carbon farming as well as special plant and food production.

As described, the restoration of the peatlands is a very complex process, that may take several decades to complete. However, the first responses can be seen quickly, if we create favorable conditions in the area. Luckily, land- and forest owners in Finland are more interested about restoration, because forest management actors, forest companies and industry have started to actively support restoration, in line with the national strategies for the implementation of the EU restoration law. Also our government is supporting the voluntary protection of all wetlands as well as naturally rich forest ecosystems through special programmes, such as The Helmi habitats programme, which is a key tool for halting biodiversity loss in Finland. However, further protection of wetlands is needed to halt the process where these habitats and species become threatened. To support nature protection and restoration, UEF has protected a peatland area, where researchers and students can study and learn together peatland ecology, biodiversity, monitoring and climate-related processes in natural Open Lab conditions. This protected area (Open Lab) will be a key component of our LL where our students and researchers can work together and is also an excellent example of responsible operations of an organization.

Forest ecosystems

The whole forestry sector in Finland is changing from timber production to multi-purpose forests (The biodiversity roadmap for wood processing industry, 2023). Although forestry areas encompass 75% of Finland's total land area, decline in biodiversity has been recognized an increasing threat affecting not only ecosystem services of forests, but also timber production and economy. Today, over 90% of Finland's forested lands are under active management, with protected areas being predominantly concentrated in northern Finland (Korhonen et al. 2024). Most commercially utilized forests are artificially regenerated, with 65% of forest regeneration carried out through planting. The commercial

forests are dominated by pine (Scots pine) and spruce (Norway spruce) monocultures, which are poor in biodiversity. Increased diversity of forest e.g. through mixed stands, deciduous species, dead and decaying wood, retention of trees protective buffer zones are the main priorities in the new silvicultural strategies.

The economy of the area is fully dependent on forestry, and therefore there is an urgent need for co-creation of sustainable and renewable forests practices, together with forest owners, forest companies and industry, management and stakeholders. While the proposed EU regulation on nature restoration aims to mitigate biodiversity loss, it can also lead to a decreased amount of land area available for forestry use. Land use is also affected by constructing energy infrastructure, housing, and recreational use. In the face of the reduced area available for forestry, it is important to utilize it as efficiently as possible from the industrial perspective, but at the same time increase the biodiversity values and multi-purpose use, which is a challenging equation. The efficiency of wood production can be increased by high quality forest regeneration material, which is one example of important NBS in the forestry area. There is also a growing need for bio-based raw materials, requiring technological development and innovative NBS. UEF LL will have a special focus in forest ecosystems, because UEF has expertise in forestry and biology, combining the perspectives of timber production, forest ecology, tree physiology and biodiversity. In collaboration with the School of Forestry our LL will participate the development of Forest and Wood Technology Platform, i.e. digital twin for real boreal forest environments, where the student can learn sustainable forest management practices in a virtual laboratory. This platform will bring together academic, business and industrial partners as well as the students from forestry, biological and environmental programmes.

Urban environment

Low biodiversity of urban areas has gained more attention in recent years in Finland, but previously urban nature has not been valued much, as it has been considered to be spoiled by humans. However, in recent decades, urban nature has gained more attention, and from the very beginning, the diversity of urban nature has aroused astonishment. Perhaps somewhat surprisingly, urban nature has proven to be high in biodiversity. This is a result of diverse – albeit small-scale – habitats and the alien species that have come with human activity. Urban nature is also the nature in which humans meet. People visit their local forest more often than they do the wilderness. Connecting with nature is important for city dwellers too. The beneficial health effects of nature have already been demonstrated. Urban nature increases people's well-being, improves health, reduces stress and increases well-being in many ways. In general, long winters and relatively short growing seasons in Finland limit the use of green infrastructures in the Finnish cities. On the other hand, summer seasons with long days are perfect for outdoor activities.

There are fresh ideas on the development of the network of pocket parks in the city of Kuopio, campus environments as well as other high-biodiversity sites where residents and citizens can create diverse collaborative activities and ideas. Our students should be more actively participating in urban nature plans, starting from their own student housing and campus areas. Therefore, we aim to organize joint events and meetings with the city planners and our students and their supervisors for that purpose. We have started cooperation negotiations with the City of Kuopio to develop a network of “pocket parks”. We have also collaborated with Aalto University for digital education materials for engineer education (focusing on renewable energy systems), combining ecological perspectives with technical constructions (Oksanen, 2025). This e-book material will pave the way for the green shift in urban and industrialized areas, including wind and sun-energy parks.

6.2.2 The actual challenge of the LL

Sustainability themes

The core sustainability themes at UEF LL include environmental education, biodiversity restoration, climate change adaptation and human health. NBS are an integral part of all themes. The activities are strongly related to the northern environment and boreal zone.

Economic and political challenges

Economic growth in Finland is slow, and therefore the demands of industry often take priority. The nature policy in Finland is poorly predictable and inconsistent. Although the Programme of Prime Minister Petteri Orpo's Government in principle supports Nature positive development and preservation of biodiversity in Finland, the concrete new actions are very few and suffer from limited funding. The National Biodiversity Strategy is in the final stage of preparation and in line with the EU restoration law, but the implementation strategies and concrete numbers e.g. for the need for additional protection area are still unclear. The promotion of commercial forestry is still often in conflict with nature protection and restoration, although several forest companies and industry are already developing roadmaps for sustainable forestry.

While working with peatland, forest ecosystems or urban biodiversity challenges actors often face financial constraints. Cities and communities have many developmental responsibilities, and biodiversity initiatives are not often as priorities. By combining the expertise and resources of actors such as NGOs with the energy and new ideas of students, we can find cost-efficient ways to enhance biodiversity in urban environments and integrate nature values as key part of the city planning and infrastructure development. Also working with real life cases motivates students, providing them with work opportunities after graduation and novel business ideas.

The main stakeholders

- UEF stakeholders (academic stakeholders) include students and teachers, researchers, administration. While teachers and researchers are responsible for the research-based learning materials, the students with different backgrounds are key players in transfer-of-knowledge from the university to society. Researchers and research projects are also important actors in our LL, as we will create a platform for them to share their expertise and research findings. This collaborative environment will enhance knowledge exchange and strengthen the connections between students, cities, NGOs, and academia.
- Governmental stakeholders are local actors that offer opportunities for our students for training, Master and Doctoral theses in real-life environments and in their projects. The most important partners and stakeholders are Centre for Economic Development, Transport and the Environment, local Forest Management associations (Metsänhoitoyhdistykset) and Finland, which are located in the campus cities.
- Community stakeholders include stakeholders of campus cities of Kuopio and Joensuu and NGOs that are already engaged in NBS, such as nature associations, for example KLYY (Kuopion Luonnon Ystäväin Yhdistys). For these stakeholders, we offer innovative ideas that students can co-create with their supervisors and teachers.

Business stakeholders include forest companies, restoration actors and landscape planners, that have new responsibilities and opportunities due to EU restoration law. At the department, we organize annually "The working life day", inviting representatives from UEF alumni community working in different business areas to meet our students. Our LL will enhance the collaboration in biodiversity and NBS-related issues.

6.3 Partners and stakeholders

The core partners

The core partners are local actors that offer opportunities for our students both at UEF and within the education networks for training, master and doctoral thesis in real-life environments and in their

projects. The most important partners and stakeholders are Centre for Economic Development, Transport and the Environment, local Forest Management associations (Metsänhoitoyhdistykset) and Natural Resources Institute Finland, which are located in the campus cities. Other key stakeholders include campus cities of Kuopio and Joensuu, management and residents of these cities, and NGOs such as nature associations. For these stakeholders, we offer energy and innovative ideas that students can co-create with their supervisors and teachers. Researchers and research projects are also important actors in our LL, as we will create a platform for them to share their expertise and research findings.

Expected benefits and outcomes

Each partner has specific expectations regarding benefits and outcomes. While students expect to find interesting training opportunities and real-life topics for their Master or Doctoral thesis, the partners anticipate new knowledge, test new practices or develop novel tools or approaches in their field. For example, the development of measurement tools for nature positive actions or biological net gain is highly important for the companies at the moment. Researchers are usually seeking for valuable data for modelling or collaboration for development of research ideas, approaches and practical solutions of NBS. UEF LL expects to extend the educational activities outside academia. Citizens and schools benefit from open courses and educational events offered by the Open University, as well hands-on activities and campaigns (for example fighting against plastic pollution and invasive alien species in our city areas).

New potential stakeholders

Additional stakeholders that can diversify the UEF LL community are welcome to our LL with their constructive ideas for developing our LL. For example, we aim to contact KLYY (Kuopion Luonnon Ystäväin Yhdistys), that organizes many nature-related activities in Kuopio area. To attract new partners, we are active in sharing information about our LL in different events through short presentations, pitch talks, leaflets, posters and social media. For example, we have already organized a panel discussion and online streaming for public at the Natural History Museum of Kuopio city.

Potential Conflicts of Interest

Potential conflicts of interest may arise due to differing perspectives and priorities among partners and stakeholders. Usually, the primary interest at the university is in research and education, while local environmental or forest managers or city planners prioritize the practical improvements in the environment or land use planning. Companies are expecting innovative ideas for product development. Our LL attempts to foster open and transparent discussion and communication on conflicts of interest, shared visions and possible solutions, highlighting the added value of co-creation, and the importance of collaboration in the mission towards sustainable development goals (SDGs), both locally and internationally. Our experimental sites in the peatland and common garden can serve as meeting points for landowners and forest managers, enhancing mutual understanding of the benefits of nature protection, biodiversity and NBS.

Agreement for Effective Collaboration

For effective collaboration, core partners make agreements covering the roles and involvement, responsibilities, contributions and shared goals in the collaboration. For transparent and effective communication, regular meetings and information platforms will be arranged by UEF LL.

6.4 Location and context

Location and physical space of UEF LL

Our LL is located at University of Eastern Finland (UEF), both Kuopio and Joensuu campus sites and managed by the Department of Environmental and Biological Sciences and the Centre for Continuous Learning (Figure 6.1. and Figure 6.2).

Ownership and Management

The owner and primary manager of the UEF LL area is UEF, Department of Environmental and Biological Sciences and The Centre for Continuous Learning. UEF provides office and laboratory space, demonstration sites (Open Labs), administrative support for management of LL and related educational networks as well as the scientific expertise required for the course development and expected collaborations.

Dimensions of UEF LL

UEF has 3200 employees, 17 000 degree students, 16 600 continuous learning students, four faculties and 100 study fields. UEF Doctoral School provides students with the competence required to create new knowledge, apply methods of scientific research critically and independently, and to work in demanding expert and research positions in academia and the business and public sector.

Alignment with the mission of UEF

UEF strategy is rooted in global challenges to which we seek solutions in our profile areas through interdisciplinary research and multidisciplinary education. In doing so, we build a responsible and sustainable future. The high standard of research and education of our university builds a global future and strengthens the vitality of Eastern Finland. The main principles area: We foster education and culture by making research-based knowledge available to benefit everyone; We have the right and freedom to learn, to teach and to do research; We are courageous, open and responsible; and Our activities are guided by ethicality and Sustainable Development Goals (SDGs).

Sustainability and intervention needs

The LL will be established at UEF Department of Environmental and Biological Sciences and Centre for Continuous Learning according to principles and physical frames of the host organization. In addition to standard university facilities, we have custom-designed modern laboratories and up-to-date equipment and instruments for interdisciplinary ecological and biodiversity studies and experiments. The field experimental facilities include Open Lab in peatland area, Kiuruvesi location (collaboration with EU project REWET) as well as forest management study areas in Joensuu. In the latter site, digital twins for sustainable forest management are being planned in collaboration with Joensuu city. Locally we benefit from microscopy services and the facilities available for plant imaging in the Spectromics laboratory. Novel hyperspectral imaging techniques have been developed in the Spectromics Lab, UEF. Although the digital learning environments are well developed, there is always need to improve communication channels with the stakeholders, general public and schools of the area.

Population and the use of the area

UEF LL serves as a space for learning, teaching, researching and recreation, bringing together students from different study backgrounds, faculties, and research communities. LL will be open for citizens, NGOs and other partners during the diverse communication and dissemination activities.

Figure 6.1: Joensuu campus

Figure 6.2: Kuopio campus

Figure 6.5: Campus events are held regularly

Figure 6.4: There are Hybrid Labs on both campuses

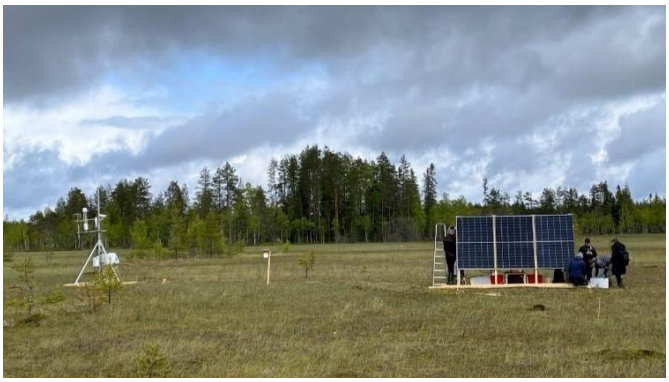

Figure 6.6: Open Labs (REWET)

Figure 6.3: UEF Hybrid Lab at the Center for Continuous learning

6.5 Reality check: experiments

We have long-term ongoing experiments and collaborations with peatland restoration, forest ecosystems and urban environments, that can serve as common platform for research, field courses, practical training, and further activities with the stakeholders at UEF LL:

Experiments with peatland restoration

UEF LL has a demonstration site (Open Lab) in the peatland, Ylpässuo. This site is also an experimental site for REWET project, where restoration of wetlands is being examined on a European scale. The site is protected by Natural Heritage Foundation, and therefore we can study and monitor natural process of rewetting and restoration. The action plan for the site has been developed with the Centre for Economic Development, Transport and the Environment, granting permission for research activities. The measurements in the REWET Open Lab include Eddy Covariance measurements for CO2 and methane fluxes, water quality analyses, modelling and biodiversity studies for vegetation, insects and vertebrates. Novel metagenomic tools are used for species identification. Our students can learn all these measurements in practice and plan their Master thesis with new ideas. The Open Lab site is valuable for developing co-created management strategies with the key stakeholders, integrating the research and education needs of the university with legal protection of peatlands.

Experiments with forest ecosystems

At UEF we have several ongoing experiments with forest ecosystems. For example, a long-term common garden experiment with our two native birch species *Betula pendula* and *Betula pubescens*, extending from Italy to northern part of Finland, was established in 2016 in collaboration with Natural Resources Institute Finland LUKE (Oksanen et al. 2024). The experiment aims to demonstrate the acclimation and adaptation capacity of birches in rapidly warming climate. The experimental area is owned by the governmental authorities (Metsähallitus), bringing together university actors, research institute LUKE and stakeholders in forest management. Therefore, the common garden experiment

can offer an excellent case study for joint activities. Birches are an important species for increasing the biodiversity of the forests in the whole distribution area and should be better addressed in the new silvicultural strategies. The clonal trees in the experiment have been measured for growth, leaf traits, herbivory and pathogen infections. Ecologically relevant data derived from this experiment can show us the acclimation capacity of *Betula* species in rapid warming, dynamic environment. In particular, the potential of southern genotypes of local tree species has been largely ignored in the current breeding programmes. We aim to continue this common garden experiment as long as possible, because long-term experiments in real-life conditions are necessary for understanding the potential of forest trees in changing climate. The experiments offer several possibilities for the students for their master and doctoral theses. Also new virtual and innovative training possibilities for the students will be planned in collaboration with the School of Forestry within the Forest and Wood Technology Platform. In addition to business and industrial partners of forestry, the city of Joensuu will be a partner in this effort. The virtual laboratory is also serving for the demonstration site for forest engineering students and teachers from Applied University of Karelia.

Experiments in urban environment

Biodiversity of cities is being studied in the city environments of both campus cities, Kuopio and Joensuu. For example, our researchers are partners in the CITY PLANt project where areas for improvement in sustainability are indicated by determining the variation in urban green infrastructure and spaces due to vegetation type, function, scale, maintenance and degree of pollution. The project aims to increase the integrity and connectivity between different green areas, which is essential to maintain the biodiversity of wildlife in urban areas. However, the activities have been mainly focused on research. Further actions are needed for training, campaigns with students, researchers and citizens and innovative ideas. Besides new courses our LL will invite students to regular meetings to discuss ideas they would like to do for enhancing biodiversity, especially in the urban environment. Together with the UEF campus development team, we'll organize concrete and regular hands-on activities in the snow-free season between April and October. We invite city managers and authorities to participate in UEF Sustainability Days to be organized every spring. Meetings and webinars are essential for collaboration. Our LL will also generate new ideas for joint experiments with the stakeholders, including citizens and landowners.

