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RESTORE OUR OCEAN & WATERS

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Catalogue of services supporting innovation

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Table of Contents

Abbreviations and Acronyms

ADRM: Association of Danube River Municipalities

AI: Artificial Intelligence

BOKU: University of Natural Resources and Life Sciences, Vienna

CCSS: Czech Centre for Science and Society

EUSDR: The EU Strategy for the Danube Region

FAO: Food and Agriculture Organization

IGB Berlin: The Leibniz Institute of Freshwater Ecology and Inland Fisheries

IPBES: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

IUCN: International Union for the Conservation of Nature

NBS: Nature-Based Solution

NGO: Non-Governmental Organization

RBO: River Basin Organization

UN: United Nations

WWF: Worldwide Fund for Nature

WRI: World Resources Institute

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List of Tables

List of Figures

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Introduction

The EU Missions: a new wave of innovation is sweeping through the European Union

EU Missions have been established by the European Commission as a new way to **bring concrete solutions to some of our greatest challenges**. They aim at tackling the problem at EU scale, and at delivering impact through:

- A new role for research and innovation (R&I);
- A portfolio of actions;
- New forms of governance & collaboration;
- Citizens' participation.

Five Missions have been established focusing on different topics (e.g. adaptation to climate change, cancer, soil); the EcoDaLLi project is part of the **EU Mission "Restore our Ocean and Waters by 2030"**. Within this Mission, the **Lighthouses** are sites to test, demonstrate, and deploy the Mission activities across EU seas and river basins, try out new ideas, and involve local businesses and people in the process. Four Mission Lighthouses have been established: the Atlantic-Artic Lighthouse, the Baltic Lighthouse, the Mediterranean Lighthouse and, of course, the **Danube Lighthouse, where the EcoDaLLi project belongs**.

The EcoDaLLi project: fostering innovation in the Danube basin and its Delta

The objective of the **Danube Lighthouse** is to **protect and restore the Danube River & Black Sea Basins ecosystems and biodiversity**. Similarly to the other Lighthouses, it is structured as shown in Figure 1 below: **six Innovation Actions (IA)** are exploring and implementing new solutions on the ground, whereas **EcoDaLLi, as a Coordination and Support Action**, collects experiences conducted in the IAs and establishes the conditions for a long-lasting spread and implementation of innovative solutions.

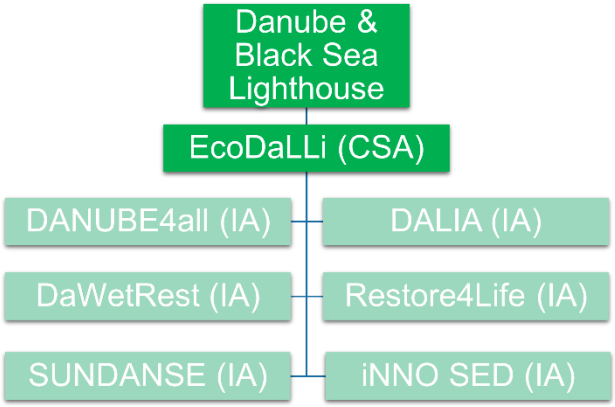

Figure 1 Projects and structure of the Danube Lighthouse

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In other words, EcoDaLLi will help achieve freshwater targets of the European Green Deal, integrating the systemic approach for restoration, protection and preservation for the entire Danube Basin provided by IAs.

Within the EU Mission to restore our ocean and waters, innovation is thus given a major role in the achievement of the Mission's objectives and is at the heart of the EcoDaLLi project. In fact, its main objective is to **centralise Danube governance structures in terms of innovative solutions for improved ecological restoration, protection and preservation of the Danube basin and its Delta by fostering a stronger innovation ecosystem** within a well-connected Living Lab System, supported by a digital Portal, completely linked to the Mission Implementation Platform.

In turn, **fostering a stronger innovation ecosystem** is the objective of Work Package 5 (WP5), which includes three Tasks:

- Task 5.1: Inventory of the **services supporting the transfer of innovation**
- Task 5.2: Setting up of trainings to **strengthen the capacity of the relevant stakeholders**
- Task 5.3: **Paving the way to upscaling** of innovation in the Danube basin

WP5 started in January 2024 (month 12 of the project) and will run until the end of the project (month 42), according to the time schedule presented in Figure 2 below.

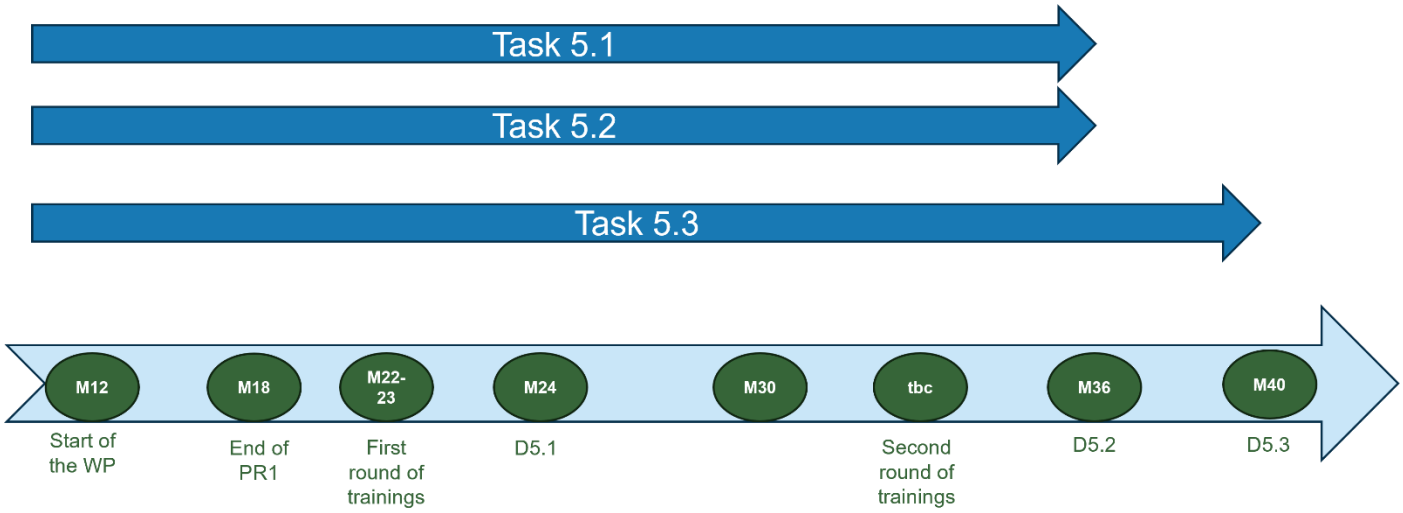

Figure 2 Time schedule of Work Package 5

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Contents of this deliverable and methodology

The focus of this deliverable: supporting the transfer of innovation in the Danube basin and its Delta

This deliverable (D5.1) presents the outcomes of the activities conducted in the first year of Task 5.1, and focuses on the following aspects:

(i) **Setting the scene: key concepts and definitions**. What do we mean by innovation and innovation ecosystems? Chapter 2 of this deliverable provides definitions of the key concepts in the realm of innovation, as a basis for building a common understanding. This was done through a literature review.

(ii) **Innovation in Ecosystem Restoration**: Innovation in ecosystem restoration is not limited to technological advancements but also includes social innovation and improvements in institutions and governance structures. Identifying the types of innovation that can occur is fundamental for this task. The objectives of chapter 3 are to:

   a. Identify the types of innovation in ecosystem restoration practices.

   b. Collect examples of these innovations, focusing on the Danube region.

   This was done through a literature review and interviews with key experts and stakeholders.

(iii) **Mapping the Innovation Ecosystem for Environmental Restoration in the Danube Basin:** Ecosystem restoration communities and innovation communities often do not interact, which is likely true for the Danube region. Creating bridges between these communities is a key objective to be pursued. The objectives of chapter 4 are to:

   a. Map the components of the ecosystem restoration and innovation communities in the Danube.

   b. Identify key components for developing an innovation ecosystem for environmental restoration (actors, resources, enabling environment).

   This was done through a literature review, information collection from existing EcoDaLLi deliverables (e.g., D3.2), and interviews with key experts and stakeholders. In addition, this chapter also provides some insights from an online questionnaire developed as part of Task 5.2: the objective of the questionnaire was to scope the needs for trainings, but it also included some questions assessing the extent to which stakeholders in the Danube are familiar with innovations in ecosystem restoration, which was considered an interesting topic for this chapter.

(iv) **Inventory of Innovation Support Services:** Building on the previous steps, this objective focuses on developing a catalogue of mechanisms and services that support innovation. The objectives are to:

   a. Develop a catalogue of available services (methods, tools, software) and service providers.

   b. Support innovation developers in the Danube region by making this catalogue available on the EcoDaLLi portal (in collaboration with WP6; finalization is ongoing at the moment of drafting this deliverable).

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The catalogue was filled through literature review, web searches, and expert and stakeholder interviews. This was achieved through a literature review, information collection from existing EcoDaLLi deliverables (e.g., D3.2), and interviews with key experts and stakeholders. **The Catalogue of Services Supporting Innovation was developed in Access format; a beta version is now available on the EcoDaLLi Portal:** **https://portal.ecodalli.eu/wp5** (although some functions still need to be added).

(v) **Lessons learnt,** and final considerations on the results presented in this report.

Task 5.1 activities in 2025 will focus on developing a **Toolbox for Supporting Innovation in Environmental Restoration in the Danube Basin,** aiming to provide practical resources to stakeholders in the Danube region. The objectives will be to:

a. Develop a guidebook to support innovation, including methodologies and guidance on business models, ex-ante impact assessment, market studies, and organizing matchmaking events.

b. Promote the guidebook and good practices at various events.

Methodological focus: interviews with key stakeholders and the survey

Interviews were carried out with Danube experts and stakeholders working in two domains:

- General innovation; and
- Ecosystem restoration.

As mentioned above, these interviews were aimed at collecting information relevant to multiple steps of Task 5.1, and in particular:

- Understanding innovation in ecosystem restoration;
- Mapping the innovation ecosystem for environmental restoration in the Danube Basin; and
- Inventorying existing and available innovation support services in the region.

Two interview guidance documents were developed for the two categories of stakeholders, including some general questions (the same for both categories) and specific questions on the work domain. The two lists of questions are provided in Annex I (general innovation) and Annex II (ecosystem restoration).

The choice of these two categories of interviewees is based on the fact that WP5 specifically aims at bridging these two worlds, which are getting increasingly connected thanks in particular to the Mission Ocean initiative.