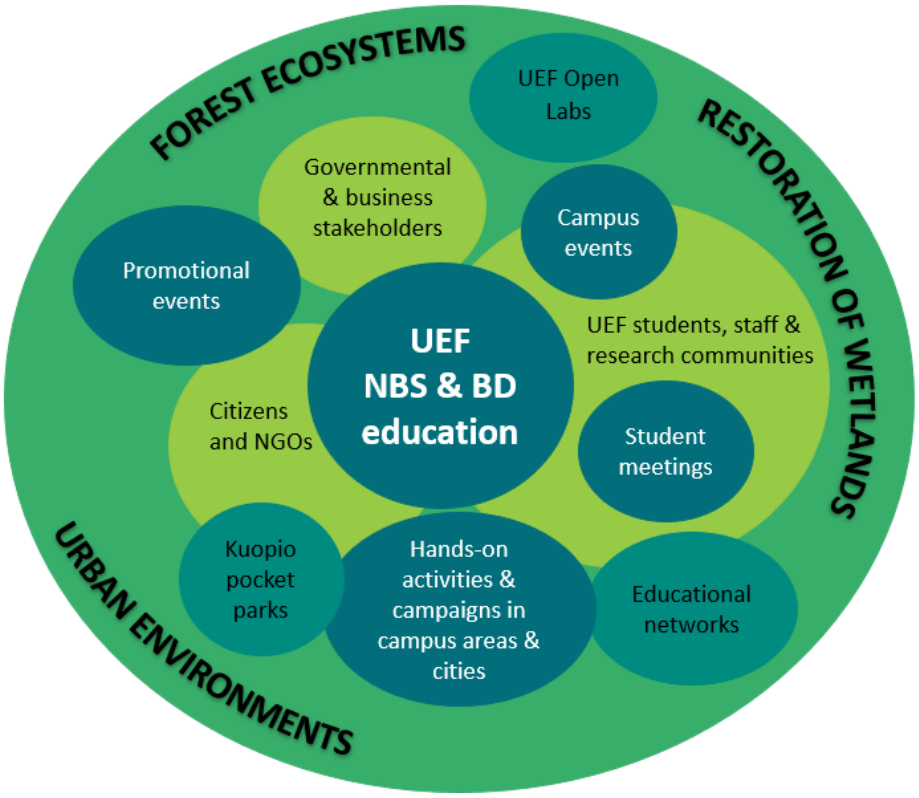

Figure 6.7: UEF NBS Living Lab action plan

1. New and concrete activities and experiments
2. Partners and stakeholders
3. Existing frameworks for further cooperation
4. LL Focus areas

6.6 Community involvement

Potentially affected citizen groups, stakeholders and authorities

The main citizen groups, stakeholders, and authorities potentially impacted by the UEF LL activities include local community members in the campus city areas, Kuopio and Joensuu, environmental and forest management agencies, city and municipal authorities and management, universities of applied sciences (Savonia and Karelia), TVET schools in the area (Sakky and Riveria), and companies. The students of UEF, our education networks and the Open University are learning the principles of BD and NBS in our courses. The stakeholders and local authorities are involved in training and shaping the topics for Master and Doctoral theses. Environmental agencies and forest managers are participating in our field experiments, giving their input to future research ideas. For co-creation of sustainable environmental and forest management, we actively participate in local events with landowners, forest managers and city planners.

Expected benefits and outcomes of the collaboration

In our LL, we aim to deliver benefits to students, researchers, NGOs, cities, and to citizens. For students, we provide opportunities to engage with real-life cases, build practical skills, and establish connections with potential employers. For NGOs and researchers, our LL offers a platform to showcase their work to a broader audience, increasing visibility and impact. NGOs and cities benefit from access to motivated students who can contribute to their NBS projects while gaining valuable experience.

Additionally, LL serves as a networking hub, helping organizations connect with potential future employees. By supporting cities in achieving their biodiversity targets, our LL also creates long-term benefits for citizens by fostering healthier, more sustainable environments.

Required participants for the UEF LL and the experiments

To ensure the success of UEF LL, participation of students and teachers from different levels and backgrounds is essential. Researchers and faculties from UEF provide scientific expertise. Partners from environmental and forestry agencies, environmental and land use engineering, NGOs and companies are essential for training opportunities for the students and development of NBS and other tools and approaches. Campus cities, Kuopio and Joensuu with their residents are important for local activities for citizen science and public engagement initiatives.

Social issues (leaving nobody behind)

Social issues and inclusiveness are a priority for UEF LL. All education materials produced and offered by our LL are available through the Open University, organized by the Centre for Continuous Learning. In addition, our new courses are mainly online courses. Therefore, our key social issues are accessibility, education, and engagement across demographics. Our basic online courses on biodiversity and NBS are suitable for all students, regardless of the age, location and background information. We also arrange webinars and virtual morning coffees, which are open for everybody interested without any fees.

Outreach and communication strategy for UEF LL

We will make an outreach and communication strategy to engage our students, teachers, researchers, stakeholders and citizens. The strategy will include LL website both at the UEF website and the ENABLS project website. It will include physical and online meetings, webinars, hands-op activities, campaigns, workshops, and other outreach activities targeted at different actions groups. It is also important to create a channel for feedback and emerging needs for education, outside the academia.

6.7 Process design

Potential contributions from partners

In our LL, we expect all stakeholders, especially students, to contribute their time for collaboration and networking. We expect that the campus and cities will provide us with real-world challenges and spaces to address them, while NGOs contribute their expertise and offer students meaningful opportunities. These expectations are aligned with the capacities of the participants. Our goal is to create a collaborative environment where these stakeholders can come together to plan and co-develop solutions to the challenges they face. Researchers will play a vital role during this planning phase, bringing their insights and expertise to the table. Throughout the LL, we will gather feedback from participants to refine and improve our approach, ensuring that the LL evolves to meet the needs of its stakeholders effectively.

Allocation of the tasks and responsibilities

Each partner has determined tasks and responsibilities according to their profile and expertise. Students will learn concepts of biodiversity and NBS both in theory and practice and participate the course development. They are also active in developing research ideas together with teachers, researchers and stakeholders. Researchers are responsible for new research initiatives, funding applications for the research, as well as scientifically sound materials for education and dissemination. UEF administration is responsible for the student and personnel management, education platforms, financial management of the project and facilities for the LL operations at UEF level. Stakeholders in environmental and forest management and city planning are introducing their current activities and regulatory requirements and participate the events organized by our LL. Business actors can offer innovative ideas for researchers and students in the field, as well as funding opportunities for co-

creation. Other participants (citizens, schoolteachers and school communities) show interest toward our activities and participate our outreach activities.

Alignment of responsibilities with capacities and competences of the participants

Responsibilities and determined tasks will be assigned according to the capacities and competencies of each partner promoting positive interactions and processes. While scientific community of UEF community manage the scientific basis for education and collaborations, the administration will handle personnel and financial management, operational and education environments. Stakeholders from environmental and forestry management and municipal authorities will be responsible for regulatory aspects and policy requirements and goals in the sustainable development in the society. Other participants (citizens, schoolteachers and school communities) are volunteers with their own interests and capacities.

Organization of UEF LL, structure of communication

The ENABLS project team maintains the official UEF Connect website, sharing information about the project activities and courses. The project team has bi-weekly meetings and organizes meetings with the key stakeholders. For communication, we use LinkedIn, "X", and other social media channels.

Reflection and adaptive processes

The project team monitors project progress, involvement of students and stakeholders at the LL activities and discusses the feedback and new ideas for education, other activities and collaborations. Adjustments will be made when necessary. Collaboration in the experiments will provide research ideas, leading to project funding applications. Positive funding decisions will expand the LL activities, while possibilities for re-submission and improvements will be evaluated after negative decisions. Feedback from the other community members will be collected during our events and activities.

6.8 The role of education in the Living Lab

Addressing the central goal of ENABLS

In our LL, education and student engagement are central to all activities and efforts to tackle the problems in the three LL focus areas (i.e. restoration of wetlands, nature-positive actions in forest ecosystems and urban environments). We already have a set of BD courses, offered in English and Finnish, making the core of the UEF LL. We are developing a new course focused on NBS and are also working to connect students with local NBS actors beyond the course. This could include extracurricular activities, as well as identifying opportunities such as thesis projects in collaboration with these actors. The courses are part of several national and international education networks (described above) sharing the knowledge outside UEF. These core courses on BD and NBS will be integrated into university curricula through established study programmes in sustainable development and are offered outside the university through the Open University portal, thus promoting transformative change in society. Our approach prioritizes students' interests and aspirations, ensuring they play a key role in shaping the connections we facilitate. By giving students a sense of ownership, we aim to foster their engagement and strengthen their understanding and application of Nature-Based Thinking. Additionally, we aim to build lasting relationships between the university, cities, and other stakeholders, ensuring that student involvement in BD and NBS continues well beyond the project's timeline.

Connecting with vocational education

As part of the project, we will not only create a new course on BD and NBS but also translate them into Finnish, enabling us to share basic knowledge for vocational schools and with a broader audience. For the vocational schools, our courses are available through Climate University.

Planned activities of UEF LL

Basic online/hybrid courses on BD and NBS will be integrated to programs on sustainable development at UEF, reaching students from all disciplines, and relevant national and international education networks.

Setting up educational activities and linking existing courses and curricula

We have been developing multidisciplinary course materials on BD and NBS, including online courses on biodiversity (Biodiversity.now A, both in English and Finnish) and hybrid courses (Biodiversity.now B, both in English and Finnish) where students from all disciplines can learn together how to solve actual problems in the field and work together with the stakeholders and companies, locally or internationally. Currently we are developing a basic course on NBS to educate students about innovative ideas and advantages of NBS. This course will also highlight successful examples and introduce students to key actors working in the field of NBS. All these multidisciplinary courses are based on the latest scientific knowledge in the field and have been done by the best experts not only at UEF but also our partner universities and stakeholders. The courses on BD and NBS belong to Sustainable Future program at UEF and national Sustainability Studies Network targeted to all students of the university and aiming at transformative change in education. Centre for Continuous Learning is offering the courses outside the academia through the Open University portal. We also have established an extensive national and international education networks (Biodiversity Education Network (BEN), Climate University, UArctic, YUFE and EBU) that can multiply the number of students and facilitate the scaling of LL outcomes to wider area. At the moment, almost 1000 students have enrolled our BD courses (since spring term 2023), and it is realistic to increase this number during and after the ENABLS project, if the course contents are up-to-date and a part of study programmes.

6.9 Reflexive monitoring, data management and reporting

Monitoring, data management and reporting

The progress of the UEF LL will be monitored regularly by the project team in biweekly meetings. We collect feedback from students enrolling the courses and people participating in our events. For the data management, we use standard UEF platforms and repositories (e.g. Peppi for educational activities), allowing data sharing among the project team members and within the UEF communities. For reporting, we collect the data from digital platforms and organize the data according to needs and target groups.

Monitoring with stakeholders to identify barriers and opportunities

We participate actively in the events and invited meetings with the stakeholders and ongoing discussions to identify possible barriers and new opportunities, e.g. need to tailored education on BD and NBS questions. We continuously monitor the new funding opportunities for collaborations both in education and research.

Impact beyond the time and location of LL

The students are key players in the transfer-of-knowledge from academia to the society, with novel skills and ideas on nature-based thinking and NBS practices. Our LL attempts to foster transformative change in the whole society, including public, through increasing awareness of biodiversity loss and related problems as well as possibilities for NBS, starting from individuals.

All activities of UEF LL are based on effective education fostering systems thinking and focus on prevailing local long-term problems in wetland restoration and biodiversity loss in forest ecosystems and urban environments. The increasing need for knowledge and education in these focus areas after the lifetime of the project is obvious, both locally and globally. Our LL will promote interactive processes for dynamic improvement in the biodiversity and state of our environment. All outcomes of the project, including online educational materials and guidelines for NBS integration will be made available through online platforms, publications, and open repositories. Long-term strategic

collaborations will be established with the key partners. The inclusion of BD and NBS issues in the Forest and Wood Technology Platform will be a fluent way of transferring the knowledge for future forest management through inspiring education and virtual training.

We also have key positions in several national and international organization, such as IPBES (Intergovernmental Platform on Biodiversity and Ecosystem Services, The Finnish working group), EPSO (European Plant Science Organization), IUFRO (International Union of Forest Research Organizations), IPCC (Intergovernmental Panel on Climate Change, The Finnish working group), Committee for Invasive Species (Vieraslajiasioiden neuvottelukunta) by Ministry of Agriculture and Forestry and Metsä Group, (Nature protection programme) ensuring the efficient transfer-of-knowledge between UEF LL and policy makers, Finnish government and foresty sector directing our LL actions towards the present and emerging societal needs and challenges in the long-term perspective (e.g. European Plant Science Organization 2023).

6.10 Conclusions

The main aim of UEF LL

The main aim of UEF LL is to create a "hub" for UEF students, staff and our stakeholders to interact and learn together about biodiversity (BD) and NBS (Nature Based Solutions) concepts and applications, focusing on three main topics relevant to our area, Eastern Finland: (I) restoration of wetlands (peatlands in particular); and nature-positive actions in (II) forest ecosystems and (III) urban environments. UEF LL enhances collaboration that will increase the skills and knowledge of society in these topics through transformative university-level education. UEF LL will generate positive interactions for renewable processes and practices for increasing biodiversity and NBS and enhance the shift from static targets to dynamic improvement in the environment, from linear thinking to systems thinking, and from compliance-orientation to value-based orientation.

Special aspects

Special aspects of UEF LL include clear focus on northern boreal environment, multidisciplinary online courses and modules, the key role of the Centre for Continuous Learning in education, dissemination and communication.

The key methods and action pathways

The key methods and action pathways in our LL are education through research-based courses on BD and NBS, national and international education networks and the Open University portal, sharing the knowledge also outside academia. Courses on BD and NBS will be integrated into university curricula through the study programmes on Sustainable Development and Climate University. While teachers and researchers are responsible for the research-based learning materials, the students with different backgrounds are key players in transfer-of-knowledge from the university to society. Feedback and ideas from the students are an essential part of the course development. For practical training and actions, we need stakeholders, companies, industry and surrounding society, including campus cities. To engage our LL members, we will organize events and communication channels that bring students, university staff, faculties and other stakeholders together, fostering connections and collaboration on local problems relating to BD and NBS.

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7 Action Plan Living Lab Lithuania: BeWell

7.1 Introduction - shared vision developed with key stakeholders

Climate change and biodiversity loss are two major environmental challenges in this era of global change (IPBES 2019; Wudu 2023; Weiskopf et al. 2024). Although the tight linkages between them have been recognized, the vast majority of attention has been paid to one unidirectional relationship—climate change as a cause and biodiversity loss as a consequence. Climate change is projected to become an increasingly important driver of biodiversity loss, and its interaction with other major drivers, such as land-use change, will indirectly accelerate its impacts on biodiversity. For example, in terrestrial systems, most species' ranges are predicted to shrink dramatically, even with a rise in global temperature below 2 °C (More et al. 2021).

The Living Lab (LL) 'Enhancing Biodiversity and Human Well-being: Education and Green Infrastructure at VMU Campus (BeWell) will play a crucial role in addressing these interconnected challenges by promoting Nature-Based Solutions (NBS) that mitigate and adapt to climate change, protect soil, prevent erosion, and foster biodiversity. Situated within the VMU Agriculture Academy campus's green infrastructure, the LL serves as a platform to showcase, study, and educate about sustainable environmental solutions. By emphasizing the importance of NBS and community involvement, the LL contributes to solving these challenges on a local scale, demonstrating the potential of biodiversity-focused innovations in real-world settings.

The LL will impact the world by creating a model for how biodiversity restoration and NBS can be integrated into educational, urban, and community settings. It will serve as an example of how higher education institutions can play an active role in promoting sustainable practices. The focus on climate change adaptation, biodiversity promotion, and green infrastructure solutions will showcase strategies that other regions, particularly urban areas, can replicate to improve their ecosystems.

Fulfilling LL's mission, the following actions is required (Figure 7.1):

- **Stakeholder Engagement**: Active and continuous engagement with a diverse range of stakeholders, including **VMU faculty staff, teachers, students, local communities, schools, dendrologists, biodiversity and nature management experts, and environmental agencies**. Stakeholders play a key role in co-designing, implementing, and providing feedback on the LL 's activities, ensuring relevance, effectiveness, and inclusivity. Their involvement strengthens collaboration, fosters knowledge sharing, and supports the long-term sustainability of the LL 's initiatives.
- **Infrastructure Development**: Establishment of essential infrastructure to support the LL 's experimental and educational activities. This includes the creation of **demonstration plots** for NBS implementation, development of **composting areas**, and construction of **interactive educational stations**. These facilities enable hands-on learning, promote experimentation, and serve as showcases for sustainable NBS.
- **Educational and Outreach Activities**: Organization of **public engagement and educational initiatives** aimed at raising awareness of NBS. This includes **seminars, workshops, community events, and interactive learning sessions** for students, educators, and the broader community. These activities enhance understanding of NBS concepts, foster public participation, and promote sustainable practices through direct community involvement.