The list of interviewees is provided in the table below:

Table 1 List of Danube stakeholders in the domains of general innovation and ecosystem restoration interviewed as part of Task 5.1

Type of interview	Interviewee	Organization
General innovation	Gabrielle Weigelhofer	University of Natural Resources and Life Sciences, Vienna (BOKU)
	Jiri Kvapil	Czech Centre for Science and Society (CCSS)

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	Ivan Hristov	ADRM (Association of Danube River Municipalities)
	Paul Goriup	The Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB Berlin)
	Carmen Hawkins	The EU Strategy for the Danube Region (EUSDR) Priority Area 8
	Helia Kovacevic	The EU Strategy for the Danube Region (EUSDR) Priority Area 8
Innovation in ecosystem restoration	Katharina Lenz Cristina Cuc	The EU Strategy for the Danube Region (EUSDR)
	Stoyan Mihov	World Wide Fund for Nature (WWF) Bulgaria
	Ana Kobašlić Florian Ballnus	The EU Strategy for the Danube Region (EUSDR) Priority Area 6

Moreover, this deliverable also presents some results of a questionnaire distributed to Mission Ocean participants and stakeholders as part of Task 5.2. This survey was aimed at understanding stakeholders' training needs in the region with respect to innovation in ecosystem restoration, and it did so by enquiring their familiarity with this concept. The list of questions included in the questionnaire is provided in Annex III.

Setting the scene: key concepts and definitions

Innovation, Innovation Ecosystems and Innovation Support Services

Innovation is defined as the implementation of new or significantly improved products (goods or services) or processes (Pénide et al., 2013). The rapid growth in innovative solutions, ideas, and businesses has led governments worldwide to adopt new policies and regulations. Objectives of such initiatives include:

- Implementing regulations to organize the work of new innovations and innovators.
- Creating an innovation environment that fosters growth in different industries and, ultimately, the economy.

The second point is closely linked to the notion of ecosystem. In the science of ecology, the term ecosystem refers to the complex web of relationships among living resources, habitats, and residents of an area, aiming to maintain an equilibrium among these components, where energy exchanges occur between different living organisms. An **innovation ecosystem** (IE) can thus be defined as the **network of actors, activities, and artifacts including technological and non-technological resources, products and services, and the collaboration and competition relations among them, which are crucial for fostering innovative performance**; the behaviour of actors within the ecosystem can be governed by different types of institutions (Granstrand and Holgersson, 2020)[1]. It is a dynamic and interconnected network that revolves around the interactions between its components, working together to either enable or impede innovation (Hoffecker, 2019)[2].

Innovation support services (ISS), in turn, **encompass a broad range of tools and services designed to assist stakeholders** – such as innovators, companies, and organizations – in developing and implementing new concepts and solutions. These services are offered by both public entities (e.g. government agencies, public research organizations) and private actors (e.g. private universities, consulting firms) to foster innovation across diverse sectors (Mathé et aL, 2022)[3]. **The primary objective of the ISS is to foster connections among the diverse actors within the innovation ecosystem**.

Based on these definitions, Figure 3 provides a graphical representation of an innovation ecosystem.

[1] Granstrand O., Holgersson M. (2020) Innovation ecosystems: A conceptual review and a new definition. Technovation, pp. 90 – 91. https://doi.org/10.1016/j.technovation.2019.102098

[2] Hoffecker E. (2019) Understanding Innovation Ecosystems: A framework for Joint Analysis and Action. MIT D-Lab.

[3] Mathé S., Hensel G., Sonfac M., Ludovic T., Ndjana J., Sadeu M. (2022) New Challenges for Innovation Support Services to Improve Cocoa Quality and Sustainability in Cameroon. ISTE Open Science – Published by ISTE Ltd. London, UK. https://www.openscience.fr/IMG/pdf/iste_std23v3n1_2.pdf

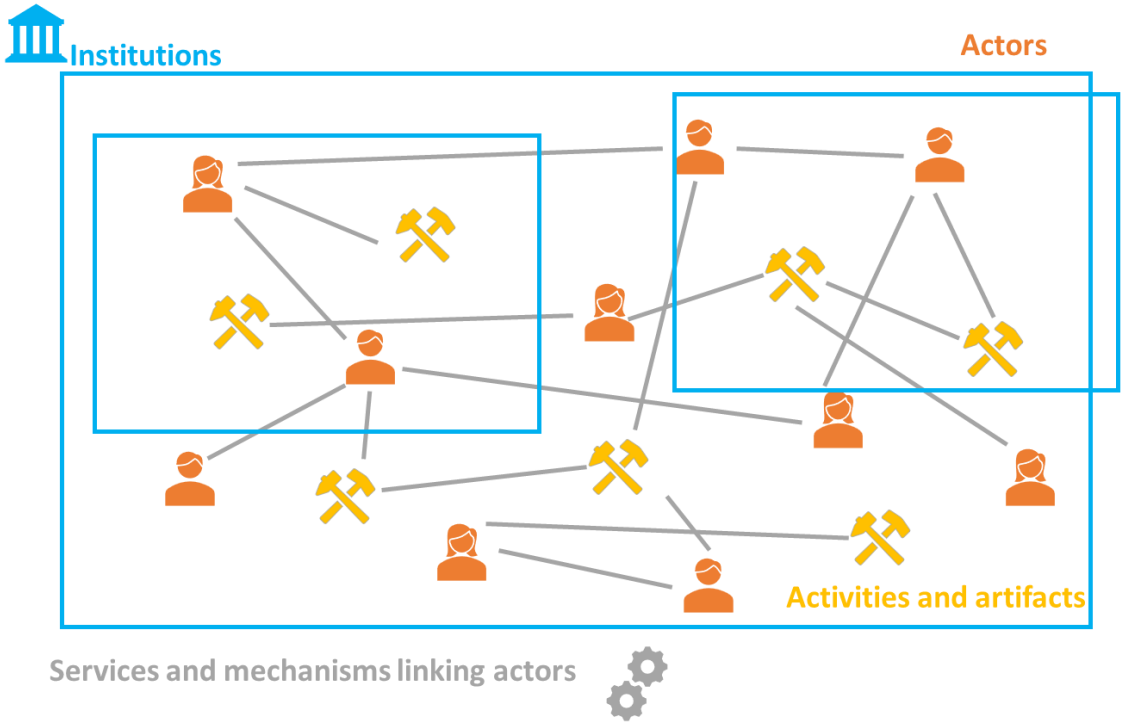

Figure 3 Illustration of an innovation ecosystem, including services and mechanisms, which create linkages among the different elements of the ecosystem (Source: own elaboration)

How to build an Innovation Ecosystem?

Three main pillars allow constructing an IE (see Figure 4): Actors, Enabling Environment, and the existing Resources.

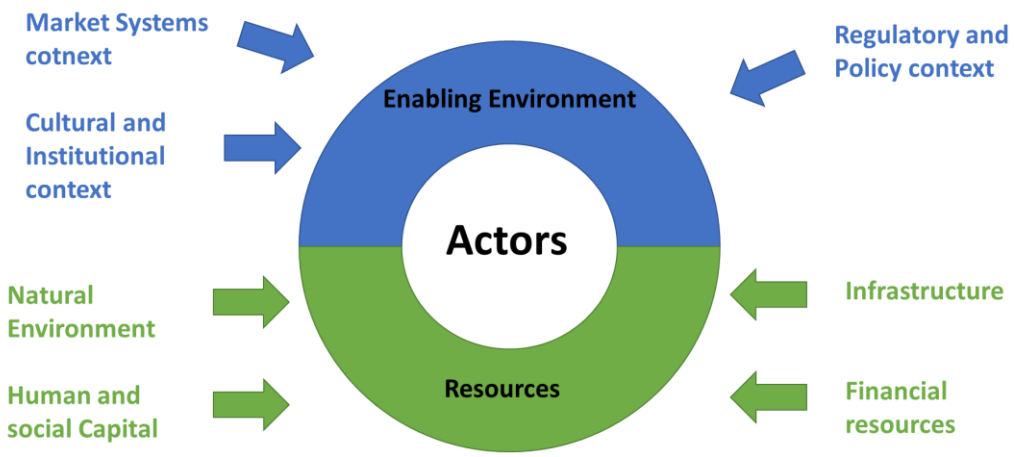

Figure 4 Innovation Ecosystem Structure (Source: own elaboration)

The **actors** are at the centre of an IE and represent entrepreneurs, individuals, researchers, and other innovators that are responsible for generating, developing, and bringing new ideas to the market. The role of actors is very important and is not limited to creating new technologies. They can participate in the ecosystem in various roles, such as:

- **Collaboration and exchange of information and knowledge among each other**. Actors from different sectors and organizations collaborate to share resources and expertise in different fields leading to emergence of new ideas and accelerating innovation. Also, it may involve providing training to acquire new skills and adapt to emerging technologies. In fact, the innovation process necessitates actors possessing specific skills (e.g. computer skills, leadership skills, language skills, etc.). Consequently, through collaboration and the exchange of information and knowledge, actors can gain the benefits of skill development.
- **Provide funding to develop innovation**. This is an important role of actors. In an innovation ecosystem, different actors (e.g. banks, private investors, public institutions, etc) offer a diverse range of funding. The presence of such actors ensures the innovators and encourages the development of new ideas and risk taking.
- **Identify and develop new technologies, ideas, systems, and processes** within a specific context.

The **resources** are the inputs required to support the innovation process, and include:

- **Natural environment:** both in terms of natural heritage and distinctive features, as well as natural capital and ecological resources – which can be either abundant or scarce. The natural environment can pose both opportunities and challenges to innovation, for example in terms of raw materials that can be locally used and transformed through the innovation process, or locally relevant constraints.
- **Human and social capital**: knowledge, skills and capacities that enable people to innovate or support innovation. It also includes the trust and social norms that exist within a group or a social network.
- **Infrastructure**: networks, systems and facilities (e.g. laboratories, incubators, roads, electric grids, internet networks, etc.) that are necessary for innovation. For instance, infrastructure can be related to the presence of good internet networks allowing developers of an application or a website to correctly perform their job and/or to research and communicate with external partners. Another example can be related to the presence of incubators allowing innovators and start-ups to be present in one place where exchange of information and new ideas can happen daily.
- **Financial resources**: funding and financial products that are available to innovators to support their innovation process and the diffusion of innovation through different channels. Financial resources can take the form of different financial products such as loans, crowd funding, grants, etc. Easy access to financial resources encourages innovators and entrepreneurs to take risks and develop new products and services.

The **enabling environment** is made of all the aspects that contribute to facilitating or inhabiting the innovation process, and namely:

- **Regulatory and policy context:** laws, regulations and policies that exist in a given location, as well as the manner and extent to which they are enforced. For example, policies in place to protect intellectual property can enhance innovation and encourage

collaboration between the different actors. Other regulatory and policy examples can be related to tax deduction or financial incentives for startups. For instance, the French government support innovation and startups through supportive loans (up to 500 000 EUR) for investing in innovation[4].

- **Market system context:** economic systems in place that facilitate (or hinder) collaboration between public and private actors, as well as the distribution, and consumption of goods and services. The market system context is highly connected to the regulatory and policy context in place. For instance, regulation encouraging low trade barriers will encourage collaboration with local and international actors to develop products that can fit the international market. Also, low market entry barriers can encourage foreign investment in national and local startups.
- **Cultural and institutional context:** cultural beliefs, values, and customs, as well as formal and informal rules, standards, norms, and shared habits that produce predictable routines of behaviour and interaction. Culture that values collaboration, and risk taking is important to boost and encourage creation of new ideas.

The role of the three pillars is very important in the innovation ecosystem, and is complementary, this means no single factor, alone, can contribute alone to the development of an IE, together with ISS: these mechanisms and services, in fact, facilitate connections among different actors and components within the innovation ecosystem.

Types of innovation potentially occurring in ecosystem restoration practices

Innovation in Ecosystem Restoration

The IUCN defines “ecosystem restoration” as the process of reversing the degradation of ecosystems to regain their ecological functionality, and to improve their productivity and capacity to meet the needs of society[5]. Traditionally, ecosystem restoration aims at repairing or reversing the damage inflicted upon ecosystems due to various human activities, natural disasters, or environmental degradation. This typically involves interventions such as reforestation, habitat rehabilitation, wetland restoration, and soil remediation[6]. The ultimate goal is to establish self-sustaining ecosystems that can thrive without continuous human intervention.

However, despite numerous ongoing restoration efforts, **current actions may not be sufficient to address today's pressing environmental challenges**. Global biodiversity continues to decline at an alarming rate[7] [8], ecosystems are being degraded or lost at unprecedented scales[9], and climate change effects are exacerbating ecological damage. Additionally, the increasing frequency and severity of extreme weather events highlight the urgent need for more robust and innovative restoration approaches.

Consequently, different types of innovation have been implemented in the field of ecosystem restoration. These innovations can be categorized as follows:

1. **Technological Innovation[10]:** This includes new materials, equipment, and techniques that enhance monitoring, assessment, and implementation efforts. Examples[11] include remote sensing technologies, aerial drones for data collection and seeding, and high-resolution imagery for landscape analysis. Innovative practices, such as Nature-Based Solutions (NBS) also fall within this category.
2. **Economic and financial innovation**: New processes related to spending, funding and financial instruments, including innovative financing mechanisms (e.g. involving the private sector) for the implementation of NBS.
3. **Governance Structure and Policy Innovation[12]**: Innovative governance structures can lead to better coordination and management of restoration projects, fostering collaboration among stakeholders. Development and implementation of new policies and regulations can support ecosystem restoration by providing clear guidelines and incentives for best practices[13].

[5] https://www.iucn.org/our-work/topic/ecosystem-restoration
[6] https://www.science.org/doi/10.1126/science.aaa4216
[7] https://www.cbd.int/gbo5
[8] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673
[9] https://livingplanet.panda.org/
[10] https://smart-structures.com/technology-and-nature-innovations-shaping-the-future-of-ecosystem-recovery/
[11] Zhen, L., Ishwaran, N., Luo, Q., Wei, Y., Zhang, Q., (2020). Role and significance of restoration technologies for vulnerable ecosystems in building an ecological civilization in China. *Environmental Development*, volume 34 https://doi.org/10.1016/j.envdev.2020.100494.
[12] Armitage, Derek & Berkes, Fikret & Doubleday, Nancy. (2007). Adaptive co-management: Collaboration, learning and multi-level governance.
[13] Phaninee Naruetharadhol, Aisling ConwayLenihan, Helen McGuirk, Assessing the role of public policy in fostering global eco-innovation, Journal of Open Innovation: Technology, Market, and Complexity (2024), doi: https://doi.org/10.1016/j.joitmc.2024.100294

4. **Social Engagement Innovations**[14]: Engaging local communities and stakeholders in restoration activities can enhance the effectiveness and sustainability of restoration efforts.

Based on the review of EcoDaLLi Deliverable D3.2, literature review and online research, examples of all types of innovation in ecosystem restoration practices have been identified, and the full list of innovation included in D3.2 is provided in Annex IV of this document. In this section, each type of innovation is elaborated upon, with specific examples and related projects provided in text boxes. These examples encompass initiatives occurring both within the Danube region and worldwide.

Technological innovation

Tools for data collection.

Remote sensing technologies, such as satellite imagery and aerial drones[15], offer valuable tools for monitoring and assessing ecosystem conditions over large spatial scales. Drones equipped with high-resolution cameras and sensors can capture detailed imagery of landscapes, allowing for the identification of ecological features, habitat types, and land use changes. This data can inform restoration planning and prioritize areas for intervention based on ecological need. Besides, Drones equipped with seed-dispensing mechanisms can accurately distribute seeds over vast landscapes, accelerating the reforestation process and improving tree establishment rates.

In the Danube region, two projects under the Danube Transnational Program[16] (the Danube Sediment[17] and GRENDEL[18] projects) have successfully implemented innovative technologies in their ecosystem restoration initiatives; as an example, the Danube Sediment project is described in the box below, whereas the list and description of all innovative ecosystem restoration projects is provided in Annex V, as inventoried in D3.2.

Danube Sediment – Danube Transnational Programme 2014-2020

Types of interventions: Collection of sediment transport data in the Danube River and tributaries and production of a Danube-wide sediment balance.

Drafting of the Danube Sediment Guidance: recommendations for reducing the impact of a disturbed sediment balance (feeding into the Danube River Management Plan and the Danube Flood Risk Management Plan).

Innovative aspects: Broad participatory process. The project was successful in bringing various experts from different European countries together to discuss these river-relevant topics. As a result, the first detailed study on sediment transport in the Danube was developed. The specifics of the project subject require close transboundary cooperation and expert exchange.

Beyond the Danube region, other parts of the world have also adopted innovative tools for ecosystem restoration. A notable example is Tana River County in Kenya, described in the Box below.

[14] Dai, H., Zhu, Z., Trachung, B., Golog, D., Riley, M., Lü, Z., & Li, L. (2024). Communities in ecosystem restoration: The role of inclusive values and local elites' narrative innovations. People and Nature, 6, 1655–1667. https://doi.org/10.1002/pan3.10675
[15] https://news.mongabay.com/2023/07/new-tree-tech-cutting-edge-drones-give-reforestation-a-helping-hand/
[16] https://dtp.interreg-danube.eu/
[17] https://interreg-danube.eu/projects/danubesediment-q2
[18] https://dtp.interreg-danube.eu/approved-projects/grendel

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Restoring Ecosystems in Kenya's Tana River County: Using Drones for Sustainable Land Management and Climate Resilience

In response to land degradation and climate change impacts in Tana River County, Kenya, World Vision Kenya[19] aims to manage sustainably the ecosystem and restore livelihoods in nine villages by using drones in 2021[20].

The project involves reseeding hotspot areas with indigenous trees, covering 250 acres per village, to manage ecosystems and mitigate climate change effects. To expedite this process, DJI P4 drones are used to conduct a mapping exercise that result in nine high-resolution ortho maps covering 2,250 acres. These maps are then analysed to determine vegetative indices, leaf coverage, and vegetation chlorophyll content/sensitivity using VARI and TGI indices, aiding stakeholders in decision-making for action planning. Then it involves aerial seeding to drop biochar seed balls in hotspot areas, expediting reseeding and reducing labor costs. Finally, the same areas are mapped again to validate the restoration efforts.

Artificial Intelligence (AI).

AI-driven algorithms and machine learning techniques are increasingly being applied to analyze large datasets that are generated from remote sensing. These AI models can automate the interpretation of complex environmental data, identify patterns, and predict ecosystem dynamics. By processing vast amounts of information quickly and accurately, AI technologies can assist restoration practitioners in making informed decisions and optimizing resource allocation. An example of this is the AZ Forest[21] initiative, described in the Box below.

AZ Forest - A Global AI-Driven Reforestation Initiative for 200 million Trees by 2030

AZ Forest is a global initiative with the goal of planting and nurturing 200 million trees across six continents by 2030, in collaboration with landscape restoration experts. The project leverages an advanced AI deep learning model to analyze drone footage and satellite imagery, enabling the monitoring of tree growth and health. Additionally, it quantifies levels of carbon sequestration to assess the environmental impact of the reforestation efforts.

Biomimicry

Biomimicry involves studying and drawing inspiration from biological systems, processes, and structures to solve human challenges. In ecosystem restoration, it seeks to imitate nature's design to develop innovative technologies that are more sustainable and resilient. For example, Airplanes, submarines, and turbine blades could benefit from adopting a more stable and agile design inspired by the bumps found on humpback whales' flippers. Examples of biomimicry in the Danube region are provided in the Box below.

Biomimicry experiences in the Danube region

In the Danube region, biomimicry has been applied to create specialized fish-friendly hydroelectric turbines. Developed in collaboration with engineering firms, fisheries experts, and environmental organizations, these turbines feature modified blade designs and intake structures that reduce fish mortality and improve safe passage for aquatic species.

Another notable example of biomimicry is the restoration of the Johler Arm[22], a side channel of the Danube. In 2018, the riverbank of the Johler Arm was threatened by erosion, putting the Hollitzer alley and the underlying wastewater pipes at risk. Instead of relying on

[19] https://www.wvi.org/kenya
[20] https://blog.flyinglabs.org/2021/07/07/drones-are-helping-large-scale-reforestation-efforts-in-kenya-2/
[21] https://www.astrazeneca.com/sustainability/environmental-protection/az-forest.html
[22] https://www.viadonau.org/en/newsroom/news/detail/oekologische-ufersicherung-am-johler-arm

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traditional hard stone structures, bioengineering techniques were employed to provide a near-natural alternative. This innovative construction method, the first of its kind along the Danube, mimicked natural riverbank features while simultaneously creating habitats for fish, offering opportunities for retreat and spawning.

Nature-Based Solutions (NBS).

NBS include all sustainable management types and approaches that use natural features and processes to address socio-environmental challenges. The IUCN defines NBS as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"[23]. NBS are incereasingly being implemented in the Danube region, and the Box below provides a couple of examples.

NBS for floodplain restoration in the Danube region

A case study in 2009 for floodplain restoration along the lower Danube has shown promising benefits of a restoration project[24]. In addition, Perosa et al. in 2021 has provided the monetized valuation of NBS of floodplain restoration in the Danube catchment along the Krka, Morava, and Danube[25].