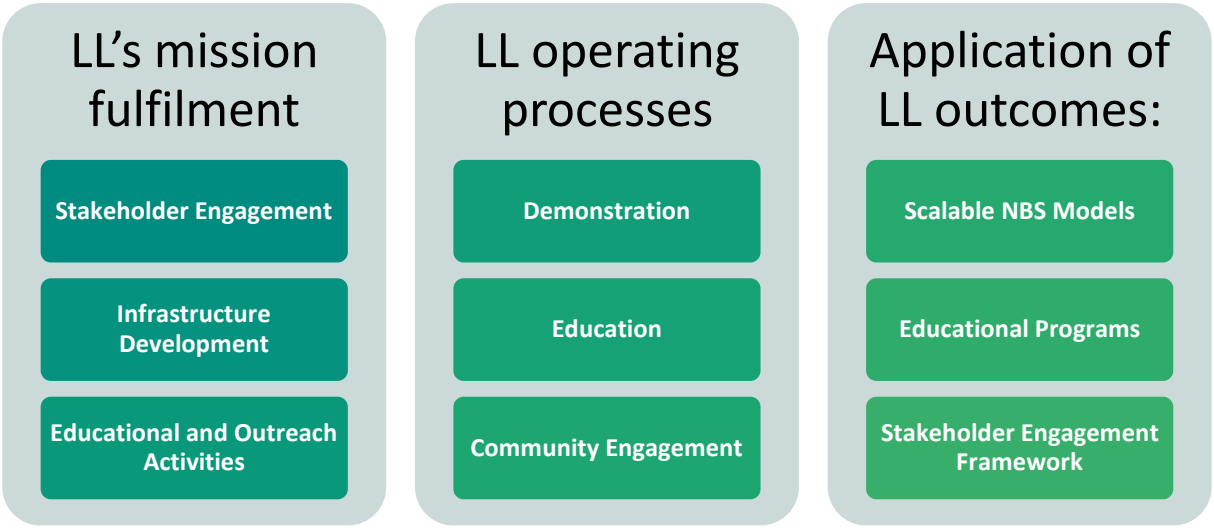

Figure 7.1: Achieving BeWell's Mission: Key Requirements, processes, and scalable outcomes

The LL will operate through several key processes:

- **Demonstration and Education**: NBS establishment, management and demonstration through educational trails, themed trails, and interactive stations, the LL will provide hands-on learning opportunities and practical demonstrations of NBS.
- **Community Engagement**: Engage local schools, community groups, and stakeholders in collaborative projects, volunteer activities, and educational sessions.
- **Digitization**: Partner with initiatives like Forest excellence centre to digitize Arboretum data, allowing broader accessibility and analysis of findings.

The outcomes of the LL will apply to other locations through:

- **Scalable NBS Models**: The climate adaptation, biodiversity promotion can be applied to urban, rural, and other ecosystems.
- **Educational Programs**: Materials, findings, and case studies generated will support broader NBS curricula, offering templates for similar projects globally.
- **Stakeholder Engagement Framework**: The LL model for engaging diverse groups in environmental efforts can be replicated to foster community involvement in environmental sustainability in other regions.

The LL directly contributes to ENABLS' goals by embedding NBS into the higher education curriculum and research agenda. By involving students, faculty staff, and the wider community in hands-on NBS projects, the LL fosters environmental awareness, sustainability-focused research, and practical applications of NBS. Community engagement plays a critical role in addressing global challenges at a local level. By actively involving local stakeholders, the LL ensures that solutions are context-specific, culturally appropriate, and grounded in local needs. This inclusive approach fosters a sense of ownership and shared responsibility among community members, enhancing the long-term sustainability and impact of NBS initiatives (Lovrić 2019).

Additionally, the LL provides a real-world example of integrating NBS into academic settings, serving as a model for other institutions to follow. This practical demonstration of NBS in action strengthens the link between education, research, and community participation, illustrating how collaborative efforts can address pressing global challenges such as climate change and biodiversity loss. By engaging communities, the LL empowers them to take part in meaningful environmental actions, further reinforcing the role of local initiatives in driving global change.

The LL aligns with the definition of NBS by using nature to solve environmental challenges, such as climate change and biodiversity loss. It focuses on sustainable, ecological solutions that leverage natural processes for ecosystem restoration and resilience. Community participation in NBS projects amplifies these efforts by integrating local knowledge, values, and practices into the design and implementation of solutions. This participatory approach not only increases the relevance and acceptance of NBS but also strengthens community resilience to environmental challenges.

Furthermore, the LL promotes Nature-Based Thinking by encouraging an understanding of ecosystem balance, resilience, and adaptive management. This perspective goes beyond specific solutions to foster an appreciation of nature as an integral part of problem-solving in environmental and social contexts. By incorporating community perspectives and ensuring active involvement, the LL bridges the gap between scientific innovation and local action. This holistic approach positions the LL as a catalyst for sustainable change, driving collective efforts to address biodiversity loss, mitigate climate change, and promote environmental stewardship at both local and global scales.

7.2 Brilliant Idea or Complex Problem

Origin of the Idea. The origin of the LL idea stems from the urgent need to address significant environmental challenges, such as biodiversity loss, climate change, which increasingly affect ecosystems and human communities, especially in urban and agricultural areas. NBS emerged as an effective strategy to leverage natural processes in tackling these environmental issues while promoting sustainable practices within communities. At the VMU AA, the Campus green infrastructure provides an ideal setting to apply and showcase these solutions in a real-world environment, inspiring sustainable practices among students, faculty administration, staff, and the broader community.

Foundation in Facts and Hypotheses. This LL is grounded in well-established environmental science and ecological theories that support the idea that nature can effectively address complex challenges. The concept is based on hypotheses such as the potential of certain tree species to sequester carbon dioxide, which can help mitigate atmospheric CO_2 levels. Additionally, native plants species are expected to boost local biodiversity by attracting native fauna, supporting pollinator populations, and enhancing habitat quality. Soil protection measures, like vegetative cover and composting, are anticipated to reduce soil erosion and improve fertility. Moreover, hands-on educational experiences are assumed to increase awareness, understanding, and community action toward sustainable practices. The overarching hypothesis is that these nature-based interventions will yield measurable environmental benefits and provide models that other institutions and communities can replicate.

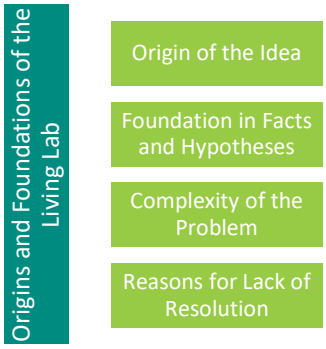

Figure 7.2: Building the BeWell Living Lab: Origins, foundations, complexities, and challenges

The complexity of the Problem. The complexity of these environmental issues arises from the interconnected nature of ecosystem variables, such as biodiversity, climate conditions, and human impacts, which are all closely linked and influence one another. Addressing one area without affecting others is challenging, adding layers to problem-solving. The long-term processes and outcomes also add complexity, as the positive impacts of NBS on climate and biodiversity often require years to become evident, necessitating sustained commitment and consistent monitoring. The problem is

further compounded by the need for coordinated stakeholder involvement; successful implementation involves not only academia but also local communities, environmental experts, and government entities. Balancing local biodiversity restoration with global climate change impacts makes the problem even more intricate, as solutions must be both locally viable and globally beneficial.

Reasons for Lack of Resolution. The problem remains unsolved due to several persistent challenges. A lack of widespread awareness and understanding of the benefits and mechanisms of NBS limits its adoption, making it difficult to gain support across different communities. Resource limitations further hinder large-scale implementation, as establishing and maintaining NBS requires financial investment, technical expertise, and dedicated resources, which are often scarce, especially within educational or public sector contexts. While NBS shows great promise, there is still a need for long-term, large-scale studies to provide robust data on its effectiveness across various climates and ecosystems. Another barrier is the competing land use priorities found in urban and agricultural areas, where space may be needed for development, agriculture, or recreation, limiting the areas available for NBS and the long-term commitment required for their success.

7.2.1 Sustainability themes

Core Environmental Focus. The LL's core sustainability themes include biodiversity restoration, climate change adaptation, and community-based environmental education. These themes are closely aligned with NBS, which leverages natural processes to restore and sustain ecological health, improve ecosystem resilience, and reduce environmental impact.

Urban and Ecosystem Improvement. A particular focus of the LL is urban ecosystem enhancement. Through green infrastructure, the LL aims to reduce pollution, mitigate the urban heat effect, and improve air quality. Additionally, the LL's emphasis on education contributes to sustainability by instilling ecological awareness, promoting nature-based thinking, and encouraging sustainable practices among students and community members.

7.2.2 Economic, behavioural, and political Hurdles

Economic Challenges. Establishing and sustaining the LL demands considerable funding, especially for research initiatives, infrastructure, and community engagement. Financial resources are often limited in academic and public institutions, making it challenging to secure the necessary support for a project of this scale.

Behavioural Challenges. A general lack of public awareness about the benefits and workings of NBS presents a significant behavioural hurdle. Without a strong understanding of how NBS can effectively address environmental challenges, gaining community buy-in and active participation becomes difficult. Engaging the public in these new practices requires overcoming scepticism and encouraging a shift in perspective toward sustainable practices.

Political and Policy-Based Challenges. The LL may also face political challenges, including the need for alignment with municipal and national environmental goals. Gaining approval and support from local authorities can be a complex process, and competing land use priorities—such as urban development or agricultural needs—may limit available spaces for NBS. Political delays and varying stakeholder priorities add further complexity to implementing the LL initiatives.

7.2.3 Main Stakeholders

The success of the BeWell LL relies on the active involvement of diverse stakeholder groups who contribute their knowledge, skills, and resources to support biodiversity restoration, climate adaptation, and community engagement. These stakeholders include academic and institutional partners, community members, environmental experts, and government representatives, each playing a distinct but interconnected role in driving the LL 's initiatives.

Academic and Institutional Stakeholders. The VMU Agriculture Academy (AA) administration, faculty staff, and students are primary stakeholders in the LL's educational, experimental, and research activities. Their role is crucial in integrating NBS into the academic framework and ensuring the LL's long-term sustainability. **Role of Faculty and Administration: Faculty** members act as educators, mentors, and project facilitators, ensuring that students are actively engaged in research and hands-on learning. Faculty staff also support the development of teaching manuals, educational modules, and NBS training content. Meanwhile, the administration facilitates the allocation of resources, funding, and policy support, ensuring that the LL activities are integrated into the university's strategic objectives. **Role of Students: Students** are active participants and beneficiaries of the LL activities. The LL provides them with access to practical learning opportunities, research projects, and experiential education. Students engage in biodiversity monitoring, climate adaptation trials, and gaining essential skills for careers in environmental science, sustainability, and green infrastructure development. This hands-on training experience bridges the gap between theoretical learning and real-world application.

The involvement of academic stakeholders strengthens the link between research, education, and sustainability. By embedding NBS concepts into the university's educational framework, the LL ensures the sustainability of its mission beyond the project timeline.

Community Stakeholders (Table 7.1). Local community members, including residents, schools, kindergartens, refugee communities, and other educational institutions, are significant stakeholders in the BeWell LL. Their involvement is crucial for promoting a community-centered approach to sustainability and fostering shared responsibility for green infrastructure conservation**.**

Table 7.1: Community stakeholder roles and contributions to sustainability initiatives at BeWell Living Lab

Stakeholder	Forms of Engagement	Main Benefits
Local Residents	Demonstration plots, unmown meadows, composting areas. Practical NBS examples applicable in gardens, schoolyards, and community spaces.	Application of practical, accessible, and low-cost sustainable solutions at household and community levels.
Schools and Kindergartens	Outdoor learning environment with field trips, educational workshops, and guided tours. Teachers are provided with educational materials and learning modules.	Education for students on biodiversity, sustainability, and climate adaptation. Promotes environmental awareness and youth engagement in sustainability efforts.
Refugee Communities	The Arboretum serves as a safe, calm, and emotionally restorative space for refugees (especially from Ukraine) to relax, recover, and connect with nature.	Emotional well-being, stress reduction, connection with nature, and emotional recovery.

Engagement of Local Residents: Residents benefit from the LL's practical demonstrations of accessible and replicable NBS, such as unmown meadows, demonstration plots, and composting areas. These tangible examples show how NBS can be applied in local gardens, schoolyards, and community spaces. The LL addresses local needs for simple, effective, and low-cost sustainability solutions that can be adopted at the household and community levels. **Engagement of Schools and Kindergartens**: Schools, kindergartens, and educational institutions benefit directly from the LL's educational outreach

initiatives. The LL serves as an outdoor learning environment where students of all ages can explore biodiversity, sustainability, and climate adaptation concepts through field trips, guided tours, and interactive workshops. Teachers are supported with educational materials and learning modules, making it easier to incorporate NBS into their curricula. These activities promote environmental stewardship and encourage youth participation in sustainability efforts. **Engagement of Refugee Communities**: Refugee groups, particularly those from Ukraine, have identified the Arboretum as a place of safety, peace, and emotional well-being. For displaced persons dealing with trauma or stress, green spaces like the Arboretum offer an opportunity for emotional recovery, relaxation, and connection with nature. By preserving and enhancing the Arboretum and other green spaces, the LL addresses the community's need for inclusive, safe, and tranquil environments. **Community-Driven Action and Participation**: Community members are encouraged to participate in citizen science initiatives, public workshops, and restoration projects. By co-designing biodiversity monitoring, tree planting, and composting activities, stakeholders become co-creators of NBS initiatives. This participatory approach strengthens local stewardship of the green infrastructure and ensures the sustainability of community-led efforts. The LL addresses the specific needs of community stakeholders by providing practical skills, mental well-being support, and community-driven action opportunities. By promoting shared responsibility for local green spaces, the LL establishes long-term community engagement and support.

Environmental and Governmental Stakeholders. The support of environmental agencies, policymakers, biodiversity experts, and local government authorities is essential for aligning the LL activities with regional, national, and international environmental goals. These stakeholders contribute to scientific research, biodiversity conservation, and regulatory compliance.

7.2.4 Addressing stakeholder needs and concerns in the BeWell Living Lab

- **Enhancing Practical Learning and Skills Development**. Students and community members often seek practical skills related to sustainability, biodiversity, and green infrastructure. The LL provides opportunities for experiential learning, hands-on workshops, and direct participation in research activities, equipping stakeholders with essential skills.
- **Providing Accessible, Practical NBS Examples.** Local residents benefit from simple, low-cost, and practical NBS solutions, such as unmown meadows, rain gardens, and composting areas. These examples serve as inspiration for home gardens, community spaces, and public areas, enabling community members to implement similar solutions in their own spaces.
- **Preserving Green Spaces as Multifunctional Community Areas.** Local community members and government officials have expressed a desire to preserve the Agricultural Academy's green infrastructure as a multifunctional space for education, recreation, and conservation. The LL actions, such as biodiversity restoration, tree planting, and creation of demonstration plots, support this goal.
- **Providing Emotional and Psychological Support for Refugees.** For refugee communities, especially those from Ukraine, the VMU AA Arboretum serves as a space for emotional recovery. Green spaces offer peace, mental well-being, and a sense of stability for displaced individuals. The LL preserves these areas as inclusive, accessible spaces for mental and emotional support.
- **Fostering Community Participation and Shared Responsibility.** The LL supports community-driven action by allowing stakeholders to propose initiatives, participate in biodiversity monitoring, and contribute to NBS design. This participatory model encourages stakeholders to become co-creators of the LL activities, fostering shared responsibility for green infrastructure.

7.2.5 Global relevance of environmental challenges

The environmental issues targeted by the LL, such as biodiversity loss, and climate change impacts, are global in scope. Urban areas, agricultural zones, and biodiversity-rich regions worldwide face similar challenges. Climate change exacerbates these issues on a planetary scale, affecting every region to varying degrees. Soil degradation and loss of biodiversity are also common in areas heavily used for agriculture or urban development, making the work of the LL applicable and potentially valuable to many different contexts globally.

7.2.6 Addressed challenge areas and approach

Focus Areas within the LL. The LL primarily addresses biodiversity restoration, and environmental awareness. These focus areas are foundational for creating resilient ecosystems capable of adapting to climate change and other environmental stressors. Enhancing biodiversity through native species planting and improving soil health through composting and vegetative cover are among the core strategies.

Educational and Community Engagement Approach. In addition to ecological restoration, the LL emphasizes education and public engagement. Educational trails, workshops, and interactive stations are designed to promote awareness of NBS and foster a deeper understanding of sustainable practices. By combining practical ecological restoration efforts with a strong educational component, the LL addresses immediate environmental needs while encouraging long-term behavioural shifts toward sustainability and Nature-Based Thinking within the community.

7.3 Partners and stakeholders

Core (Founding) Partner. The core partner of the LL includes researchers and faculty staff from VMU AA, who bring scientific expertise and academic rigour to the project. Additionally, VMU serves as the idea and location owner, providing both the vision and the physical space for implementing NBS. Local citizen groups, including schools and community organizations, are also core partners, as they contribute to and benefit from the LL's educational and environmental initiatives. Together, these founding partners form a collaborative foundation for the LL, each playing a vital role in the LL 's success (Figure 7.3).