One example of NBS in the Danube region is the restoration initiative along the Danube River east of Vienna[26]. The goal is to enhance lateral river-floodplain connectivity and restore the floodplain ecosystem's functionality, aiming to achieve good ecological and navigation status. This initiative is part of the EU Horizon2020 project MERLIN, which promotes ecological restoration of freshwater-related ecosystems. The actions include riverbed widening, recycling of removed riprap, and an integrative and adaptive approach to restoration. The restoration is expected to impact around 10.8 hectares of floodplain area, benefiting ecosystem functioning, biodiversity, and flood management.

Several other NBS-based restoration projects exist in the Danube region, such as Austria's largest renaturation initiative, the LIFE+ Traisen project[27], as well as the IDES project[28] under the Danube Transnational Programme, and the NetworkNature initiative[29]. Further details on these projects are provided in Annex 4.

Economic and financial innovation

Financing mechanisms for ecosystem restoration are the most common type of economic and financial innovation; these involve novel approaches to funding and investment for projects with environmental benefits. These mechanisms are designed to mobilize private capital and leverage public funding to ensure sustainable financing for restoration activities.

Hungary's Green Bonds Drive Environmental Restoration Efforts in the Mosoni-Danube River

Green bonds are financial instruments designed to raise funds for projects with environmental benefits. They have gained popularity in recent years as a means of attracting

[23] https://portals.iucn.org/library/node/46191
[24] https://www.tandfonline.com/doi/abs/10.3763/cdev.2009.0022
[25] Perosa F, Gelhaus M, Zwirglmaier V, Arias-Rodriguez LF, Zingraff-Hamed A, Cyffka B, Disse M. Integrated Valuation of Nature-Based Solutions Using TESSA: Three Floodplain Restoration Studies in the Danube Catchment. Sustainability. 2021; 13(3):1482. https://doi.org/10.3390/su13031482
[26] https://networknature.eu/casestudy/28683
[27] https://www.life-traisen.at/en
[28] https://dtp.interreg-danube.eu/approved-projects/ides
[29] https://networknature.eu/

socially responsible investors. The integrated green bond report of Hungary 2021[30] offers detailed insights into the utilization of Hungary's Green Bonds Proceeds, demonstrating their role in advancing the country's environmental objectives and goals. One of its financed projects is the water level rehabilitation of the Mosoni-Danube.

Due to both natural processes and human interventions, the Mosoni-Danube's natural state has undergone significant changes over time, including the drying up of tributaries, reduction in wetland areas, and a decline in ecological diversity. To address these challenges, a weir/floodgate has been constructed at the mouth of the Mosoni-Danube to regulate water levels and restore the river's ecosystem. The projects primary objectives are to enhance water quality, mitigate river fluctuations, restore the natural ecosystem of the Szigetköz region, and protect human settlements and infrastructure from flood damage. The project, primarily funded by Green Bond proceeds, receives 54.5% of its financing from this source.

Governance structures and policy innovation

Innovative partnerships

Innovations in **governance structures** aim at fostering cross-sectoral collaboration and aligning diverse interests. It mainly involves the development of new partnerships and networks among stakeholders.

Various organizations possess diverse resources and expertise. When their interests intersect, forming partnerships can facilitate decision-making processes and enhance effectiveness. For instance, collaboration among government agencies, NGOs, private companies, and local communities can effectively tackle ecosystem restoration challenges. Establishing accessible communication exchange platforms can foster information sharing among key stakeholders. For instance, online forums and workshops provide avenues for collaboration among individuals from diverse regions and with varying specializations.

One specific example of such collaboration in the Danube region is the TID(Y)UP project[31], which is part of the Danube Transnational Programme. It is illustrated in the Box below.

The TID(Y)UP project

This project focuses on improving water quality and reducing plastic pollution in the Tisza River, one of Europe's most polluted rivers, while also examining the impacts of plastic pollution on the Danube and the Black Sea.

The TID(Y)UP project involves partners from multiple sectors who develop and implement a set of integrated actions to address the issue. These include providing tools and consulting with relevant stakeholders and fostering long-term transboundary and cross-sectoral cooperation. The goal is to establish a robust system for monitoring and eliminating plastic pollution in the region. Through this collaborative approach, the project exemplifies how partnerships can enhance the scope and impact of environmental restoration efforts.

Innovative policies and regulations

The development of new regulatory frameworks could stimulate investment and promote long-term sustainability in ecosystem restoration. One famous example is the Payment for Ecosystem Services (PES). Increasingly established around the world in the last few years,

[30] https://akk.hu/download?path=631eea18-a51a-4084-866a-fbcee27e3625.pdf
[31] https://dtp.interreg-danube.eu/approved-projects/tid-y-up

PES programs offer financial incentives in exchange for ecosystem conservation. The Box below presents and example from the US.

Bipartisan Infrastructure Law - $1.4 Billion Investment in Ecosystem Restoration and Resilience Efforts Across the U.S.

The Bipartisan Infrastructure Law, also known as Infrastructure Investment and Jobs Act, was enacted in the United States in 2021 with the objective of providing resources toward the restoration of America's natural infrastructure [32]. This legislation includes a funding allocation of $1.4 billion specifically designated for ecosystem restoration and resilience efforts. Under this budgetary provision, the Department of the Interior[33] will engage in collaborative efforts with states, tribes, and local communities to enhance habitat connectivity for aquatic species nationwide. Additionally, it aims to promote habitat restoration, control invasive species, and conserve at-risk and listed species.

Social innovation

Innovations in **social engagement** focus on promoting community engagement and education to empower local stakeholders and cultivate ownership of restoration initiatives. Innovative approaches, such as participatory decision-making processes and environmental education programs, can mobilize public support, and enhance the resilience of restoration projects. In particular:

- Community Participation involves engaging local communities in restoration decision-making, planning, and implementation can improve project sustainability. Schulze[34] has identified four major mechanisms of public participation (informing, consultation, program planning and decision-making) by analyzing five international River Basin Organizations (RBOs).

1. Education: Implementing training programs could not only raise public awareness about the importance of ecosystem restoration but also equip stakeholders with the knowledge and skills needed for effective participation.

An example form the Danube region is provided in the Box below:

Horizon project Connecting Nature

Within the Danube region, the Horizon project Connecting Nature[35] proposes the establishment of an urban garden at a state-run Children's Home in Sarajevo, situated adjacent to a Centre for Healthy Ageing. This initiative aims to foster connections between citizens and nature, while also educating and engaging the community in enhancing urban biodiversity and promoting responsible consumption practices.

By involving residents in the gardening process, the project seeks to cultivate a sense of stewardship towards the environment and encourage sustainable habits within the community. Similar initiatives can be found in other projects throughout the Danube region. For example, the Horizon CLEVER Cities project[36] plans to develop a linear park on the site of a former railway track that was previously used for the transportation of hazardous waste[37]. The goal of this project is to implement co-creation and participatory processes,

[32] https://www.fws.gov/library/collections/bipartisan-infrastructure-law-ecosystem-restoration-program
[33] https://www.doi.gov/priorities/investing-americas-infrastructure/ecosystem-restoration
[34] Schulze, S. (2012). Public Participation in the Governance of Transboundary Water Resources – Mechanisms provided by River Basin Organizations. L'Europe en Formation, 365, 49-68. https://doi.org/10.3917/eufor.365.0049
[35] https://connectingnature.eu/
[36] https://clevercities.eu/
[37] https://clevercities.eu/news/?c=search&uid=1ygvGdna

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leveraging the creativity of the local community to transform the space into a vibrant and sustainable urban environment.

Engagement activities can also be developed at a much larger scale: the UN Decade on Ecosystem Restoration[38] (launched in 2021), for example, aims to prevent, halt and reverse the degradation of ecosystems on every continent and in every ocean. The program's objective is to raise public awareness and garner support for restoration initiatives through campaigns, workshops, and educational materials.

[38] https://www.decadeonrestoration.org/

The actors: ecosystem restoration and innovation communities

The Danube River basin spans across multiple countries in Central and Southeastern Europe. Various countries have joined forces in collaborative efforts to preserve and restore the ecosystem services within the river. Consequently, several actors are involved in **Innovative Actions for ecosystem restoration**.

The **Danube Region's innovation communities are vibrant networks of stakeholders**, including businesses, academics, legislators, investors, and members of civil society, working collaboratively to drive innovation and economic growth. These communities **operate across multiple scales** – European, regional, national, and local – addressing diverse fields such as technology, energy, agriculture, and environmental sustainability. They serve as hubs for information exchange, resource sharing, and creative problem solving, crucial for tackling local and global challenges. These communities can be distinguished between **actors working on innovation in general, and actors working on innovation for ecosystem restoration**.

Concerning the first type of actors, there exist **various platforms that facilitate collaboration and innovation at European scale**, such as:

- The European Commission supports research and innovation through platforms like the **European Cluster Collaboration Platform (ECCP)** that serves as a platform for cluster organizations, businesses, and other stakeholders to collaborate and exchange knowledge, expertise, and best practices. Clusters play a crucial role in driving innovation, competitiveness, and economic growth by bringing together companies, research institutions, and other actors within specific industries or sectors. The ECCP supports cluster organizations in accessing funding opportunities, identifying potential partners for collaboration, and participating in European and international cluster initiatives.

- The **European Strategy for the Danube Region (EUSDR)** that connects researchers, entrepreneurs, and innovators through initiatives such as the **Danube Innovation Partnership (DIP) and the Danube Strategy Point (DSP)**. The DIP promotes innovation capacity in the region, while the DSP coordinates efforts related to the EUSDR's goals.

Several initiatives also exist on **national and local levels**, such as:

- The **Danube Cup network** comprises nine international universities situated along the Danube River in five countries, including the Budapest University of Technology and Economics, Corvinus University of Budapest, University of Belgrade, Johannes Kepler University Linz, University of Passau, Regensburg University of Applied Sciences, University of Regensburg, and Vienna University of Economics and Business. This collaborative network seeks to unite entrepreneurs from these diverse academic institutions, fostering the exchange of innovative ideas and promoting healthy competition among participants.

- The **Water Innovation Lab (WIL)** is an immersive leadership development program tailored to address water-related challenges specific to the Danube River basin region.

Funded by the European Union

Similar to other Water Innovation Labs, Danube WIL brings together young professionals, researchers, policymakers, and entrepreneurs from countries along the Danube River to collaborate on innovative solutions for water management, conservation, and sustainability. Danube WIL programs include a combination of workshops, training sessions, field visits, and project development activities, all focused on fostering cross-sectoral collaboration, developing leadership skills, and promoting creative problem-solving in the context of water issues within the Danube region. Participants engage in discussions on topics such as water governance, ecosystem conservation, pollution prevention, and climate change adaptation, while also exploring opportunities for technological innovation and community engagement. The programme includes several partners, notably the Media Education Center (MEC), and Our Future First's Nasa Gora initiative that collaborated on a new youth entrepreneurship project in the field of water that combines the strengths of each organization and creates new opportunities in the Danube River Basin.