Expected Benefits and Outcomes. Each core partner has specific expectations regarding benefits and outcomes. Researchers anticipate valuable data and insights into NBS applications, contributing to both academic research and practical solutions for biodiversity and climate resilience. The university expects to enhance its educational offerings, providing students with real-world experience in sustainability, while also showcasing VMU as a leader in sustainable practices. Local citizen groups and schools benefit from hands-on learning opportunities, gaining awareness of NBS and contributing to community-based environmental stewardship. Collectively, partners expect the LL to foster both environmental benefits and an informed, engaged community that is equipped to support sustainable development.

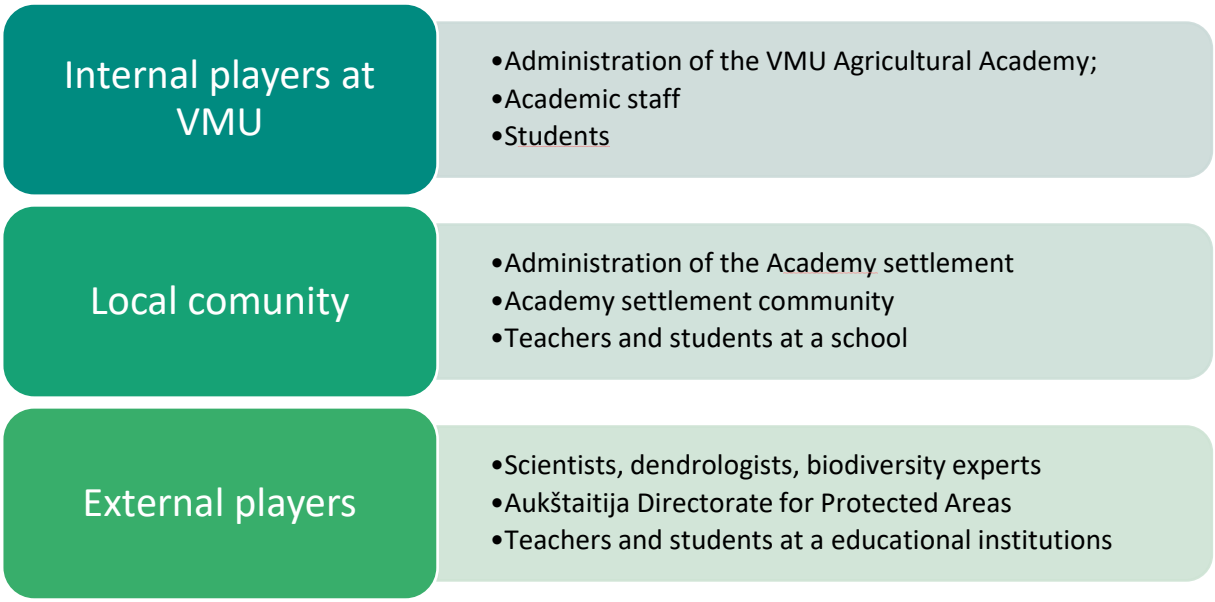

Figure 7.3: The main actors of the BeWell Living Lab

Levels of Participation. Participation levels are structured according to the operational framework of the LL. Researchers and faculty staff are deeply involved in the design, implementation, and analysis of projects, taking on active roles in decision-making and project direction. The university administration provides logistical support and oversees alignment with institutional goals. Community members, including local schools, participate in activities, workshops, and citizen science projects, serving as both learners and contributors to data collection and project success. By ensuring varied levels of involvement, the framework allows stakeholders to contribute meaningfully according to their expertise and interests.

Additional Stakeholders and Engagement Strategies. Additional stakeholders who could enhance the LL's impact include local government agencies, environmental NGOs, and businesses with a focus on sustainability. These groups bring diverse expertise, resources, and networks that could expand the LL's reach and effectiveness. To engage these stakeholders, the LL will employ targeted outreach strategies such as informational sessions, partnership meetings, and collaborative events to illustrate the value of NBS and demonstrate alignment with their goals. Formal invitations to participate in specific projects or workshops will be extended to facilitate partnerships and broaden the LL's impact.

Potential Conflicts of Interest. Potential conflicts of interest may arise due to differing priorities among stakeholders. For instance, the university's primary focus on research and education may sometimes clash with community needs for immediate environmental improvements or the interests of local government in land use planning. Businesses may seek branding or recognition in exchange for support, which could conflict with the LL's community-focused mission. Addressing these potential conflicts will require open communication, transparency, and alignment on shared goals and values to ensure that all contributions support the LL's mission.

Agreements for Effective Collaboration. To foster effective collaboration, founding partners established agreements that outline roles, responsibilities, and shared goals. These agreements ensure clarity on each partner's level of involvement, contributions, and benefits from the project. Regular meetings and communication channels were also established to maintain alignment and address any emerging challenges collaboratively. These foundational agreements create a structure for cooperation, transparency, and mutual support, setting a strong foundation for the LL's ongoing success.

7.4 Location and context

Location of the LL. The LL will be situated within the VMU AA Campus. The green infrastructure in this area comprises the Arboretum collection, Dendropark, Tree plantations, Tree nursery and Main Building Square (Figure 7.4). This setting provides an optimal environment for the implementation and study of NBS, while engaging the university and local community in practical sustainability initiatives.

Figure 7.4: Location of BeWell Living Lab action area

Ownership and Management. The owner and primary manager of the area, VMU, is also one of the core partners in the LL initiative. VMU provides the space, administrative support, and the scientific expertise required for the project, aligning its educational mission with the LL's sustainability goals.

Size of the Area. An LL action area of approximately 50 hectares provides sufficient space for the implementation of a range of NBS interventions. This size allows for the integration of diverse project activities, including biodiversity restoration, climate adaptation demonstrations without compromising the effectiveness or sustainability of the area.

Alignment with Mission and Challenges. VMU AA Campus green infrastructure are aligns closely with the mission and challenges of the LL. Originally designed for botanical and dendrological study, it provides a rich foundation for biodiversity projects and is already home to a variety of plant and other species. Its role as an educational site also complements the LL objective to foster sustainability awareness and environmental stewardship.

Suitability and Intervention Needs. The area is well-suited for the LL's goals, as it already hosts a diverse ecosystem with over 900 taxa of woody plants from various geographical zones. However, certain interventions may be needed to adapt specific sections for enhanced public access, install monitoring equipment, or create dedicated spaces for community activities and workshops. These adaptations will ensure the area can support both the ecological and educational aspects of the LL effectively.

Population and Usage of the Area. The selected LL action area serves as a space for both work and recreation, drawing students, faculty, researchers, and community members. Arboretum collection is

open to the public during daylight hours from April 1 to November 1, allowing numerous local residents, students, and visitors to engage with its biodiversity and participate in the LL's educational activities. The campus setting fosters regular usage by a significant number of people, providing a constant flow of potential participants and contributors to the LL.

Additional Relevant Specifics. The Arboretum collection accessibility and integration with the VMU campus make it an excellent resource for hands-on learning and community involvement. The green infrastructure located near educational buildings, it offers convenient access for students and faculty while also providing a recreational area for the community. Its diversity of plant species and microhabitats enables a wide range of research and educational opportunities, supporting both ecological study and public engagement in sustainability efforts.

7.5 Reality check: experiments, location, context

7.5.1 Description of Experiments in the LL

The LL will actively conduct experiments to refine its approach to environmental challenges, strengthen the project's impact, and validate its vision for sustainability. These experiments will focus on four key areas: biodiversity restoration, climate adaptation plant trials, and public engagement initiatives.

Biodiversity Restoration Experiments. The LL will monitor the growth, health, and interactions of native plant species with local fauna, focusing on both woody and herbaceous plants. A key aspect of these experiments will be the emphasis on **unmown meadows** as an example of NBS. This approach will aim to study how biodiversity thrives in these meadows, which will be contrasted with traditionally managed areas. The goal is to identify the most effective plant combinations for attracting and supporting local wildlife, particularly pollinators, while simultaneously demonstrating the benefits of **unmown meadows** to the local community. By actively involving the community, the LL will foster greater awareness and understanding of the ecological value of these natural areas, encouraging sustainable practices, and enhancing local engagement in biodiversity conservation.

The biodiversity restoration efforts will not only focus on supporting native flora and fauna, but also explore **NBS** like unmown meadows. This approach will help restore ecological balance by creating diverse, resilient habitats that can buffer against climate change. The experiments will provide valuable insights into how these areas contribute to increasing biodiversity, particularly by promoting the growth of both woody and herbaceous plants while simultaneously offering ecological benefits to pollinators and other wildlife. These efforts will also empower the local community by demonstrating how simple, sustainable practices—such as allowing meadows to grow without mowing—can support long-term environmental resilience.

Climate Adaptation Plant Trials. These trials will focus on assessing the role of green spaces in mitigating the **urban heat island effect** by integrating vegetation into the landscape. By testing various drought-resistant and heat-tolerant plant species, the LL aims to identify the most suitable plants for reducing surface temperatures and improving local microclimates. Through simple measurements of air and soil/ground surface temperatures and humidity levels, the LL will demonstrate the benefits of green space expansion in combating extreme heat. These measurements will serve as a tool to educate and engage stakeholders on the importance of greening urban spaces, linking it to enhanced biodiversity in these areas. By incorporating more green spaces, the project will not only address climate adaptation but also promote the growth of diverse plant and animal species, enhancing overall ecosystem stability.

The LL will focus on utilizing **green waste** generated not only in the **Agriculture Academy's green infrastructure**, but also in all **green spaces** to create compost, enriching soil fertility and improving soil structure. This approach ensures a more **natural nutrient cycle** by recycling organic material back into the ecosystem, minimizing the need for synthetic fertilizers. The LL will use these experiments to teach

and demonstrate the importance of natural cycles, showing stakeholders how sustainable practices, like composting green waste, can enhance soil quality and resilience against climate-induced stressors, such as heavy rains or droughts. This approach will also highlight the connection between soil health and biodiversity growth in green spaces, further promoting the benefits of NBS.

Public Engagement Initiatives. The LL will conduct public engagement experiments through educational trials and workshops, aiming to foster community involvement in sustainability efforts. These initiatives will focus on not only raising awareness but also encouraging the community to actively participate in NBS, such as biodiversity restoration, and climate adaptation. The goal is to empower the community by providing knowledge and skills on sustainable practices while demonstrating the tangible benefits of green spaces and biodiversity conservation.

Through hands-on experiences, the LL will measure the effectiveness of these activities in shifting public behaviour toward eco-friendly practices and long-term sustainability. The community will not only gain insights into environmental challenges but also contribute valuable perspectives and ideas that will guide future biodiversity and education projects.

While the LL offers a platform for new initiatives, it is essential to recognize that the community plays a critical role as both **knowledge adopters and knowledge enforcers**. Engaging the public in these experiments ensures that the benefits of NBS are understood, implemented, and supported at the grassroots level. The active participation of local stakeholders will significantly contribute to the development, implementation, and long-term success of sustainable solutions, fostering biodiversity conservation and enriching local ecosystems.

7.5.2 Experiments as validation of the Living Lab's value and feasibility

These experiments are integral to demonstrating the LL's value and feasibility. Results from biodiversity, climate adaptation will provide tangible evidence of the ecological benefits of NBS. Additionally, public engagement initiatives will validate the LL's role as a valuable educational resource. Through systematic testing and outcome measurement, the LL will build a comprehensive body of evidence supporting its approach. This evidence will guide adjustments to improve its effectiveness and ensure its ongoing relevance as a resource for environmental resilience and sustainability education.

Key objectives

- Promote the integration of Nature-Based Thinking into the education system.
- Create an open learning environment that involves the university community, local stakeholders, and international partners.
- Develop educational tools and methods focused on experiential learning through nature-based examples.

7.5.3 Activity structure, spaces and experimental locations

The activity layers are structured to ensure a comprehensive approach to education, capacity building, and knowledge dissemination, fostering active engagement from educators, students, and the wider community.

- **Teacher Training**: Creation and implementation of teacher training programs, utilizing pilot projects and feedback mechanisms.
- **Learning Community Development**: Meetings of education community members, experience-sharing sessions, and other engagement activities.
- **Testing and Evaluation of Educational Tools**: Experimental trials to test and evaluate new learning methods and tools.

- **Dissemination and Knowledge Application**: Organization of open symposia, public events, and publication of teaching manuals to share knowledge and insights.

The project phases (Figure 7.5) are designed to ensure a systematic and strategic approach to implementation, from initial planning and stakeholder engagement to the development, testing, and dissemination of results, fostering continuous improvement and long-term impact.

- **August – December 2024:** Project initiation phase. During this phase, discussions will be held with key stakeholders, including university faculty, local community members, and business and industry representatives. The aim is to identify the key goals, define stakeholder roles, and establish the project's scope and objectives. Initial stakeholder engagement activities will be conducted through workshops and meetings to foster early buy-in. Additionally, a comprehensive project plan will be developed, outlining the timeline, resource allocation, and initial risk assessments.
- **November 2024 – April 2025:** Planning and co-creation phase. This phase focuses on forming working groups composed of researchers, students, local community representatives, and other stakeholders. The primary task is to co-design specific project activities and initiatives. Detailed planning sessions will ensure that each working group has clear goals, deliverables, and milestones. This phase also includes preparatory activities for the first public event, with event logistics and promotion plans being finalized. Collaborative workshops will be conducted to gather stakeholder input and refine project plans as needed.
- **April – June 2025: Implementation and Testing of Educational Tools.** This phase focuses on the development, production, and testing of educational tools to support biodiversity, climate adaptation, and sustainability education. Key activities include creating teaching manuals, learning modules, and interactive materials for students, educators, and community members. Pilot testing is conducted in workshops and classrooms to gather feedback and refine the materials for broader use. Community engagement activities, such as interactive workshops and training sessions, allow stakeholders to contribute to the development and improvement of educational resources**.**
- **April 2025 – June 2026: Monitoring and Evaluation Phase.** This phase focuses on continuous tracking and evaluation of project activities to ensure impact and identify areas for improvement. Key activities include ongoing monitoring of biodiversity growth, climate adaptation, as well as data collection and analysis of biodiversity and educational impact metrics for quarterly progress reports. Feedback and adaptation sessions with stakeholders are conducted to refine activities and ensure responsiveness to emerging needs. Progress reports, key findings, and impact insights are shared with stakeholders and partners to maintain transparency and facilitate evidence-based decision-making.
- **April – September 2026: Dissemination and Results Application Phase.** This final phase focuses on sharing results and ensuring long-term impact. Key activities include the publication of reports, research papers, and case studies that showcase successful project outcomes and educational resources. A final public event or conference is held to present key achievements and engage stakeholders. Legacy resources, such as open-access manuals, guides, and learning materials, are developed to support the replication of best practices. Knowledge sharing is facilitated through online platforms, academic journals, and policy briefings to promote scalability and ensure that successful NBS interventions can be adopted by other universities and communities.

Figure 7.5: BeWell Living Lab: Step-by-step implementation timeline

The **Activity Spaces and Experimental Locations** are strategically designed to support biodiversity restoration, climate adaptation, and community engagement through hands-on learning, research, and practical demonstrations, fostering a dynamic environment for education, experimentation, and stakeholder involvement.

Arboretum Collection: The Arboretum Collection serves as a primary area for **biodiversity enhancement experiments**, particularly focusing on biodiversity restoration through the establishment of **unmown meadows** as a key example of NBS. This space allows for research on the interactions between native and introduced plant species, especially woody and herbaceous plants, with local fauna, including pollinators. Community engagement and educational activities are also integral to this space, with interactive nature trails and educational tours that offer opportunities for hands-on learning and active participation in biodiversity conservation initiatives.

Dendropark: The Dendropark is a **specialized collection of diverse tree species** that supports research on tree biodiversity, health, and climate adaptation. This space facilitates **long-term monitoring of tree species resilience** to environmental stressors such as heat and drought, thereby contributing to experiments on climate adaptation. The Dendropark also serves as an educational space where students, researchers, and community members can learn about the role of trees in mitigating the **urban heat island effect as well as noise prevention**. Educational tours and interactive sessions in this area provide practical insights into tree health and the ecological importance of tree diversity.

Tree Nursery: The Tree Nursery plays a central role in **supporting biodiversity restoration and climate adaptation efforts**. It serves as a propagation site for **native and climate-resilient tree species** used in biodiversity enhancement projects across other experimental areas, such as the Dendropark, Tree Plantations, and Arboretum Collection. The nursery also provides a space for **educational workshops on tree propagation, grafting, and cultivation techniques**, involving students, community members, and stakeholders in practical training sessions. By fostering a local supply of high-quality planting material, the Tree Nursery contributes to the LL 's goal of promoting sustainable greening efforts across green spaces.

Main Building Square: The **Main Building Square** serves as a central, **high-visibility location for public engagement and community education**. As a **prominent, accessible gathering space**, it facilitates community events, exhibitions, and hands-on workshops aimed at raising public awareness of NBS and

biodiversity conservation. This area is a hub for stakeholder interaction, where visitors, students, researchers, and local community members can engage in participatory activities such as biodiversity monitoring, workshops on green infrastructure, and practical demonstrations of NBS (Figure 7.6).