- The **Danube Tech Valley Initative (DTVI) by Globsec** seeks to enhance the innovation capacity within the Danube region. Its primary goal is to strengthen competitiveness and stimulate growth in comparison to other regions of Europe and the world. This is achieved through fostering synergies, aligning existing initiatives, and facilitating grassroots cross-border interactions and collaboration among a diverse range of stakeholders in the Danube region. The DTVI aims to accelerate the innovation potential of the region. For that reason, it has put in place the Danube Innovation Tracker that provides information on all the startups, universities, funding organizations and investors and accelerators that entrepreuners/innovators can access for information.

Within this broad innovation ecosystem, specific efforts focusing on **ecosystem restoration** exist. These efforts are divided between actors at different scales, for instance:

- **The European Union Strategy for the Danube Region (EUSDR)** plays a critical role by coordinating cross-border initiatives to address environmental sustainability, water quality, and biodiversity. It supports projects related to ecosystem restoration and fosters knowledge exchange among stakeholders.

- **The International Commission for the Protection of the Danube River (ICPDR[39])** contributes by formulating policies and collaborative initiatives aimed at reducing pollution and protecting river ecosystems across the Danube basin.

- **National governments, research institutions, and NGOs** are pivotal at various levels. For instance:
  - **International Association for Danube (IAD)**,the oldest NGO of an active network of scientists in the Danube River Basin. The main activities of the association include dialogue with stakeholders, promoting nature conservation, and emphasizing the role of aquatic biodiversity for ecosystem functionality. The IAD collaborates with national authorities, the ICPDR and the EUSDR to provide scientific inputs and enhance policy dialogue.
  - The **Danube Delta National Institute for Research and Development (DDNI)**, focusing on research related to the Danube Delta. Their work includes biodiversity studies, water quality assessments, and habitat restoration efforts.

[39] https://www.icpdr.org/about-icpdr/framework/about-us

- **WWF Bulgaria**, notably through the WWF **Danube Carpathian Programme**, a regional initiative aimed at conserving the unique biodiversity and ecosystems of the Danube River and Carpathian Mountains. The programme aims on protecting wildlife, promoting sustainable land and water management practices and advocating for policy changes to ensure the long-term health and resilience of these ecosystems.

The interviews carried out with the different stakeholders revealed the same level of information at the different scales as mentioned in the research. The following illustration Figure 5 summarizes the different types of actors that exist in the Danube Region and are involved in innovative actions for ecosystem restoration.

Figure 5 Actors for innovative actions in ecosystem restoration (Source: own elaboration)

Moreover, the literature review did not provide detailed insights into the mechanisms of interaction and information sharing among the various actors involved in ecosystem restoration. This information was clarified through interviews with different stakeholders, which uncovered two primary modes of interaction:

- **European Collaborative Research Projects**: Interaction among actors frequently occurs through participation in major European research initiatives such as Horizon Europe, Interreg, and Life programmes. These projects serve as platforms for collaborative research and development, where stakeholders from various sectors and countries come together to work on joint projects, share expertise, and exchange valuable insights related to ecosystem restoration and sustainability.
- **Coordination through ICPDR and EUSDR**: Another key interaction mechanism is facilitated by the ICPDR and the EUSDR. These organizations convene stakeholders from different levels and sectors, creating opportunities for comprehensive information and knowledge exchange. They serve as central hubs where actors can collaborate, share updates, and align their efforts towards common goals in ecosystem restoration and environmental sustainability.

Role of ICPDR in the elaboration of Danube River Basin Management Plan – 2021

The EU Water Framework Directive mandates the development of a single river basin management plan for international river basin districts. In 2000, the International Commission for the Protection of the Danube River (ICPDR) countries, including non-EU member states, committed to implementing this directive throughout the entire Danube basin, with the ICPDR serving as the facilitating platform. Additionally, the ICPDR assumed responsibility for coordinating the implementation of the EU Floods Directive in the Danube basin in 2007.

Since the initial publication of the Danube River Basin Management Plan (DRBMP) in 2009, the ICPDR updates it every six years in accordance with the EU Water Framework Directive. The latest update, the DRBMP Update 2021, outlines priorities for joint water resources management from 2022 to 2027. It includes updated assessments of key pressures on the basin's waters, progress achieved, and joint actions agreed upon by Danube countries.

The DRBMP 2021 Update focuses on five Significant Water Management Issues (SWMI) affecting water status, such as pollution by organic substances, nutrients, and hazardous substances, hydromorphological alterations, and the effects of climate change. Additionally, it addresses other relevant issues like sediment quality management, invasive alien species, and Danube sturgeon conservation.

Coordinated with the Danube Flood Risk Management Plan Update 2021, the DRBMP Update ensures synergy and compliance with environmental objectives outlined in the Water Framework Directive.

Horizon Europe projects to support innovation in the Danube region

The European Union has offered financial assistance for numerous initiatives aimed at fostering regional collaboration among various entities to facilitate ecosystem restoration in the Danube region. For instance, the Horizon Europe program played a role in funding the Danube Region Programme 2021-2027, aimed at creating a smarter, greener, more socially cohesive, and better-coordinated Danube region. This initiative incorporated four priorities and Mission Ocean and Water Objectives, notably focusing on promoting renewable energy, climate change adaptation, and disaster management, enhancing water and sediment management, and conserving biodiversity in ecological corridors and eco-regions. Each project funded under this program involved three partners from the Danube region.

Another notable initiative is the RIS4Danu project, which seeks to facilitate socio-sustainable-technological transition in the Danube region by revitalizing unused industrial sites. This project involves seven partners from various research and consultancy sectors in the Danube region.

As a result, these diverse funding programs enable enhanced cooperation and contribute to achieving the objectives of ecosystem restoration.

The available resources

The reviewed literature revealed insights on the available resources in the Danube Region. In particular Muzikarova et al. (2022)[40] argued that access to appropriate and sufficient finance is vital factor contributing to the productivity and sustainability of the IE.

The development of resilient innovation ecosystems depends on a diverse range of financial institutions that offer various financial products and services. These institutions play a pivotal role in supporting innovative businesses across different developmental stages, ranging from the development of ideas to impactful outcomes, and from startup to scale-up. This diverse spectrum includes accelerators/incubators, angel investor networks, private foundations, impact investors, venture capital firms, private equity firms, crowdfunding platforms, public/semi-public funders, and banks.

Additionally, the authors provided information on different funding sources and organizations operating in the Danube region, including:

1. **The Danube Cross-border Private Equity (PE) Fund:** This fund aims to address the scarcity of growth capital for high-growth tech SMEs in the Danube region. Collaboration with the European Investment Bank (EIB) or the European Investment Fund (EIF) is proposed to structure a dedicated growth equity fund, with a cross-border dimension.
2. **The Danube National Recovery Plan Hub:** This initiative suggests mapping, comparing, and pooling national recovery plans under the EU Recovery and Resilience Facility. The hub aims to achieve common regional goals through a comparative analysis of recovery plans in Central and Eastern Europe, facilitating high-level political discussions and a multi-stakeholder action plan for implementation.
3. **The Danube Region Fintech Sandbox:** This proposal advocates for the establishment of a joint sandbox to test and adapt compliance to regulations for innovative companies in the region. It aims to support the development of new cross-border access channels for businesses and investors.
4. **The Digital Economy Alternative Funding Sources Platform:** Emphasizing the increasing availability of funding for early-stage software/e-commerce projects from digital platforms, this platform includes crowdfunding, peer-to-peer services, blockchain, and tokenization. These sources bridge initial capital needs for innovation and foster community engagement.
5. **The Danube Region "Green & ESG-Thematic Bonds" Support Structure:** This initiative aims to enhance the region's competitiveness by strengthening capital markets through the development and promotion of green and ESG-related bonds. GLOBSEC would track relevant ESG debt issuances to ensure the region stays abreast of the latest developments.
6. **The Danube Capital Markets Single Access Point:** This proposal suggests creating a single access point for the DTV, housing financial information of companies. The initiative aims to increase transparency, comparability, and stimulate investment, including cross-border investment.

[40] Soňa Muzikárová, Gordon Bajnai, Campbell Lutyens, Vazil Hudák, Willi Molterer (2022) : Globsec Danube Tech Valley Initiative (DTVI) Innovation Report : Building an Innovation Ecosystem in the Central and Easter Europe (CEE) Region.

7. **The Danube Primary Education Financial Literacy Initiative:** Focused on improving the financial literacy of Central and Eastern European youth, this initiative proposes institutionalizing financial literacy and basic economics in school curricula. It involves mapping current conditions, devising a common action plan, and presenting policy suggestions to education authorities. The initiative also includes a CEE Financial Literacy Regional Competition for high school students with attractive prizes.

Regarding human capital, it is recognized as the primary and most crucial element driving long-term economic growth (Muzikarova et al., 2022). Human capital encompasses individuals within a region possessing the requisite education and experiences essential for fostering innovation, entrepreneurship, or a combination of both. The cultivation of human capital involves strategic investments in educational infrastructures, such as schools, universities, and research and development institutions. In the Danube region, various initiatives and projects have been initiated to foster human capital development, including:

1. **The Danube "MIT" Campus:** The reinforcement of the Danube innovation ecosystem entails the attraction of globally top-ranked educational institutions, comparable to high standards, to establish a campus in the region. This initiative aims to equip the Danube Valley with indispensable managerial and technical talent by fostering collaborations with research institutes, attracting esteemed educators, and securing capital. The presence of a leading university is envisioned as a catalyst for nurturing innovative ideas and ensuring a consistent supply of talent.

2. **The Danube Region Migration Programme:** Geared towards retaining talent within the EU and addressing the pressing need for skilled individuals in the CEE region, this program serves as a centralized access point for the immigrant workforce to participate in start-ups and scale-ups. Given the context of talent circulation triggered by events such as the conflict in Ukraine, tangible support from CEE governments is pivotal to expedite immigration procedures and work permits for highly educated or specialized migrants.

3. **The GLOBSEC – European Investment Bank (EIB) Advisory Hub:** This comprehensive Advisory Hub seeks to facilitate knowledge transfer regarding capital mobilization, project pitching ("Masterclass on Pitching"), market assessment, and regulatory measures. Under the guidance of the EIB's Vice President, the initiative is poised to contribute to mapping legislatures across the Danube region and supporting innovative ideas with the EIB's expertise in advisory matters.

4. **The GLOBSEC Bottom-Up Hub:** Building on recent GLOBSEC analysis, this proposed hub concentrates on effective bottom-up approaches to human capital generation as a complement to top-down education reform efforts. Serving as a platform, the Hub consolidates existing bottom-up reskilling and training initiatives in the Danube region. Other stakeholders can directly engage, collaborate, or draw inspiration from these initiatives with the aim of rapidly enhancing the workforce's quality by providing market-relevant skills and competencies.

The information above only provides knowledge for innovation in general without going into details for the available resources that exist for innovation in the ecosystem restoration field. In fact, no literature exists on this specific topic.

The lack/gap of information was completed throughout the interviews carried out with targeted stakeholders. The results of the interviewees revealed different resources from which three stand out.

First, the **funding opportunities** that exist for ecosystem restoration. The interviewees revealed that funding exist through three main sources, namely: governmental grants (in the context of EU directives), EU funding – through the different EU funding programmes: Horizon Europe, Interreg, and Life programmes – and private funding. However, it should be noted here that the most significant funding for ecosystem restoration is coming from EU institutions, whereas the governmental and private funding play a less important role (insignificant for the private sector funding).

The interviewees mentioned that the importance of EU funding is very crucial to continue the research and innovation actions activities. This was also mentioned in the UNEP-WCMC, FFI and ELP (2020)[41] report on funding ecosystem restoration in Europe. The report argued that, between 2010 and 2020, various sources of funding committed to 412 marine, freshwater, and terrestrial ecosystem restoration projects. From these sources of fundings international bodies such UNDP and EU institution contributed the greatest, around 646.6 million euros, representing 77% of the overall funding.

However, this report provides data for all EU MS. Looking closely only for the Danube MS region and for ecosystems related to freshwater, the overall funding provided was 182.7 million euros. By applying the same proportion of 77% coming from international institutions, the amount of funding coming from EU institutions would be 140.6 million euros. In fact, looking closely at the data, other international organizations such as UNDP, contributed very little to funding projects in the region. The following illustration (Figure 6) shows the distribution of funding following the proportional distribution provided in the report. The report findings also come in accordance with what was mentioned in the interviews, in particular concerning the private sector funding which corresponds only to 4% of the overall funding (insignificant when compared to the funding coming from EU or the governments).

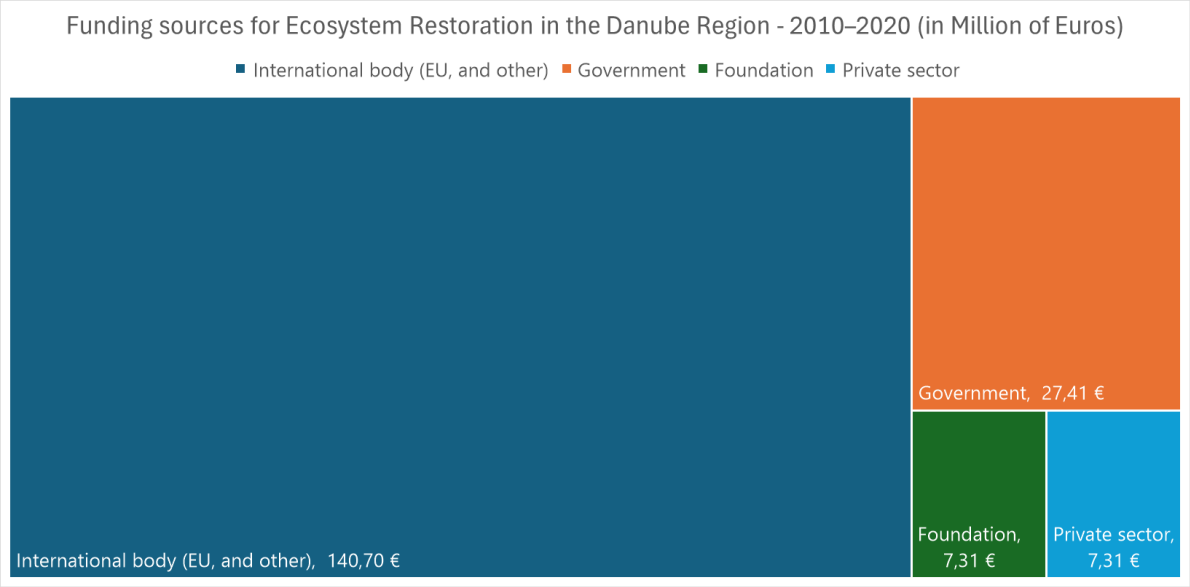

Figure 6 Funding sources for ecosystem restoration in the Danube Region – 2010 - 2020 (Source: own elaboration based on UNEP-WCMC, FFI and ELP, 2020)

The other important resources in the Danube Region are the **existing human resources**, notably the skilled human capital and established/existing infrastructure, both of which are

41

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crucial for successful implementation, restoration, and monitoring of ecosystem restoration projects.

On the one hand, the Danube Region is a region with experienced professionals and experts with specialized knowledge in fields such as ecology, environmental science, and sustainable land management. This skilled workforce includes scientists, researchers, conservationists, and technicians who possess the technical expertise and practical experience needed to execute complex restoration projects. The skilled human resources are essential for designing effective restoration strategies, and applying advanced technologies and methodologies. Furthermore, their local knowledge of the region's ecosystems and environmental challenges enhances the effectiveness of restoration efforts and ensures that projects are tailored to the specific needs of the Danube's diverse habitats.

On the second hand, the region benefits from a **robust network of infrastructure** that supports environmental conservation and restoration activities. This includes research institutions (such as Universities, and other research centres), environmental monitoring facilities, and conservation centres that provide the necessary tools and resources for project implementation. The existing infrastructure plays different roles in the ecosystem restoration. For instance, the research institutions conduct critical studies on local ecosystems contributing to the production of valuable data and insight that inform policy makers on the restoration strategies. The monitoring facilities track the environmental changes and assess the outcomes of restoration efforts, ensuring that the implemented solutions/measures are achieving their intended goals and allowing adaptive management.

The enabling environment

As for the resource's elements, Muzikarova et al. (2022) provided insights on the enabling environment in the Danube region, notably on the markets and regulatory framework in place.

Concerning the markets, the authors outlined that the innovation ecosystems of countries should be systematically developed and shaped to close market gaps. The strategy of the countries should involve areas for innovation efforts, with a forward-looking and ambitious approach. The goal is to promote innovations in areas that may not have achieved mainstream status but could shape the global economy in the future, giving the country a competitive advantage. Noteworthy projects in the Danube region include:

1. **DTV Impact-Interest Analysis:** This project proposes a comprehensive data-based analysis to identify 3-5 industrial verticals where CEE countries can benefit from cooperation rather than competition. Examples include mobility, fin-tech, climate-tech, artificial intelligence, and cross-border collaboration in agriculture. The focus involves developing an implementation roadmap to foster an innovation value chain across the Danube Region.
2. **DTV Ease of Entry Focal Point:** This initiative seeks to create a central point for pooling information, expertise, and practical assistance to facilitate the entry of DTVI firms into EU markets (approximately 500 million people) and US markets (including Silicon Valley affiliates of the DTVI). Priority access is recommended for sales platforms based on DTVI membership.
3. **Investing in Dense, Sustainable, and Functional CEE Physical Infrastructure:** Recognizing the importance of efficient cross-border activities, this project emphasizes extending the physical infrastructure in the region. The infrastructure development aims

to support a range of green transportation, including EV charging infrastructure, exploration of hydrogen alternatives for buses and trucks, and sustainable rail systems.

Enabling innovation in ecosystem restoration in the Danube: the role of EcoDaLLi

Within the Danube region, the Horizon project Connecting Nature[42] proposes the EcoDaLLi facilitates innovators' connections to governance structures through dedicated Living Labs, knowledge co-creation, workshops, a customized digital portal for synergies, and innovation support services. This enables experimentation with new solutions and fostering a circular service ecosystem for a sustainable blue economy within the Danube basin and beyond.

In particular, EcoDaLLi has established four Living Labs across the Danube basin, and in particular:

- **Upper Danube: Danube Innovation ecosystem** – Activities in this Living Lab focus on the development of entrepreneurship in the basin, and on the facilitation of knowledge and technology transfer;
- **Middle Danube: Climate change** – Activities in this Living Lab focus on the protection of local communities and ecosystems from extreme events, and on the development of climate change mitigation measures;
- **Lower Danube: Water Systems** – Activities in this Living Lab focus on the advancement of local economic activities and man-made solutions; and
- **Danube Delta: Biodiversity** – Activities in this Living Lab focus on the conservation and restoration of biodiversity through best practices (from WP3), the facilitation of innovation actions and the deployment of solutions for fisheries.

In relation to the regulatory framework, their influential role in shaping the effectiveness of innovation processes and actors cannot be overstated. In the Danube region, various regulatory initiatives are in place, and these were described in the following studies:

1. **Danube "Ease of Starting a Business" Insight Report, Cross-Border Working Group, and Policy Recommendation:** This study aims to map current bottlenecks hindering business launch, addressing issues such as red tape, costs, and duration. The outcomes will be presented to Ministry of Economy/Finance officials in a roundtable format. The platform will explore opportunities for sharing best practices, streamlining registration procedures, digitalizing the application process, and exchanging information through shared databases.

2. **Fiscal Incentives and Tax Instruments Study with Policy Recommendation:** This study delves into mapping the existing tax regimes of CEE countries. It identifies economically sound and politically acceptable avenues for potential changes. The study particularly focuses on tax deductions and rebates for R&D activities, emphasizing collaboration with universities, technological centres, and qualified R&D personnel.

3. **SWOT Matrix for Regulation of Innovative Labour Market Outcomes and Brain Circulation Ecosystem in CEE:** Addressing the multifaceted and politically sensitive talent challenge from a regulatory perspective, this initiative optimizes migration frameworks to welcome talent from third countries outside the European Union. It also considers labor market regulation and the relaxation of employment protection laws to enhance labor mobility and talent circulation.

[42] https://connectingnature.eu/

4. **Product Markets Deregulation Study with Policy Recommendation:** This study aims to remove regulatory barriers for entry for new innovative start-ups and improve coordination across the region. The analysis focuses on identifying opportunities for loosening regulations to foster innovation.

5. **Brief "Incentivizing Entrepreneurship" through targeted policy:** This initiative analyzes international best practices, such as the Swedish example where employees can take a 6-month break from regular employment to start their own business. The policy recommendations aim to incentivize entrepreneurship in the CEE region, tailored to the specific needs of the area. While not necessarily requiring cross-border harmonization, a collective analysis of the region can help pinpoint effective policy approaches.