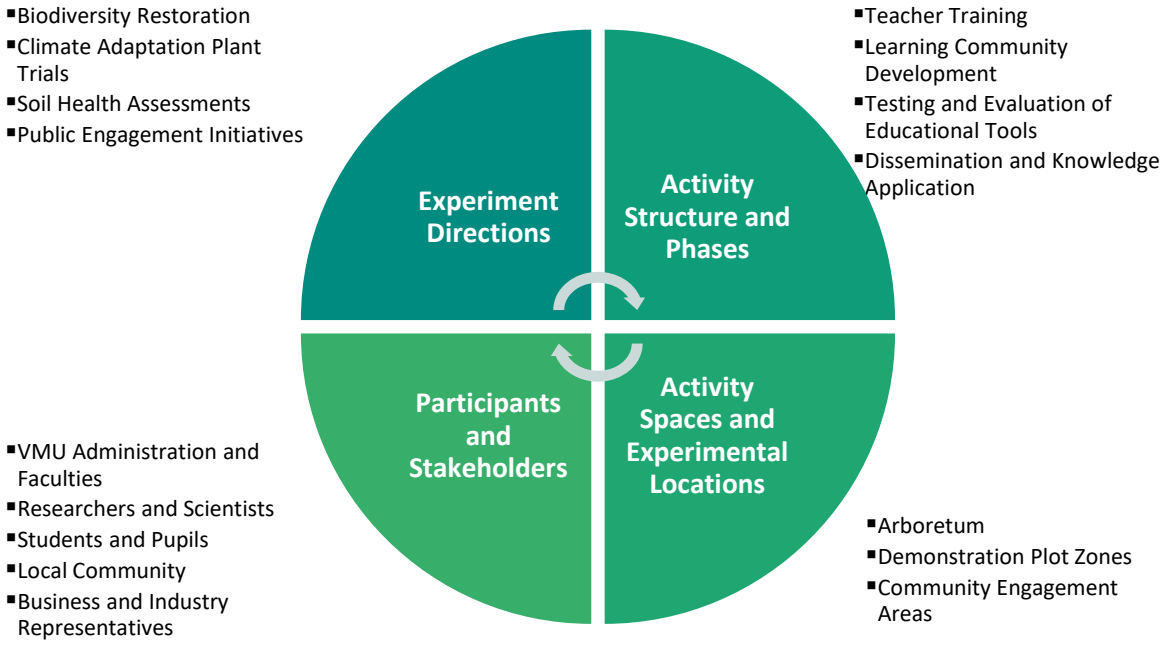

Figure 7.6: BeWell Living Lab Framework: Experiments, spaces, and phased implementation

The **BeWell LL** represents a comprehensive framework for advancing **biodiversity restoration, climate adaptation, and community engagement** through a structured approach that integrates experimental activities, educational initiatives, and stakeholder participation. By utilizing dedicated spaces such as the **Arboretum Collection, Dendropark, Tree Nursery, and Main Building Square**, the LL fosters hands-on learning, research, and community-driven action, promoting the development and implementation of **NBS** for sustainable environmental resilience.

7.6 Community involvement

Potentially Affected Citizen Groups, Stakeholders, and Authorities. Key citizen groups, stakeholders, and authorities potentially impacted by the LL's initiatives include local community members, environmental organizations, municipal authorities, educational institutions, and businesses. Specifically, local residents and schools near the VMU AA are important citizen groups, as they will directly experience the LL's environmental and educational efforts. Environmental organizations, such as the Aukštaitija Directorate for Protected Areas, are valuable partners in biodiversity initiatives, while municipal authorities in the city of Kaunas play a role in land use, regulatory oversight, and aligning the LL's activities with regional sustainability goals. Local businesses, especially those focusing on sustainability, may be involved in supporting eco-friendly practices or partnering on educational programs (Figure 7.7).

Expected Benefits and Outcomes for Citizen Groups and Stakeholders. These citizen groups and stakeholders can expect a range of benefits and outcomes. For local residents and schools, the LL provides hands-on learning opportunities and increased green space, promoting environmental awareness and encouraging sustainable practices. Environmental organizations benefit from data and findings related to biodiversity restoration, which can inform broader conservation efforts. Municipal authorities can leverage the LL's results to develop NBS and sustainable practices within city planning,

while local businesses benefit from the LL's focus on, potentially leading to partnerships that improve their environmental impact and public image.

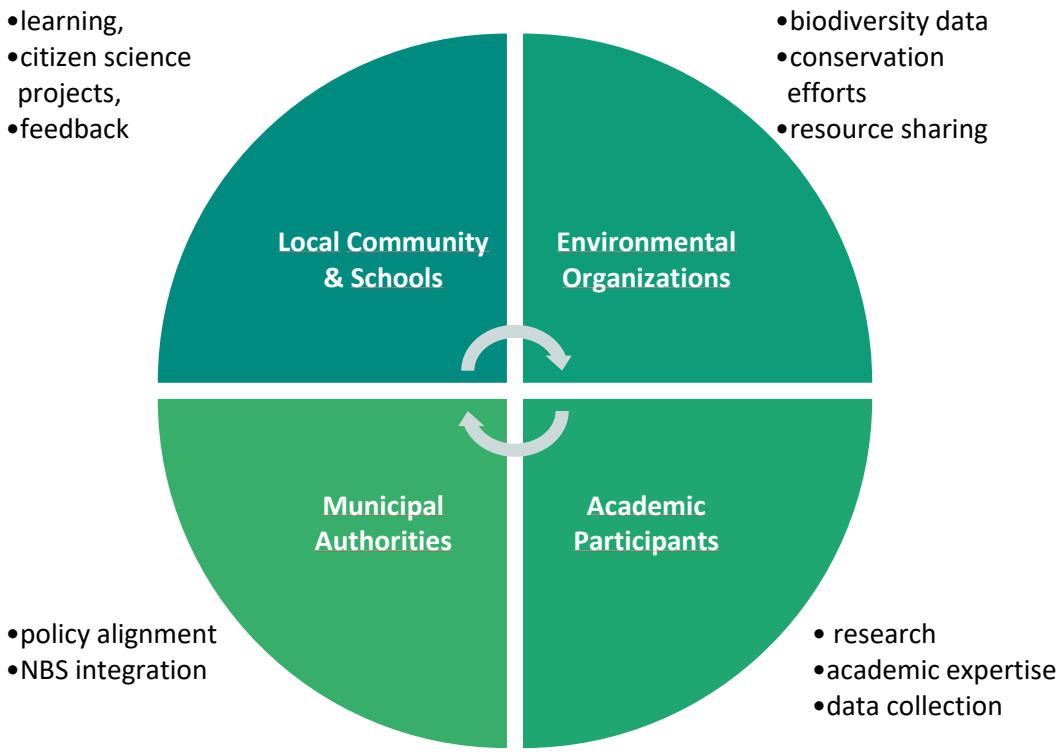

Figure 7.7: Acting stakeholders and their roles

Required Participants for the LL and Experiments. To ensure the success of the LL, participation from a diverse array of individuals and disciplines is essential. Researchers and faculty from VMU provide academic expertise, while students bring new perspectives and assist with data collection. Local community members are key for citizen science and public engagement initiatives. Representatives from environmental organizations, municipal authorities, and local businesses offer external insights and resources. Additionally, involvement from specialists in plant sciences, environmental engineering, urban planning, education, and social sciences is crucial to address the LL's multidisciplinary objectives.

Disciplines Needed in the LL. The LL requires contributions from multiple disciplines to address the ecological and social challenges effectively. Key disciplines include environmental science, ecology, botany, silviculture and horticulture for plant and ecosystem studies. Urban planning contributes to land use and integration of NBS within urban spaces, while education and social sciences are needed for public engagement, behavioural change, and assessing social impacts. This interdisciplinary approach ensures that the LL can comprehensively tackle the complexities of sustainability.

Citizen Participation and Levels of Involvement. Citizens will participate at various levels based on the operational framework. Community members, including local schools, will be invited to engage in educational workshops, hands-on activities, and citizen science projects, allowing them to contribute data and observations that support biodiversity and climate adaptation research. The LL will also offer interactive public spaces and trails, giving citizens opportunities to learn about NBS directly within AA campus green infrastructure. At a more engaged level, citizens will have the chance to participate in feedback sessions, allowing their insights to shape future activities and projects in the LL.

Social Issues and Inclusivity. Addressing social issues and inclusivity is a priority to ensure that the LL benefits all community members without leaving anyone behind. Key social considerations include accessibility, education, and engagement across demographics. The LL will focus on providing inclusive learning opportunities that cater to diverse groups, including youth, elderly individuals, and those with limited access to green spaces. Additionally, partnerships with local organizations aim to reach underrepresented communities, ensuring that the benefits of the LL's work are equitably distributed.

Ensuring All Required Participants Are Involved. To ensure all necessary participants are on board, the LL has established outreach and communication strategies to engage stakeholders, citizens, and interdisciplinary experts. Through regular meetings, collaborative workshops, and outreach to community leaders, the LL actively includes each necessary participant, fostering a network that supports its mission and goals. This inclusive approach ensures that all voices contribute to the LL's success and that a comprehensive range of expertise guides its efforts.

7.7 Process design - roles and responsibilities

Potential Contributions from Stakeholders. Stakeholders will contribute in various ways, mainly by offering time, sharing the initiatives and information, and other essential inputs. Researchers and faculty from VMU will commit time and expertise to design and execute experiments, guide students, and analyse data. VMU will provide funding, space, and administrative support, ensuring the LL has the necessary physical and operational resources. Local businesses may contribute financially or supply materials for sustainable practices, while environmental organizations and municipal authorities will offer expertise, data, and regulatory insights to help align the LL's activities with local conservation and policy goals. Community members and local schools will contribute volunteer time, assisting through citizen science, public engagement initiatives, and feedback.

Task Allocation and Responsibilities. Each partner will have designated tasks and responsibilities aligned with their expertise and capacity. Researchers will be responsible for developing and leading scientific studies, analysing results, and sharing findings. University administrators will handle project oversight, funding allocation, and facility management. Local businesses may assist in educational outreach, provide resources, and support sustainability workshops. Municipal authorities will contribute by offering regulatory guidance and ensuring the LL's activities align with urban and regional development plans. Community members and schools will participate in educational events, provide input on public engagement strategies, and contribute data through citizen science activities. Each role will be tailored to match the skills, resources, and interests of the participants, ensuring that responsibilities align with individual capacities and expertise.

Alignment of Tasks with Capacities and Competences. Tasks will be assigned according to the capacities and competencies of each partner to maximize effectiveness and ensure the success of the LL. Researchers and faculty will manage the technical and scientific aspects, leveraging their academic and research skills. University administrators will handle logistical and operational aspects, while environmental organizations and municipal authorities will use their regulatory and conservation knowledge to guide project alignment with broader environmental goals. Community involvement will be structured to allow citizens to engage at various levels, ensuring their contributions are valuable and accessible based on their interests and availability.

Organization of the LL and Communication Structure. The LL will be organized with a collaborative and flexible structure to accommodate its interdisciplinary and community-focused nature. A central project team, led by university researchers and faculty, will oversee day-to-day operations and coordinate with other stakeholders. The project team will conduct regular meetings with each stakeholder group to ensure alignment and progress toward shared goals. Communication will flow through dedicated channels, including email updates, a central online platform for document sharing and project updates, and in-person or virtual meetings. Each stakeholder will have a designated point of contact within the LL, ensuring streamlined communication and quick resolution of any issues.

Reflection and Adaptive Process. The LL will employ a reflective and adaptive approach, continuously assessing project progress and making necessary adjustments. Regular feedback sessions with all partners will provide insights into what is working well and where improvements may be needed. Data from experiments and public engagement activities will be reviewed periodically to evaluate effectiveness and identify areas for improvement. The LL will also invite community feedback to ensure activities remain relevant and accessible. This iterative process of reflection and adjustment will ensure that the LL remains responsive to challenges and opportunities, supporting its long-term success and alignment with sustainability goals.

7.8 Education in the LL

Addressing the Central Goal of ENABLS. The LL will directly address the central goal of ENABLS by integrating NBS into the educational framework at VMU AA. Through hands-on, experiential learning projects, students will actively engage with NBS concepts, conducting experiments on biodiversity, climate adaptation. This direct involvement will deepen their understanding of NBS, making it a core part of their educational experience. Additionally, by developing curricula that focus on real-world applications of NBS, the LL will highlight the relevance of sustainable practices in higher education, fostering a generation of students who are equipped with the skills to promote environmental resilience.

Connecting with Vocational Education. The LL has potential connections to vocational education, particularly in areas like sustainable landscaping, agriculture, and ecological management. The LL plans to reach out to vocational schools to explore partnership opportunities, where vocational students can participate in workshops, demonstrations, and collaborative projects focused on NBS. The LL will also explore creating training modules that align with vocational curricula, allowing students to gain practical experience while learning from experts at the university. These collaborations can bridge academic and vocational pathways, providing a well-rounded approach to sustainability education.

Planned Activities and Exploration. While specific activities are still being finalized, the LL will focus on three main areas: curriculum integration, public workshops, and interdisciplinary research. To explore how best to connect with vocational and other educational partners, the LL will conduct consultations with educators, community organizations, and environmental groups. These consultations will guide the design of activities and help identify priority topics. The LL will also gather feedback from students and teachers to shape its educational approach, ensuring that activities align with learning goals and effectively engage participants.

Setting Up Educational Activities and Linking to Curricula. The LL will establish educational activities by applying/adopting modules created within the frame of ENABLS project that can be embedded within existing courses, particularly in environmental science, agriculture, and urban planning programs. Additionally, extra-curricular activities, such as workshops, public lectures, and field days, will be designed to attract a broader range of students and community members. To maximize the impact, the LL will involve faculty from relevant departments, local environmental organizations, and vocational education partners. This collaborative approach ensures that the LL's educational activities reach diverse audiences and contribute meaningfully to both academic and community learning.

Real-Life Learning Experiences. Using the operational framework, the LL aims to implement several types of real-life learning experiences. These will include hands-on biodiversity projects where students can monitor plant and animal interactions, climate adaptation experiments on resilient plant species. Students will also have opportunities to conduct fieldwork, collect data, and analyse the results, gaining practical experience that reinforces theoretical knowledge. This real-world learning approach prepares students to apply NBS concepts beyond the classroom, equipping them with the skills needed for professional careers in sustainability.

Incorporating Reflection and Nature-Based Thinking. Reflection on the different interpretations of NBS will be a core part of the educational process. The LL will incorporate discussion sessions, where

students and participants can explore various perspectives on NBS, considering cultural, ecological, and practical implications. Nature-Based Thinking will be emphasized, encouraging students to view ecological systems as integrated solutions for human and environmental challenges. This reflective approach will be integrated into courses and projects, allowing students to critically analyse how NBS can be applied in different contexts.

Realistic Goals Within the Project Timeframe. Within the project's timeframe, realistic goals include establishing a baseline curriculum for NBS, conducting a series of introductory workshops, and launching a pilot program for biodiversity monitoring. These activities will lay the groundwork for long-term educational integration, providing initial insights and establishing a structure for ongoing learning. Additionally, setting up partnerships with local vocational schools and community organizations will be a priority, ensuring that future collaborations are built on a solid foundation.

Long-Term Growth Beyond the Project. The efforts of the LL can grow after the project by expanding educational partnerships, developing advanced NBS-focused curricula, and continuing public engagement initiatives. Research findings from the LL can contribute to new educational materials, case studies, and public resources that extend the LL's impact beyond the campus. Additionally, by fostering a network of students, researchers, and community members invested in sustainability, the LL will create a lasting legacy of Nature-Based Thinking and sustainable practices that will inspire ongoing involvement in environmental initiatives.

7.9 Monitoring, data management and reporting

Organizing Monitoring, Data Management, and Reporting. The LL will establish a structured approach for monitoring, data management, and reporting to ensure transparency and facilitate continuous learning. Monitoring will be conducted by project teams, with responsibilities divided among researchers, faculty staff, and participating students. Data collection may cover various aspects, such as biodiversity changes, and climate adaptation effectiveness, as well as engagement metrics from public workshops and educational activities. Data will be gathered systematically through field observations, surveys, and digital monitoring tools.

Reporting will occur at regular intervals, with comprehensive updates shared with stakeholders, including VMU administration, environmental organizations, and local authorities. These reports will include quantitative metrics (e.g., plant growth rates, species diversity) and qualitative insights (e.g., community feedback, workshop effectiveness) to present a holistic view of the LL's progress and challenges.

Monitoring with Stakeholders to Identify Barriers and Opportunities. The LL will engage stakeholders in ongoing discussions to monitor both barriers and opportunities in incorporating NBS concepts into education. One focus will be identifying obstacles in curriculum integration, such as resource limitations, time constraints, or the need for specialized training. Stakeholders will also help assess community receptivity, enabling the LL to adapt its strategies based on feedback and address any misunderstandings about NBS. Changing attitudes toward NBS among stakeholders, such as shifts in perception among students, faculty, and community members, will be monitored through surveys, feedback sessions, and regular meetings.

The LL will also track opportunities that arise from stakeholder involvement, such as potential collaborations with environmental organizations, vocational schools, or businesses interested in sustainability practices. By engaging in active dialogue with stakeholders, the LL will continuously refine its approach, ensuring that educational activities are relevant, accessible, and aligned with participants' evolving needs.

Impact Beyond the LL's Time and Location. The LL's impact is designed to extend beyond its physical location and project timeframe. The knowledge and resources generated, such as research data, educational materials, and NBS implementation guides, will be made available to other institutions

and communities through online platforms, publications, and open-source resources. Additionally, the LL's partnership with local organizations and educational institutions establishes a network that can continue promoting NBS concepts long after the project concludes.

By training students and community members in Nature-Based Thinking and sustainable practices, the LL fosters a mindset that participants will carry forward into their future endeavours. This approach not only raises awareness but also equips individuals with practical skills to apply NBS in their own communities or professional roles. The LL will serve as a model for similar projects at other universities or community settings, offering a replicable framework for implementing NBS in educational and community environments. Through these ongoing efforts, the LL aims to create a legacy that promotes environmental resilience and sustainable practices on a broader scale.

7.10 Conclusions

1. Comprehensive Nature-Based Solutions (NBS) Framework

The BeWell LL integrates biodiversity restoration, climate adaptation, and community engagement into a holistic framework. Utilizing spaces like the Arboretum Collection, Dendropark, Tree Nursery, and Main Building Square, it promotes hands-on learning, research, and practical application of NBS to address environmental challenges and support sustainable development.

2. Phased Implementation and Adaptive Management

The project follows a five-phase process (initiation, co-creation, implementation, monitoring, dissemination) to ensure structured planning, stakeholder engagement, and continuous learning. Adaptive management enables real-time adjustments based on feedback, ensuring effective execution and long-term impact.

3. Stakeholder Engagement and Collaborative Learning

The LL fosters stakeholder collaboration by involving students, researchers, community members, and environmental experts. Through participatory processes and interactive workshops, stakeholders play an active role in shaping activities and promoting Nature-Based Thinking. Open-access resources and educational tools support knowledge sharing and enable scalability beyond the LL's initial scope.

4. Experimental Validation and Data-Driven Decisions

The LL's four key experiments focus on unmown meadows for biodiversity, climate adaptation trials, and public engagement. These experiments generate evidence on the impact of NBS, guiding future decisions. Data collection and monitoring systems track biodiversity growth, and educational outcomes, supporting evidence-based management and continuous improvement.

5. Sustainable Legacy and Global Replication

The LL aims to create a sustainable, replicable model that promotes biodiversity, climate adaptation, and nature-based education. By sharing open-access resources, best practices, and case studies, the LL facilitates global replication in other universities, communities, and policy initiatives, ensuring that its impact extends well beyond its project timeline.

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8 Action Plan Living Lab The Netherlands: Nature-inclusive Education

8.1 Introduction

Within this Living Lab (LL), a community of stakeholders in and around Wageningen University and Research will explore nature-based ways of thinking and doing in education, to foster Nature-Based Thinking (NBT). Nature-Based Thinking is a more fundamental approach to NBS, that aims to broaden the concept from technological solutions to deeper transformation of thinking and doing in relation to nature (Randrup et al. 2020). In the field of NBS, there is a growing concern that NBS will not effectively change sustainability issues without reflection on the predominantly instrumental values which underly discourses around ecosystem services, green infrastructure or NBS. There is also a concern that within technological approaches, the spontaneous and motivated interactions between people and nature are not designed for, although they have proven to be important for place-based, culturally specific and long-lasting solutions (Randrup et al. 2020). Nature-Based Thinking and doing arises from such direct and self-directed processes in which intrinsic values play an important role (Franzescaki 2017).

At Wageningen University, there is a growing interest in educational approaches that can foster NBT across disciplines. This interest is strengthened by a national movement for Nature-inclusive Education (NiE). The Dutch ministry of Agriculture, Food Quality, Fisheries and Nature (LVVN) has formulated a 'Nature-inclusive Agenda' to '*change the tide by society-wide nature-inclusive thinking and doing*' (Translated from Collectief Natuurinclusief). One of its nine domains is aimed at 'awareness and education'. Within that domain, educators from around the Netherlands are collaborating on a vision for nature-inclusive education.

NiE, Nature-inclusive Education, builds on a participatory worldview, in which learners have the opportunity to practice knowledge, skills and attitudes which support responsible, caring and balanced participation within the greater community of life. This means participation in a complex web of relationships with human and non-human stakeholders, and demands the practice of relationality. Relational learning differentiates itself from mainstream education in the sense that 'knowledge, understanding, meaning and competence are viewed as interrelated and emergent properties of the relationships we establish with others and the place of which we are part' (van den Berg, 2023).

NiE takes a whole-person approach, in which cognitive, emotional, physical, spiritual and action-oriented domains of learning are fostered and integrated. NiE thereby includes several layers of interaction in relationship with the greater community of life: through cognitive knowledge about nature and solution-oriented teaching for nature, but also physical experience in nature, the emotional/affective relationship with nature, and an existential or reflective exploration of values and worldview, exploring the perspective of being nature ourselves. Within this LL, we see all these layers as necessary dimensions in fostering Nature Based Thinking. In this LL, we will use the terms Nature-inclusive Education (NiE) and Nature-based education interchangeably.

In the NiE LL at Wageningen University, a diverse group of stakeholders is eager to explore and evaluate NiE/NBE through practice. How do we nurture nature-based thinking among staff and students? What is the role of nature itself within this type of education? NBT implies an exploration and transformation in basic attitude towards the relationship between humans and nature. This is relevant for all disciplines, and necessary for all involved in NBS, from governance to technical, maintenance and citizen engagement. In order to answer these questions, we need experimental space in which nature-based or nature-inclusive learning methods are explored and evaluated. This is what this LL aims to provide, starting at Wageningen University through a teacher training and a community of practice for

staff, action groups for institutional change and reaching national impact through our collaborations with other higher education/TVET institutions and societal partners.

The NiE LL will serve as a connecting factor between several parties that are either already applying nature-based teaching methods, are interested in doing so, or (could be) beneficiaries of such methods. It will be a catalyst for nature-based teaching and learning initiatives at WUR, and because of the LL's embeddedness in national and international partnerships, the lessons learned in Wageningen will be widely shared. The LL will closely align with current educational effort going on in the Netherlands, especially around 'Nature-inclusive education'.

8.2 The complex, multidisciplinary problem the Living Lab tries to solve or the idea the Living Lab wants to realize and why that is challenging

8.2.1 Problem description

Nature-inclusive Education is key to developing Nature-Based Thinking. Nature-Based Thinking is an emerging term in the field of NBS, which shifts NBS from a solutionist approach to a systemic one: "*To break boundaries, the epistemological framework at the foundation of our thinking needs to move beyond technical and anthropocentric solutions. At this fundamental level, there is a need to focus on the interactions between people and nature, especially at the individual and community level. Therefore, the aim of NBT to be socially inclusive goes beyond participatory processes to include local residents in decision-making processes. Based on the concept of leverage points (Meadows 1999), we argue that in order to contribute to transformative change, NBT must also reconnect (urban) populations with nature directly, physically as well as spiritual, emotional etc."* (Randrup et al. 2020).

A technical approach to NBS may risk to lose sight on the long-term context and interdependencies in the oftentimes unpredictable and changing environmental, social and governance dimensions. In line with the slow-timescale of nature, place-keeping and place-making through community interactions are essential in NBS (Wild et al. 2008; Dempsey and Burton 2012). Moreover, many potential benefits of NBS are not realized due to dominant economic thinking, lack of political will or weak governance. For NBS to thrive, there is need to invite more recurring and positive nature interactions. To challenge hampering human-nature relationship and develop more nature-inclusive thinking and governance, as well as deepened understanding of ecological processes and how to interact positively within them. Nature-inclusive education addresses these challenges across all disciplines, not only technical.

This problem is complex because it challenges very fundamental cultural assumptions and patterns. The meaning and value of nature is different for each person and is often not discussed in decision making processes. It is value-laden and sensitive. However, this dialogue is fundamental for change and good collaboration. Nature-inclusive education fosters such fundamental dialogue through experiential methods.

Nature-inclusive Education can also be viewed as a nature-based solution in itself: a cost effect-effective solution that is supported by nature, which address challenges in education such as student motivation, health and wellbeing, cross-disciplinary learning, sustainability learning, development of skills and attitude, place-making, relationality and boundary crossing, but also active hope in the face of climate change and environmentally responsible behavior. How can learning in and by nature contribute to these skills? And to sustainable, nature-based solutions? Education worldwide faces many challenges in adapting to increasing globalization, sustainability concerns and disciplinary segregation (Macintyre et al. 2024). Nature-based education can offer approaches to build connections.

8.3 Brilliant idea or complex problem

8.3.1 The underlying challenge of the Living lab

The mission of Wageningen University and an increasing number of other institutions is to "educate students to become academic professionals, who can contribute to sustainable solutions for existing and future complex issues in the domain of 'healthy food and living environment' all over the world, and who take their social, personal and ethical responsibilities seriously" (WUR mission statement). Many of the world's most complex issues revolve around balancing human need (and greed) with the needs of other species, ecosystems and landscapes. Cultural assumptions on fundamental human-nature relationships play an important role in how needs are balanced in governance, economic and social activities.

Although the development of sustainability education has created valuable dialogue around competences and values for a sustainable world, it has also set in motion a trend in which knowledge and experience of nature are fading into the background, when compared to the discourse of nature and environment education of the 1970s and 1980s (Ashwell 2010; Macintyre et al. 2025). In implementing sustainability education, the focus is also increasingly on solving socio-economic or technical issues, rather than (the role of) direct nature experience for sustainability.

A critical concern expressed in the literature is that the goals of environmental education and education for sustainability will not be realised if people no longer get direct nature experiences. Research shows that regular, direct and meaningful contact with nature is one of the most influential factors for commitments to - and learning for - environmentally responsible behaviour (Kals et al. 1999; Bögeholz 2006; Chawla 2006). Such experience is key to developing a sense of 'nature connectedness' which is defined here as: '*the extent to which an individual's thoughts (e.g. reflective perceptions, conscious or implicit attitudes or cognitive beliefs) and actions (e.g. instinctive, reflexive, reasoned or cultural practices) embody the relatedness between themselves and nature and reflect a sense of personal responsibility, respect and reverence for all life over spatial and temporal scales and contexts."* (Zylstra 2014).

While experience of nature is one of the most influential factors for developing a sense of connectedness, such experience in free time or education is declining rapidly among younger generations, to the extent that scholars are warning for the '"extinction of experience" (Miller 2005; Samways 2007) and for 'ecological blindness' - which is both the inability to perceive and experience nature as well as the inability to see oneself as dependent upon and part of nature (Naess 2008; Nisbet et al. 2008). The kind of nature experiences that are necessary to develop nature connectedness are an ongoing subject of research and debate, the more since it differs across individuals, (sub)cultures, age groups or specific social settings.

Besides the loss of regular contact with nature, the debated character of the concept sustainability also plays a role in how people learn to relate to the world. In the 21st century, the concept of sustainability gains increasing international criticism. Sustainability is a complex concept, susceptible to instrumental use in the playing field of economic and political interest. A central issue is that the move from nature and environmental education to the terminology of sustainability has created space for aligning environmental education and Education for Sustainable Development (ESD) with an agenda of socio-economic needs and a market-based approach to development (Ashwell 2010, Zylstra 2014; Huckle & Wals 2015). ESD and related terms are therefore vulnerable to being 'transformed' into neoliberal discourses (Le Grange 2011). In practice, sustainability is often given a technocratic interpretation, in which it is mainly about material use, renewable energy, reduced pollution or

increased efficiency in industrial processes, without focusing on dialogue about values of care and responsibility.

Another model for understanding these different views of sustainability, is the regenerative design framework by Daniel Wahl (2016, Figure 8.1). The sustainability paradigm oftentimes limits itself to 'doing what we do but doing it better' whereas restorative, reconciliatory or regenerative approaches envision a more transformative future where humans can rediscover a more participatory role in or as part of nature. Learning about nature can serve to control and dominate its processes, or to support its restoration (stewardship for nature). When learning in and with nature are added, this may foster a sense of partnership to collaborate with nature's processes for the benefit of both. When learning through and as nature are added, people can experience what it is like to participate in or feel one with nature. In Nature-Inclusive Education, these perspectives and their role in society are deliberately experienced and explored. Teachers and students learn to have meaningful dialogue about different perspectives, value systems and worldviews, which is fundamental in addressing complex societal issues with diverse stakeholders. It explores how a participatory view of nature can inform policy making and economic thinking.

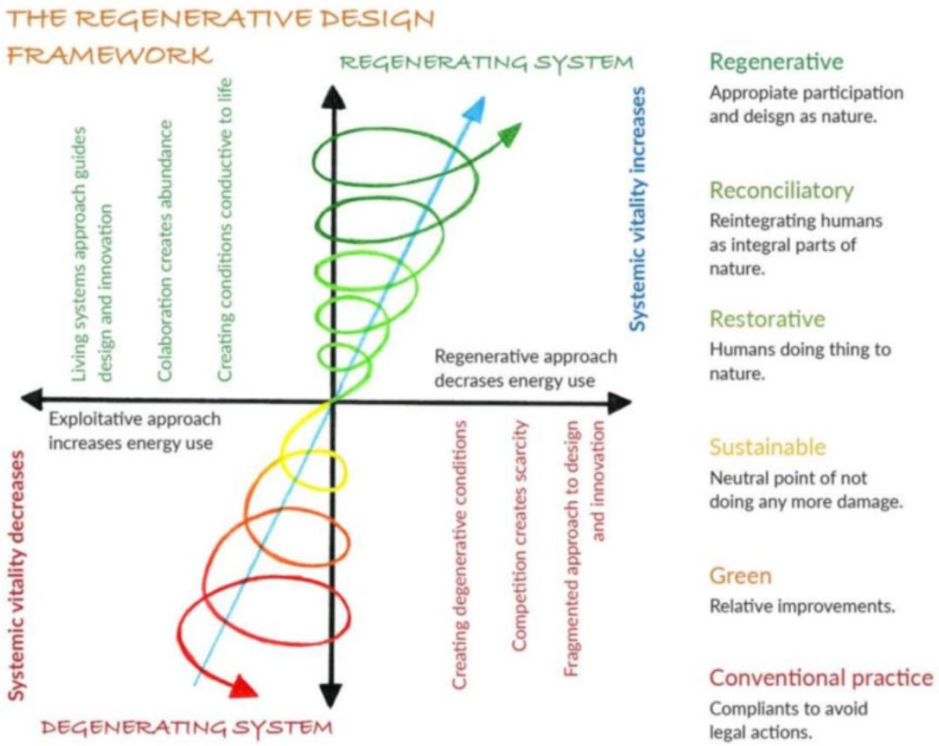

Figure 8.1: Regenerative Design Framework (Wahl, 2016).

8.3.2 A challenge for whom?

Within the context of this LL, the issues described above will be researched within the micro-society of Wageningen University and Research and then expanded through national and international partnerships, including other educational institutes including TVET and societal partners. The main beneficiaries are students, teaching staff and educational policy makers. But indirectly, the field of NBS benefits from educational approaches that foster NBT. In the Netherlands, there is a national effort to explore and implement nature-inclusive thinking in all societal domains, including education. The NiE LL works in close collaboration with other initiatives in the country to exchange knowledge and experiences. The main part that the WUR initiative, but also other projects are addressing, is the practical implementation of nature-based thinking through Nature-Inclusive/Based education in higher education.

Besides the fundamental complexities that have been described above, there are also many practical challenges: there are limited outdoor educational spaces, higher education curricula are strongly focused on mere cognitive development instead of skills and attitudinal development, there is lack of time and money to change education, there is lack of skill among teachers to implement NiE, there is lack of awareness around the importance of NBT. These challenges are addressed in the LL by inviting stakeholders into working groups for the next two years to research various options for change.

8.4 Stakeholders and partners

8.4.1 Overview of partners

The NiE LL is primarily focused on the educational context at Wageningen University. This will be the setting in which testing of educational methods and interventions takes place. However, there will be multiple stakeholders either interested in the learning process taking place at Wageningen University, or able and willing to provide input from expertise and experience elsewhere.