Concerning the enabling environment for ecosystem restoration, three factors were identified in the interviews:

1. **Communication and collaboration among stakeholders and EU MS**: the existing communication between the different stakeholders – including governmental bodies, research institutions, NGOs, and private sector actors – is considered to be one of the most important enabling environment factors. Platforms such as the European Union Strategy for the Danube Region (EUSDR), the International Commission for the Protection of the Danube River (ICPDR), and various EU-funded projects play pivotal roles in fostering this collaborative environment.
2. **The Strong Policy Framework, and Regulatory Support**: the existing policy and regulatory framework is also encouraging for the development of innovation in the field of ecosystem restoration.
3. **The existing EU, Governmental, and Private funding**: Funding is a critical enabler of ecosystem restoration efforts, with various sources available to support projects in the Danube Region: EU funding (notably from Horizon Europe, Interreg, and LIFE programmes), governmental grants, and private funding (see section above).

Are EcoDaLLi and Mission Ocean stakeholders familiar with innovation in ecosystem restoration?

So far, this chapter mapped the innovation ecosystem in the Danube region, with a focus on innovation for ecosystem restoration. To complete this overview, it is useful to provide some additional insights on whether, and to what extent, stakeholders in EcoDaLLi and in other Danube Lighthouse projects are familiar with innovation in ecosystem restoration, by presenting the results of a questionnaire distributed as part of task 5.2 – which was originally intended and used to scope stakeholders' training needs.

The questionnaire was distributed to: (i) participants to a Danube4All event in June 2024; and (ii) participants to Danube Lighthouse projects and other stakeholders through the Mission Ocean mailing list. A total of 51 participants responded to the questionnaire.

Respondents work, for the largest part (43%), for academic and research institutions, but also for private companies or businesses organisations (23.5%), NGOs (19.6%) and public authorities (11.8%). This is shown in Figure 7. Their expertise is, for a large part, in the domains of engineering (39.2%) and natural sciences (31.4%); a much smaller share of them are social scientists (9.8%) and economists (5.9%). This is shown in Figure 8.

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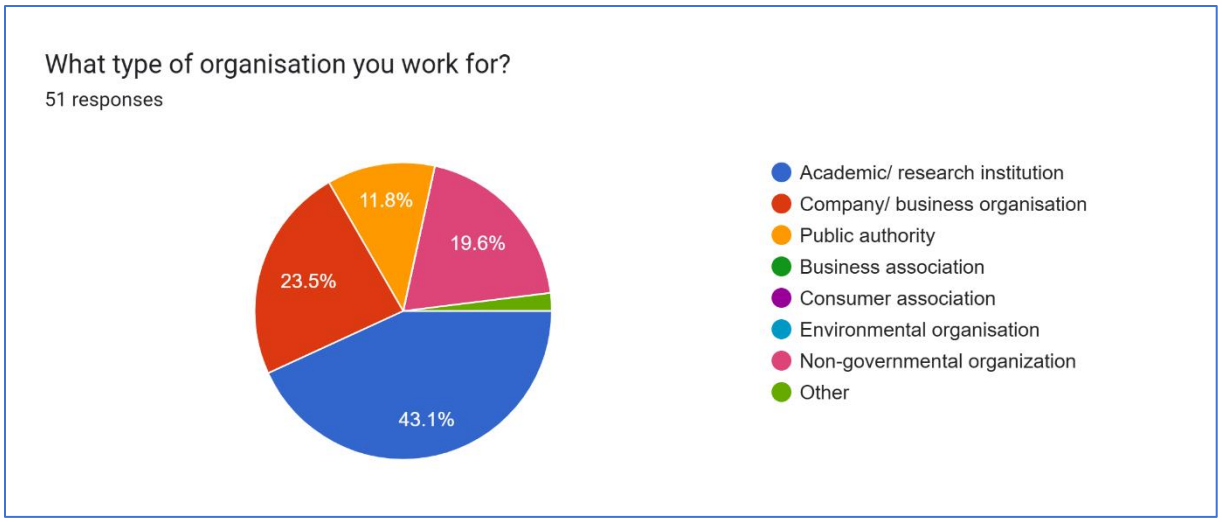

Figure 7 Types organisations respondents to the questionnaire work for

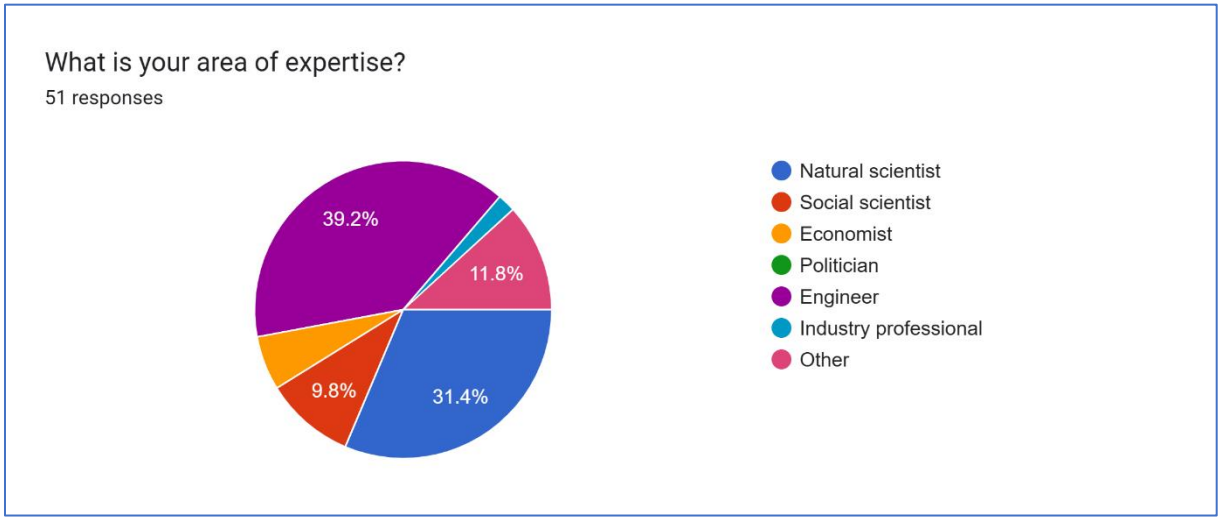

Figure 8 Domains of expertise of respondents to the questionnaire

All of them have come across, in their daily work, with innovation in ecosystem restoration: a large part of them (70.6%) is involved in some projects dealing with innovative restoration practices or other forms of innovation in ecosystem restoration; for some of them (17.6%) innovation in ecosystem restoration is the core of their daily work; a small portion of them (11.8%) have just heard about this concept at recent conferences, through colleagues or in other ways (Figure 9).

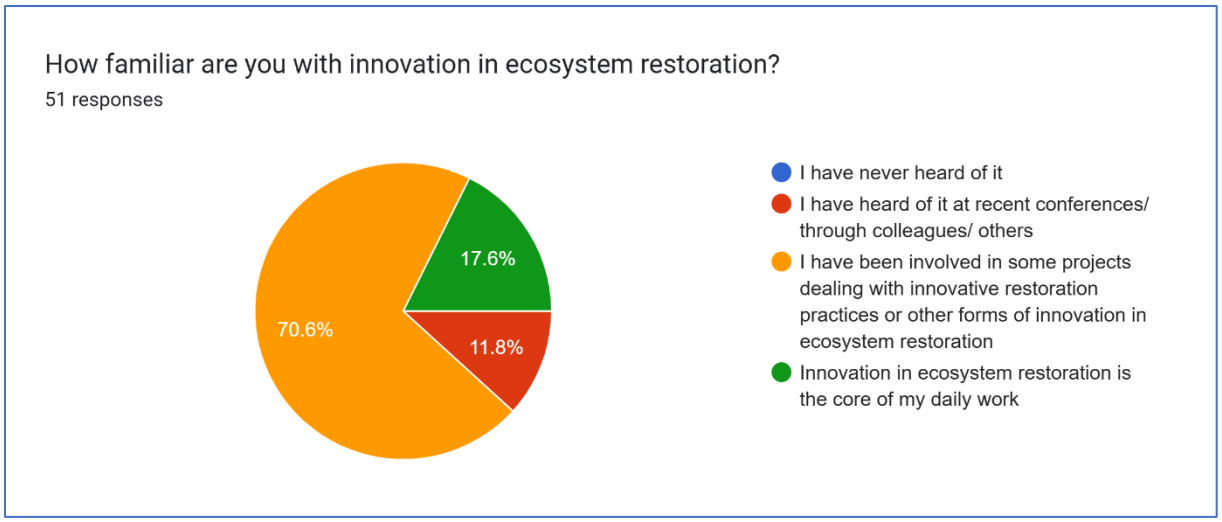

Figure 9 How familiar respondents are with innovation in ecosystem restoration

According to respondents, **all four types of innovation are relevant for ecosystem restoration**, with a preference for technological innovation which is deemed to be relevant by 78.4% of respondents (Figure 10) – which is not surprising, considering that a large share of respondents is either engineers or natural scientists.

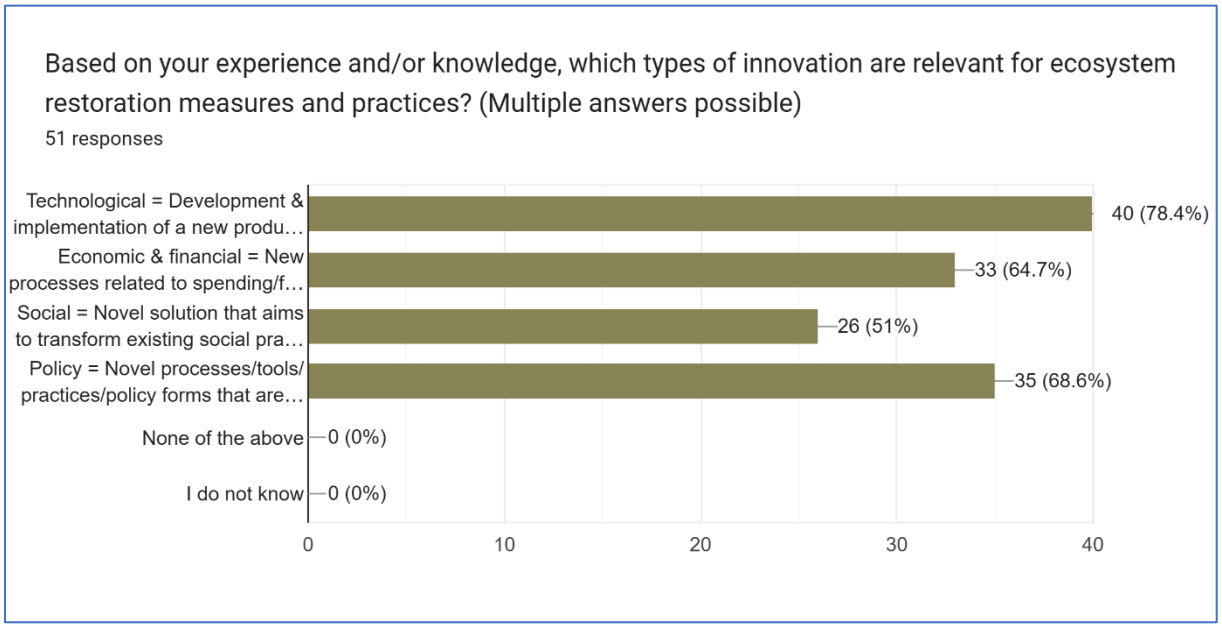

Figure 10 Types of innovation relevant for ecosystem restoration according to respondents

Finally, respondents were asked what the main challenges are towards the spreading of innovation for ecosystem restoration, and were given a series of options that were all deemed relevant (a few respondents also indicated “others”). These options, listed from the most voted to the least voted, are the followings:

1. Lack of knowledge and/or data;
2. Lack of human resources;
3. Lack of training;
4. Lack of required competencies and skills; and Lack of supporting services and mechanisms (e.g. incubators, info points, etc.);

5. Lack of transversal/ multidisciplinary approaches; and
6. Lack of technological infrastructure (hard-/ soft-/ org- ware).