Wageningen University and research:

- **Education and Learning Sciences group (ELS)** - ENABLS consortium partner and initiator of the LL.
- **Teaching and Learning Center (TLC)** - In charge of the University teaching qualifications of WUR staff. TLC also offers elective modules for further training of teachers, under which it is developing the Teacher Training in Nature-inclusive teaching that will be a part of this LL.
- **Society Based Education group (SBE)** is also a part of the TLC and is interested in providing students with real-life projects/challenges to work, an essential part of NBT.
- **ReGeNL**: National project (on education for) regenerative agriculture (also working with TVET schools). Withing ReGeNL, there is a work package that closely aligns with our LL aim to apply the Whole Institutional approach within WUR to foster more nature-based thinking and doing across disciplines.
- **Wageningen Pre-university** – Working on outreach towards high schools in the Netherlands. One of their projects is focused on running a Community of practice for high school teachers on nature-inclusive teaching methods. We collaborate in the formulation of principles and methods for NiE.
- **Special Chair on Human-Nature Relationships in the Anthropocene** (Forest and Nature Policy group FNP) - The chair group focuses on research around human-nature relationships in the Anthropocene, and how this relationship can be shaped/transformed.
- **Droevendaal Food Forest Project** – Potential outdoor location in which educational experiments with Nature-based methods take place. This Food Forest on the WUR campus already hosts several educational activities, including management with student groups.
- Many highly motivated (teaching-) **staff interested in nature-based teaching**. Many teachers report enthusiasm and willingness to teach in a more Nature-inclusive way, but are hesitant to do so because they do not know exactly how or what. We hope to be able to provide the tools and encouragement they need.
- **Students**: students that have participated in previous pilots and existing courses that apply Nature-inclusive methods, report finding it highly valuable. We hope to be able to let more and more students experience this enrichment of their studies.

TVET:

- **AERES Wageningen** - Vocational training for future teachers in multiple green subjects. This is a local TVET school, and it focuses on educating future teachers. We want to explore with them to which extend they are already familiar with nature-based thinking and nature-based teaching methods, and if they are interested in exploring how this could be applied in their programs.
- **Windesheim Zwolle** (higher vocational training in multiple subject) - Windesheim is starting a new project on Nature-inclusive teaching, and has reached out to us to help them set it up.
- Societal organizations/initiatives:
- **NatureCollege Foundation** – One of the foundational partners of the LL that has initiated and supported several initiatives and course that are exploring Nature-inclusive teaching methods at WUR and organized two symposia in its More Nature Deeper Education program. It is also a (financial) partner in the Teacher Training that will be a core part of the LL.
- **Collectief Natuurinclusief** – National, government supported initiative to support Nature-inclusive thinking and doing in several societal domains, including education. The Collective is in the process of defining Nature-inclusive Education, its scope, its principles and its methods. Through this collective, the LL is supported with dissemination, research collaboration and events.
- **ReGeneration Foundation** – a partner foundation that works on complex agroforestry as a regenerative practice, but also develops courses for primary, secondary and higher education on ecoliteracy and regenerative farming. ReGeneration will be a partner in outreach, and implement nature-inclusive methods in its courses.

8.4.2 Arrangements between partners

The foundational partners of this project are the WUR Education and Learning Sciences group, which is the executive partner in ENABLS, NatureCollege Foundation and the Teaching and Learning Centre of the WUR. The latter two are collaborating on the first pilot of a Teacher Training in Nature-inclusive teaching, which will be ongoing and play a key role in the LL. The project is a result of many previous years of dialogue, initiative and research by the founding partners. However, the idea and problem are shared by all stakeholders.

The level of participation of other partners varies. In November, a meeting was held with core partners (ReGeNL, TLC/SBE, ELS, students and several motivated teachers). In this meeting it was discussed how to organize the LL. Two main activities had already been drafted, namely the development of a teacher training and handbook, and the formation of a Community of Practice of teachers applying and evaluating nature-inclusive teaching. These will be core activities of the LL. However, in addition to that it was proposed to form action groups around themes. These action groups will have strong control in the LL process because they will operate independently, however in close contact with the LL coordinator. The action groups will focus on institutional barriers and support for nature-based education.

One of the more prominent core partners in the project is ReGeNL, which brings additional financial capacity to the project and strongly aligns with the project aims. The financial contribution may support some of the working groups in the LL. This is to be decided in follow-up meetings. All partners expect to make impact within WUR education and beyond, to foster more nature-inclusive thinking across disciplines. All partners are interested to participate from a deeply felt motivation to make change for sustainability. Some project partners may end up gaining professional status or achievements from the project, however this is not the main intention from the start. Agreements on collaboration will be made in a LL meeting January 2025, with as many stakeholders as possible present to secure everybody's consent on the way ahead.

Several stakeholders still need to be approached to achieve the goals of the project, such as policy and campus facilities staff, and more students within the WUR micro-environment, and collaboration needs to be defined with several societal stakeholders (i.e. the Collectief Natuurinclusief and the TVET schools). These stakeholders will be approached by the LL coordinators, incited to join some of the upcoming LL meetings, and/or directly contacted through the action groups. Part of the work that the action groups will do is map out key stakeholders, and devising strategies to make them enthusiastic for NiE. Students will be approached through the main student associations in Wageningen, and motivated to join by offering credits or study compensation for active participation into the project. Throughout the project, publishers will be approached to co-produce materials for nature-inclusive education/nature-based thinking. This will be done when some convincing materials and tools have been developed.

Within this project we do not foresee strong conflicts of interest. Some teachers may not be in favor of NiE, but this is not problematic since it does not need to be implemented by everyone. There is a certain amount of freedom for every teacher to use alternative or new teaching methods. As long as learning goals are achieved, this is not a problem However, NiE will not align with all current teaching and learning policies and practices. The main conflict will arise in changing these – but is also the change challenge of this project.

8.5 Location and context

The NiE LL is focused on the educational institution of Wageningen University. This will be the setting in which testing of educational methods and interventions takes place. However, there will be multiple stakeholders from a broader Dutch societal context either interested in the learning process taking place at Wageningen University, or able and willing to provide input from their expertise and experience. These partners have influence in their own spaces. We therefore define the area of focus as Wageningen University, with fuzzy edges. In line with the Whole School Approach (Wals et al. 2025) we see Wageningen University as a micro-society. The Whole School/Whole University Approach allows us to look at the educational context of the university not only from the perspective of didactics, curriculum or pedagogy, but also at institutional factors such as buildings and outdoor spaces, professional development of staff, and the surroundings of the school in terms of societal collaborations.

> *'To explore the potential of nature to improve the quality of life' That is the mission of Wageningen University & Research. Over 7,600 employees, 13,100 students and over 150.000 participants to WUR's Life Long Learning from more than hundred countries work everywhere around the world in the domain of healthy food and living environment for governments and the business community-at-large.The strength of Wageningen University & Research lies in its ability to join the forces of specialised research institutes and the university. It also lies in the combined efforts of the various fields of natural and social sciences. This union of expertise leads to scientific breakthroughs that can quickly be put into practice and be incorporated into education. This is the Wageningen Approach. Collaboration with other parties such as government, business and NGOs is indispensable. This is in line with the Finding Answers Together ambition'.*

(Wageningen University and Research website, 12 November 2024)

Wageningen University is an ideal place for this LL. Its mission is in line with the LL mission and in fact, this LL can contribute to the fulfilment of the WUR mission. Its focus on natural sciences is in line with a focus on nature-based solutions. Within the Wageningen University, the Education and Learning Sciences chairgroup (ELS) will be the owner of the LL. This ensures the educational focus. ELS is known for its research and education around transformative learning for sustainability, adding the much-needed expertise and experience around the topic.

'Sustainable development was already in the core of our mission. However due to ongoing global challenges we felt the need to rethink our mission. Our new mission is to understand and facilitate the unfolding of human potential in response to global challenges. This means that we want to understand and facilitate learners throughout their lives to contribute to worldwide challenges in a meaningful, responsible and critical manner. Hereby, we realize that sustainable development is more than just knowledge creation and innovation, it concerns the drive of individuals and groups'.

(WUR education and learning sciences website, 12 November 2024)

8.6 Reality check: experiments, location, context

8.6.1 Like a sprouting onion: a layered Living Lab

NiE LL offers an opportunity to combine existing ánd new initiatives into a lively learning community with many partners both within WUR and beyond. The aim of this LL is to use a multi-stakeholder process in order to explore, operationalize and evaluate nature-inclusive educational methods at WUR and beyond, that contribute to the wider national and international search for educational transformation for sustainability. In this LL, we want to nurture an institution-wide learning process by piloting and evaluating nature-inclusive methods within diverse educational initiatives and institutional departments.

In line with the eNaBLS project plan, the NiE LL aims for multi-stakeholder engagement to obtain input for educational needs around NiE and NBT. We will facilitate an iterative process with testing of methods and materials, and organize multiple stakeholder events.

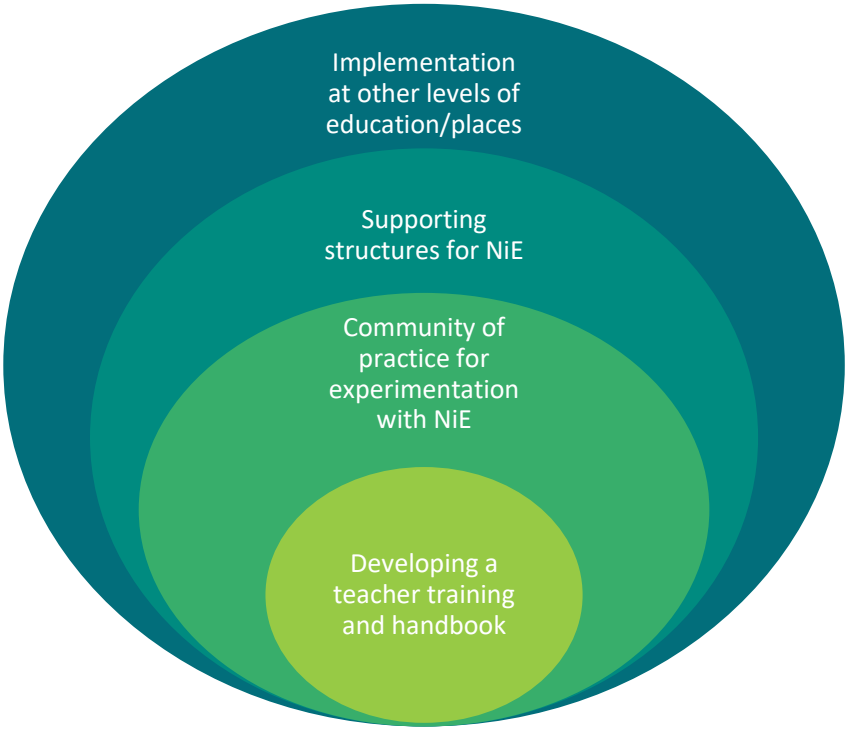

Figure 8.2: Levels of action in the NiE Living Lab

The LL is organized in four layers of activities, covering stakeholder processes around teaching methods, institutional and infrastructural arrangements for nature-based (nature-inclusive) education (Figure 8.2). The LL combines and supports several existing projects and initiatives, creating added value through a sharing of insights, mutual support, inspiration for new initiatives, and

dissemination. Activities 1 and 4 rely heavily on existing initiatives led by partners, whereas activities 2 and 3 are activities in which ENABLS takes the lead by initiating and facilitating the efforts.

1. Development and piloting of modules within the Teacher Training in Nature-inclusive Teaching (initiative of TLC and NatureCollege Foundation), and developing a Handbook for Nature-inclusive Teaching.
2. Activating a community of practice where teachers and students explore and experiment with nature-based education in existing or new courses. This activity includes the creation of a new experimental course by the ELS team. The experimentation contributes to an evaluation of what Nature-inclusive Teaching is/could be, its teaching principles, and its methods. These findings will be shared in multiple stakeholder events, and will be used to improve the Handbook.
3. Organization in several working groups based on the Whole School Approach (WSA), to foster deeper institutional change for nature based approaches. This is facilitated in collaboration with the ReGeNL initiative. So far, the following action groups were proposed in a stakeholder meeting:
    a) **In/Outdoor learning spaces:** how can we arrange learning spaces on and beyond campus to create more possibilities for NiE? Concrete ideas are to create a nature walk, map or create outdoor learning spaces, bring nature more indoors.
    b) **Food culture and community building at WUR**: how to connect people through food to the landscape and each other? Concrete ideas were locally connected catering, yearly harvest festival, students harvesting their food from the food forest, other local spaces, link to loneliness and wellbeing.
    c) **Voice for nature:** how can nature become a voice in educational and managerial processes at WUR? Nature as commissioner, stakeholder or voice in courses/policy making/meetings.
    d) **Teaching support:** how can teachers be supported with NiE? Link to skills program, society-based education, teacher training and manual, community of practice, peer learning.
    e) **New learning arrangements/curriculum:** What could be new learning arrangements to foster NiE/NBT? Community service learning (in many countries this is part of education), adventure club, food forest course, year-long course for developing connection to nature, skills module Nature Based Thinking.
    f) **Research** on NiE: how can we research the effect of NiE on staff and students? What is the understanding of and wish for NiE at WUR?
4. Dissemination of findings – implementation beyond WUR. The fourth layer of the LL is concerned with outreach beyond WUR and implementation in other places or levels of education, incl. TVET. It includes the following activities:
    a) Symposia (at least 2) on Nature-inclusive Teaching for a professionals in education in collaboration with partners NatureCollege Foundation and Collectief Natuurinclusief.
    b) Publishing of a Handbook with principles and practices of nature-based teaching (form T.B.D.) in collaboration with foundational partner NatureCollege Foundation.
    c) Collaboration with other educational institutions including TVET schools, to translate findings to other places and levels of education.
    d) Contributions at other symposia and public events (to be determined).
    e) Contributions to other existing projects and initiatives nation-wide (on invitation).

8.6.2 Estimated timeline

Here we include an estimated timeline of the several phases of the project, based on phases defined in the ENABLS LL framework. Phases are not strictly separate but overlap in time in several instances.

August - December 2024: Initiation phase where the topic is discussed initially, stakeholders are identified, the LL way of working is agreed upon, and commitment to the process is expressed by all involved.

- Aug/Sept 2024: initial conversations with stakeholders/potential partners about their interest and level of involvement ;
- 30 October 2024: kick-off meeting with core partners, setting common goals and agreements for the project, co-defining activities/initiatives by stakeholders, and defining the frequency and form of interactions amongst stakeholders;
- Making a plan for data collection, measurement and documentation;
- Setting up a common online working environment to share and collaborate on documents;
- December 2024: LL project-plan is finished.

November 2024 – April 2025: Planning and co-creation phase, where ideas about addressing the topic are gathered and discussed, other perspectives are invited, the knowledge needed is identified and brought in.

- 21 January 2025: second meeting with all partners, refining the working groups formed in the first meeting, defining an action plan for the multiple groups;
- Several stakeholder/working-group meetings and preparatory activities for 1st public symposium;
- 15 April: Symposium for a broad public and WUR community.

April – June 2025: Co-creation phase where specific actions are decided upon and stakeholders agree and commit to implement them.

- Partners implement testing of methods within their own educational context;
- Data collection around testing of methods/educational interventions;
- Several stakeholder/working-group meetings;
- Production of materials to be tested (TBD): i.e. educational materials, principles and methods of NiE, teaching manual.

April 2025 – June 2026: Monitoring and evaluation phase, where stakeholders reflect on progress or lack there-off to determine whether and how actions need to be adjusted (overlapping with the preceding phase).

- Several community of practice meetings to discuss and evaluate methods and improve their application.

April – September 2026: Refinement and dissemination phase, where all involved celebrate successes and capture the lessons learnt, and improve the product or solution for further use.

- Refining of materials (TBD): i.e. educational materials, principles and methods of NiE, teaching manual;
- 2nd Symposium for a broad public.

8.7 Community involvement

8.7.1 Community involvement in at different levels

We will have community involvement on four levels, corresponding to the four main activities within the LL (Figure 8.3). Since the main space of experimentation within the LL is primarily the micro-community of the Wageningen University, we define the community members as all those that participate or benefit from the various activities organized, namely: (teaching) staff and students. Corresponding to the 4 main activities, these are:

1. (teaching) staff of Wageningen University that participate in the teacher training in Nature-inclusive Teaching.
    - Through teaser sessions and inspirational talks we will invite a growing participation of staff in the course.
2. Teaching staff and students that participate in the Community of Practice (CoP) to experiment and evaluate Nature-inclusive teaching methods.
    - We will put out a WUR-wide invitation to join the Community of Practice;
    - There will be a WUR-wide open intranet page for the CoP;
    - Students will be reached through the teaching staff and their interventions. Special care needs to be taken in gathering student perspectives/feedback on the various interventions.

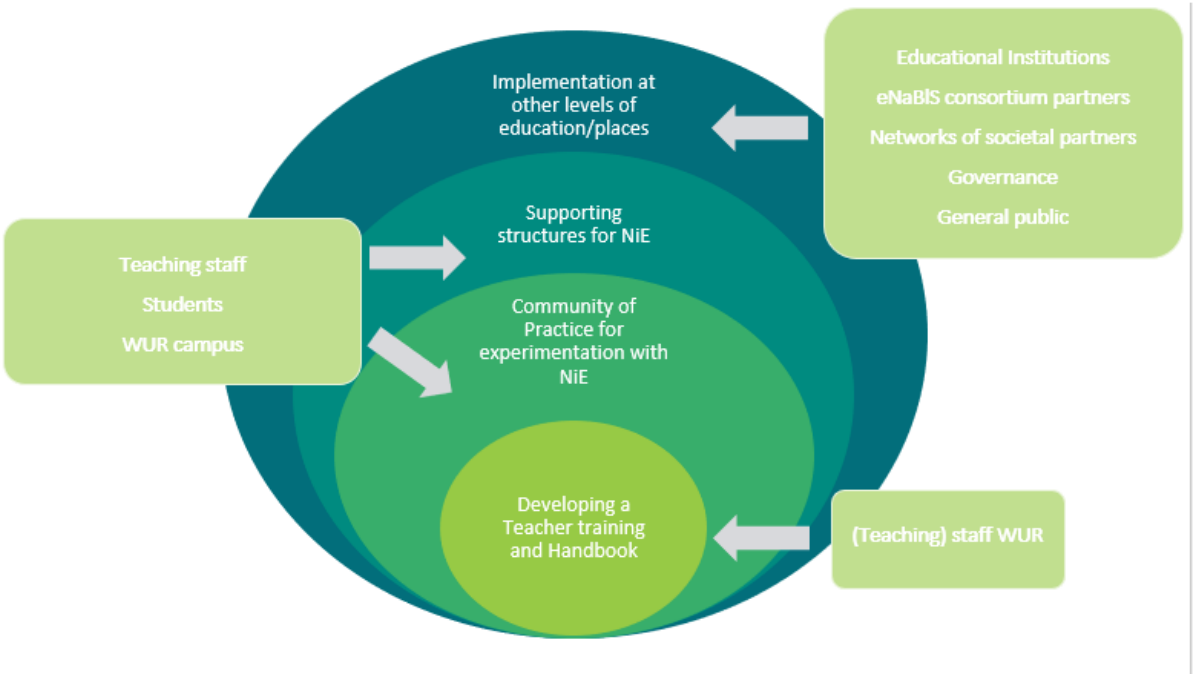

Figure 8.3: Levels of action and stakeholder involvement in the NiE Living Lab

1. Staff and students involved in, or reached by the various working groups (including some partners from outside WUR).
    - The working groups will be defined during the stakeholder process. See section 5.1 for the initial list of proposed working groups established in stakeholder meeting 1.
    - Special care will be taken to involve/reach students in the various working groups. A specific idea mentioned is to commission an Academic Consultancy Training (ACT) project, in which a group of students gets the chance to work on a LL related topic for 8 weeks.

2. Stakeholders outside the WUR: other educational institutions including TVET schools, ENABLS consortium partners, dissemination through our societal partners, governance, and general public.
    - Several activities will allow us to reach this part of the community: Symposia on Nature-inclusive Teaching for a broad public, publishing of the teacher manual, close collaboration with schools interested in setting up a teacher training, and other public events (form to be decided following the stakeholder process and interests).

The level of involvement of these community-members is covered in section 3 (partners), since the community is closely related to the activities of the partners. The community covers a wide array of disciplines and backgrounds needed, pedagogical science and skills teachers that will help us define educational principles and methods, educational staff eager to apply and evaluate these methods giving us a rich learning environment, and students that will help us define the particular learning demand and help us report on the actual learning benefits of these methods. A potential pitfall is that we will not get enough students involved. We will actively reach out to student organizations, and include the topic of student involvement in the upcoming stakeholder meetings.

Main beneficiaries of the LL are teaching staff at WUR. They will benefit from the guidance and support given through the teacher training and/or in the Community of Practice. Students will also benefit through all the initiatives of teachers, they will be exposed to a richer, nature-inclusive learning environment. Teachers and educators outside the WUR will have a secondary benefit through the dissemination of insights and teaching methods.

There are several boundary-crossing themes that will be addressed during this LL. We are aware that several topics that will be addressed are viewed differently by actors with differing social and cultural backgrounds. We will make sure to make space for any (need for) reflection that this may result in. We are also interested in any potential social issues that may pop up during the process, since defining those is part of the definition of teaching principles that we are looking for. So we see this as part of our learning process in the LL.

8.8 Process design

8.8.1 Roles and responsibilities in the Living Lab

LL ownership: Wageningen Education and Learning Sciences is the host of this LL. The project team consists of 5 people.

LL coordinators: Louise van der Stok and Lian Kasper will coordinate the LL. This includes the writing of this project plan, taking the initiative to bring stakeholders together, managing the main communications, facilitating and overseeing the planning and implementation phases, gathering input and insights, and playing a key role in the evaluation and dissemination of the outcomes.

Inspiration and organizational support: Mieke de Wit, Arjen Wals and Valentina Tassone

The LL is organized in 4 layers as depicted below. In each of the layers, the ENABLS team plays a leading role in facilitating activities and communication. In each of the layers, other partners and stakeholders play a role that fits their position and competences. The activities in the lab have been formulated and development in collaboration with the partners. Each partner can contribute time, expertise, network, tools and in some cases money for specific activities.

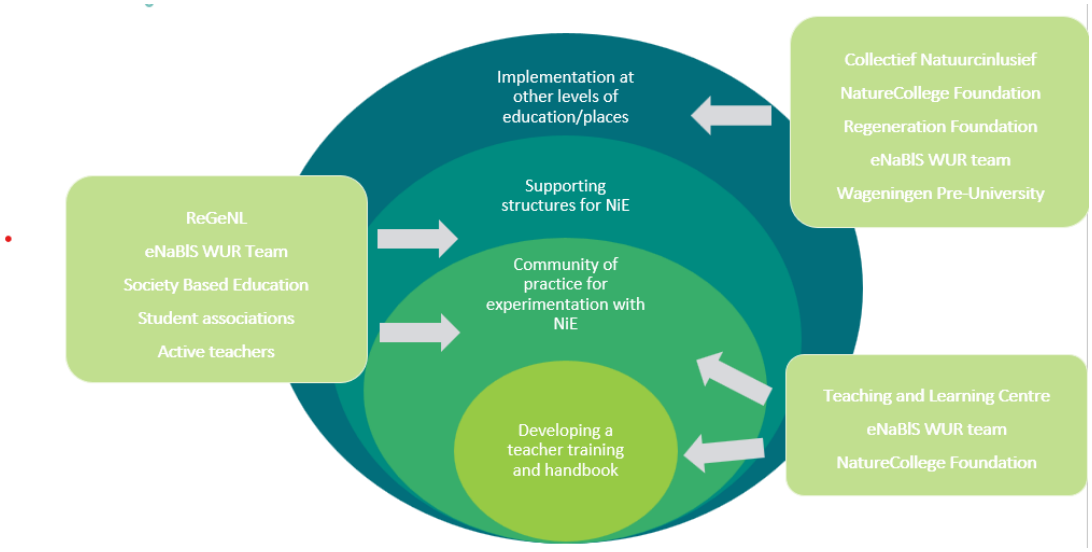

Figure 8.4: Levels of action and partner involvement in the NiE Living Lab.

The eNaBLS team is taking responsibility for developing a ***Teacher Training*** with the Teaching and Learning Centre at WUR. In this task the responsibilities are equally shared. The eNaBLS team takes a leading role in developing a ***Handbook.*** The Teaching and Learning Centre plays a supportive role. Other stakeholders will still be invited to provide feedback on the handbook.

The ***Community of Practice*** around NiE will be organized with the eNaBLS team in the leading role, with strong support of the Teaching and Learning Center. ReGeNL can contribute financially to support this as well as fund university staff in key positions to support this initiative and other ***Supportive Structures.*** Staff from the Society Based Education department will play a supportive role in the community of practice and in the supportive structures, through the action groups. Student associations and teachers will actively participate in the action groups (supportive structures) and community of practice, by leading particular groups, experimenting with methods and evaluating.

The activity of ***Implementation at other levels of education or other places*** is mostly supported by the governmental and societal partners. There is a close collaboration with Wageningen Pre-University which works on NiE at high school level. The eNaBLS Wur team does not play a leading role in this activity, but collaborates with these networks and organizations to create win-wins.

8.8.2 Process structure

Starting from January 2025, there will be bi-monthly LL meetings with representatives from all activities. In these sessions, steps taken and feedback will be gathered on progress. Together with relevant stakeholders, steps ahead will be formulated and planned.

Each activity will also organize their own meetings at a pace suitable to stakeholders and activities. The eNaBLS team will participate in core action groups and activities, according to capacity. Every action group will be asked to make minutes from meetings, so everyone can openly see the progress.

In May/June 2025, the first period of the LL process will be evaluated with the partners. In this meeting, adaptations of the overall working structure will be discussed and planned for the period sept-dec 2025. After this period, a progress meeting will be organized again, to make adaptations for the next period to come, and so forth.

8.9 The role of education in the Living Lab

In this LL, the central goal to generate more attention for NBS in higher education is addressed through developing pedagogical approaches, curriculum and supportive structures for Nature-inclusive Education to support Nature-Based Thinking across curricula and levels of education. Our LL takes

place in an educational setting, therefore the link to education is rather straightforward. However, there are particular planned activities to involve students in researching and exploring the aims of this project.

During the teacher training and within the community of practice for teachers, several pilot projects will be executed in existing courses and programs. This will involve the students directly in nature-based learning settings. We will ask teachers to gather input from students on (the effect of) these pilots.

We will directly approach students (i.e. through students associations), inviting them to be a part of the LL working groups. In the first session, we had two student participants and we have meetings planned with student associations and organizations to increase and structure participation.

WUR has an Academic Consultancy Training course (ACT) in which students work on a real-life project for 8 weeks in transdisciplinary groups. Withing the LL, several cases can be offered for such an ACT project. One of the ideas is to research the need for and perspectives on NiE among students and staff at WUR. Another idea is to ask an ACT group to link nature-based methods to particular fields of study, for example BioEngeneering, Land & Water Management, Urban Planning or International Development Studies. One such project is planned to start in March 2025.

At WUR, there is also an honours program, which talented students can join during the 2nd and 3rd year of their Bsc. During these years, they work on a project. We are setting up a project on nature-based learning for the students starting in September 2025. There are also several existing courses on educational design that could contribute to the LL through course assignments. Opportunities are being explored here too.

Students will also play a role in the LL through thesis and internship projects. Two students will start their Msc. internship within the LL starting from January 2025, looking at new curriculum design and supporting activities in the LL.

Through the Society Based Education department, there is an effort to connect courses actively to societal projects working on NBS or nature-based approaches.

8.10 Reflexive monitoring, data management and reporting.

We will reflect and monitor (the effects of) this LL on the four activities defined, as described below. As this LL takes a rather fundamental approach, we will be monitoring mostly on the changing attitudes towards NBS through the encouragement and application of Nature-Based Thinking.

8.10.1 Monitoring Approach

1. Development and piloting of modules within the Teacher Training in Nature-inclusive Teaching.
    a) Evaluation forms will be used, mainly evaluating shifts in attitude in the participating teachers, both personal and towards their teaching practice. A baseline questionnaire will be sent out at the beginning of the training, and follow-up questionnaires after each educational module to asses effectiveness of the training and educational material. Based on this, improvement and re-design of the teacher training takes place.
    b) Monitoring of eventual application of teaching methods in courses: keeping track of number of educational interventions applied.
2. Creation of a diverse Community of Practice (CoP) with initiatives that mutually enhance and inspire each other.
    a) Shared evaluation of nature-based teaching methods: exchange of findings and insights through creative stakeholder sessions.

b) Gathering and organizing input from different education settings following these sessions, potentially with one-on-one follow-up conversations with stakeholders

c) Monitoring of uptake of NiE/NBT in curricula: keeping score of the (number and quality of) actual educational interventions done by stakeholders during the duration of the LL. This includes tracking the number of students reached, and their feedback on the learning experiences.

3. Organization in several working groups based on the Whole School Approach (WSA), in collaboration with the ReGeNL initiative.

   a) Recurrent meetings with working groups in which progress of the working groups is shared. Including a half-yearly shared evaluation of working groups, potentially re-aligning goals and strategies.

   b) Evaluating barriers and opportunities towards the application of Natur-Based Teaching. The working groups work on an institutional level, so organizing a stakeholder session would be an ideal way to get insights on barriers and opportunities

4. Dissemination of findings – implementation beyond WUR.

   a) Monitoring changing awareness and understanding of Nature-Based Thinking and Nature-Based Education among educational institutions, students, teachers and local governance/organization during and following the main public events we will organize

   b) Stakeholder participation: keeping track of attendance numbers of all events organized in this LL, including type of attendee and potential outreach we can accomplish through this attendance

   c) Monitoring of any uptake of Nature-Based Teaching that we contribute towards during this LL, in other educational institutions. And/or any change in attitude in local or national policy towards education.

8.10.2 Data Management

Data will be gathered through digital questionnaires, notes of stakeholder sessions and one-on-one conversations, and event attendance logs. Data will be securely stored in a centralized, encrypted digital platform accessible to LL partners. Sensitive data will be anonymized to protect participant privacy, in compliance with data protection regulations. Qualitative data from interviews and stakeholder sessions will be analyzed to identify recurring themes and insights.

8.10.3 Reporting

Reports will be compiled according to the eNaBLS GA. Customized reports for key stakeholders, including educational institutions, government agencies, and community organizations, could summarize relevant findings, share insights on NBT integration, and offer practical recommendations. At the end of the project, a comprehensive impact report will be produced (WP4), summarizing overall findings, key outcomes, and recommendations for sustaining NBS integration beyond the LL's timeframe and area.

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9 Conclusions

Nature Based Solutions are inherently context-dependent, and their meaningful design and implementation requires a deep understanding of the NBS concepts, awareness of the local environment and stakeholder needs, and a systems approach. The seven eNaBLS LLs presented here provide a set of seven unique case studies for NBS learning embedded in the local context. Each of the LLs will have local impact through raising awareness and acceptance of NBS, hands-on experience of implementation of NBS and promoting a systems approach and nature-based thinking. Simultaneously undergoing the LL approach with flexibility to make adjustments also creates great opportunity for mutual learning between the eNaBLS LLs and partners. And finally, the many different factors between the LLs, while all focusing on the same goal of integrating NBS in education, will make for interesting comparison between the LLs. This will allow for the identification of common success factors and barriers, as well as skills and competencies that need to be developed in students and professionals, for NBS mainstreaming.

Next steps and roll-out of eNaBLS Living Labs

At this stage, most partners are in the process of introducing their partners and stakeholders to the concept of NBS in relation to the local context. As the LLs develop in the next few months, relationships and understanding will grow, and focus will shift from understanding the concept of NBS to zooming in on more practical application of a certain (type of) NBS in the local context. As the LL activities further develop, the LL partners will be able to feed their local experiences and findings to 3s for the development of two TVET modules on NBS and a teacher training guide under T2.3. Vice versa, TVET partners involved in de LLs will be able to provide feedback on the course materials that are being developed by 3s Through this joint process, the materials created by 3s will be grounded in real-life case studies.

Under T3.2, the WUR team will continue to support eNaBLS partners in the further development of the LLs, guiding them through the different stages as outlined in the LL Operational Framework (D2.1). The Operational Framework will also be further updated to provide further guidance on some of the specificities of the eNaBLS LLs. In 2025, monthly WP3 meetings are planned. Depending on the partners' needs, these will be used for progress updates, discussion, helpdesk, information and experience sharing, expert presentations to deepen knowledge and understanding on certain aspects of the LL. The buddy system appears to be a time-efficient way to ensure mutual learning between LLs. The composition of the buddy groups may be changed as LLs enter different phases and new differences, similarities or issues may occur in the seven LLs. Inter-LL learning is one of the key assets of the eNaBLS project.

As mentioned above, the seven LLs have different starting points and will go through the different LL stages at their own pace. Each LL defines its own goals (in alignment with the eNaBLS project aims), with a unique set of qualitative (and quantitative if appropriate) indicators to monitor progress. From January 2025, monitoring of the seven LLs will be initiated by the UHOH team under T3.3. This will be done in close collaboration with WUR for meaningful monitoring of LLs, and with CERTH to align with the overall eNaBLS impact monitoring and assessment developed under T4.1. Continues LL monitoring in T3.3 will allow the LL partners to follow each other's progress and learn from valuable insights, and will be instrumental for evaluation of the LLs at the beginning of P2. This evaluation will provide an opportunity to revise the plans presented here and to adjust the planned processes and activities as insights may have developed in new directions. Importantly, this will be a moment for each LL to reflect on the stakeholders involved, and to look for opportunities to further expand the LL partners and stakeholders to representatives from the quintuple helix).

While each of the LLs is busy setting up with their partners and stakeholders, WP3 task leaders will convene in January 2025 to discuss learning between all partners and stakeholders of the LLs through upscaling and networking activities in T3.4. The aim of this task led by FOCUS is two-fold. Firstly, it is

aimed at sharing and exchanging information and experiences between all those involved in the LLs. To this end, activities that interest a plurality of stakeholders with similar interests from several LLs will be designed. Secondly, T3.4 aims to disseminate the findings and outcomes to a wider public to facilitate broader adoption of the eNaBLS LL insights as they unfold. As a first step, webpages for each of the LLs are being set up as part of the eNaBLS website in both English and the LL's native language.

Given the 'living' nature of LLs, each LL will keep the flexibility to follow the path that generates most resonance and impact among their partners and stakeholders, learning what works best in the local context along the way. Together, the eNaBLS LLs form a great set of case studies on promoting NBS and linking it to higher education. Through within and inter-LL learning, important lessons for acceptance and implementation of NBS among various stakeholders and contexts will be learned.

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