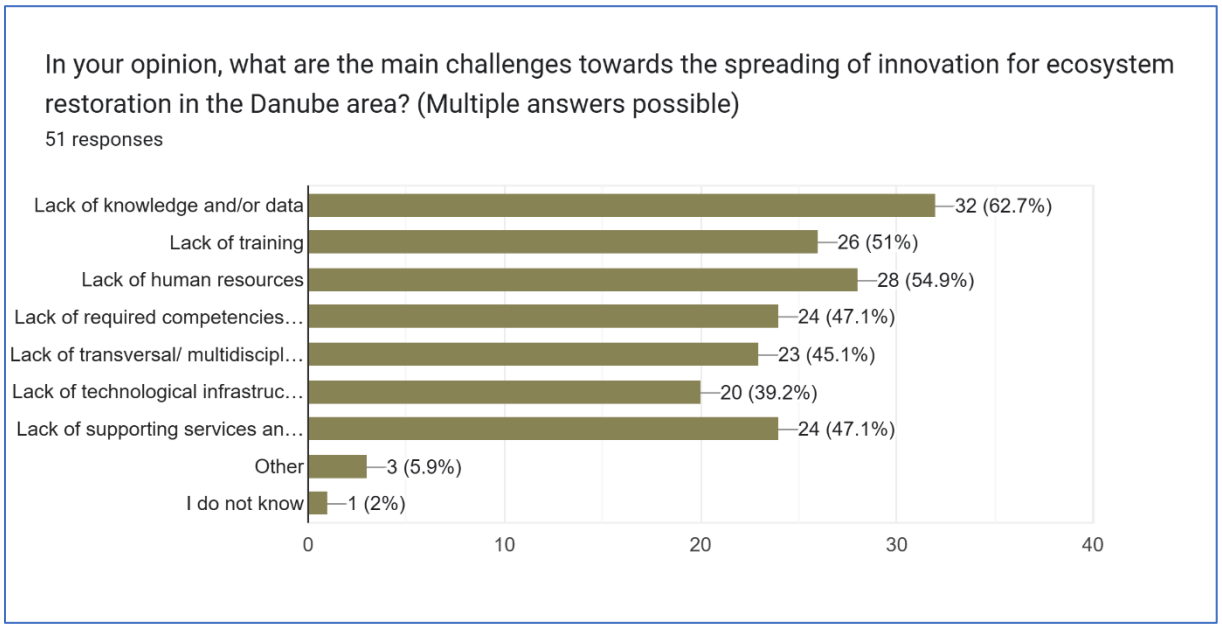

Figure 11 Main challenges to the spreading of innovation for ecosystem restoration in the Danube area, according to respondents

Catalogue of services supporting innovation

The Catalogue of Services supporting innovation was developed in Access format, and it is now available on the EcoDaLLi Portal:

https://portal.ecodalli.eu/wp5

Overview of ISS, and objectives of this chapter

ISS includes a diverse range of tools and resources aimed at assisting innovators, companies, and other stakeholders in overcoming challenges and advancing their projects. These services include:

1. **Technical support**, offering expertise and training in areas such as engineering, programming, and artificial intelligence, to help develop and refine innovations;
2. **Legal services,** providing guidance on intellectual property protection, regulatory compliance, and startup creation, ensuring a strong foundation for new ventures;
3. **Financial services,** addressing funding challenges, offering advice on accessing grants, loans, and tailored investment opportunities;
4. **Marketing services,** assisting innovators in expanding their reach through market research, communication strategies, and targeted advertising campaigns;
5. **Knowledge and technology transfer services,** connecting researchers and businesses, facilitating collaboration, and enabling the transformation of research outcomes into societal benefits; and
6. **Institutional support services,** focusing on creating a conducive environment for innovation by providing infrastructure, regulatory frameworks, and initiatives like incubators to encourage interaction and collaboration within the ecosystem.

The objective of this chapter is to present a database compiling a comprehensive catalogue of existing ISS relevant to ecosystem restoration. This catalogue aims to simplify access to important resources, enabling innovators to find the information and support they need efficiently. By offering detailed insights into ISS categories and services, **the catalogue empowers stakeholders to identify and utilize services that align with their innovation goals**.

The approach used to develop this catalogue involved a combination of internet-based research and interviews with stakeholders. Internet research enabled the identification of publicly available ISS information, while interviews provided qualitative insights and practical perspectives. This methodology ensures a thorough understanding of available services and their practical applications.

The subsequent sections detail the database developed through this effort and summarize the key findings derived from the catalogue of services.

The database

The database was constructed to comprehensively catalog the various actors offering ISS. It provides a detailed overview of organizations, capturing general information such as their type (e.g., NGOs, SMEs, research institutions, academic entities), country of operation, scope of activities, and the nature of their operations.

Beyond these general descriptors, the database delves into more specific details. It includes insights into the investment focus of these actors, their investment range, and the eligibility requirements for accessing their services. Additionally, the database outlines the specific ISS provided by each actor, offering a clear understanding of the resources and support available to innovators across the ecosystem.

The full database is accessible through the EcoDaLLi portal[43], where users can explore its comprehensive contents and connect with service providers to facilitate innovation and ecosystem restoration efforts.

Summary of main findings from the catalogue

The database consists of 21 entries, capturing a comprehensive range of organizations involved in delivering ISS across the Danube region. These organizations represent 10 unique types, primarily from the public sector (e.g., NGOs, academic institutions, and EU funding programs), but also include private firms and multinational initiatives. Geographically, these actors operate in 11 different countries, underscoring the regional diversity and cross-border collaboration that characterize the Danube innovation ecosystem.

The ISS provided by these actors reflects a broad spectrum of support mechanisms tailored to meet the varied needs of ecosystem restoration innovators. The services include:

1. **Capacity Building and Education**: The most frequently provided service, emphasizing knowledge transfer, skill enhancement, and public awareness.
2. **Knowledge Exchange and Networking:** Facilitating connections and collaborations among stakeholders, crucial for innovation.
3. **Cross-Border Cooperation:** Promoting regional collaboration and integration across different countries.
4. **Research and Development Support:** Access to specialized expertise, technology transfer, and advanced research facilities.
5. **Advisory and Consultancy Services:** Assistance in project development, policy design, and strategic implementation.

These services aim to address key innovation bottlenecks, such as financial constraints, knowledge dissemination, and market accessibility.

Finally, the database reveals that the public sector dominates the landscape of innovation support, with many actors being government-affiliated bodies, research institutions, or universities. Their mission often aligns with public interest objectives, such as environmental sustainability and regional development. Private sector actors, while fewer in number, contribute significantly by offering specialized services, particularly in areas like technical consultancy, advanced technology solutions, and investment management.

This dual structure of public and private actors ensures a robust and comprehensive support network, fostering innovation through collaborative efforts and shared resources.

The following table provides a **comprehensive overview of the types of innovation support service offered by the actors in the Danube region**, which are included in the database. It

[43] https://portal.ecodalli.eu/

details the specific components and activities included within each service, highlighting the diverse mechanisms available to support ecosystem restoration and innovation.

Table 2 Types of innovation support services found in the Danube River basin, and included in the EcoDaLLi database

Innovation Support Service	Definition and inclusions
Capacity Building and Education	This service includes programs aimed at enhancing skills and knowledge through training sessions, workshops, and public awareness initiatives.
Knowledge Exchange and Networking	This service includes facilitating connections among stakeholders through conferences, networking events, and platforms for sharing best practices.
Cross-Border Cooperation	This service includes initiatives that encourage collaboration across different countries, promoting regional partnerships and joint projects.
Research and Development Support	This service includes providing access to specialized expertise, technology transfer, and advanced research facilities to drive scientific advancements.
Advisory and Consultancy Services	This service includes offering expert guidance in project development and innovation upscaling.
Financial Support	This service includes grants, loans, and investment opportunities targeting sustainability-focused innovations to alleviate financial constraints.
Technical and Research Support	This service includes access to specialized expertise and advanced research facilities, including technology transfer and scientific collaboration.
Legal and Regulatory Assistance	This service includes legal support for innovators, such as intellectual property protection, compliance with environmental regulations, and startup formation.
Implementation of Conservation Strategies	This service includes developing and executing plans to preserve and restore ecosystems.
Integration of Traditional Knowledge	This service includes the use of local and regional knowledge in modern conservation and innovation efforts
Public and Stakeholder Engagement	This service includes involving communities and stakeholders in decision-making processes to foster transparency and collaboration.
Policy Dialogue and Advocacy	This service includes engaging in discussions and advocacy efforts to influence policy and promote innovation-friendly environments.
Internationalization Support	This service includes assisting innovators and organizations in expanding their reach and operations across international borders.
Facilitation of Cross-Sectoral Collaboration	This service includes encouraging cooperation between different sectors to leverage diverse expertise and resources.
Application and Implementation	This service includes supporting the practical application and execution of innovative ideas and projects.
Data Collection and Processing	This service includes gathering and analysing data to inform decision-making and improve innovation outcome.

Consultation and Services	This service includes providing expert advice and services tailored to specific needs and challenges.
Access to Funding and Resources	This service includes connecting innovators with financial resources and tools necessary for project development and execution.
Promote Cooperation and Collaboration	This service includes encouraging joint efforts and partnerships to achieve common goals and enhance innovation outcomes.
Development of Educational Outreach Initiatives	This service includes creating programs to educate and engage the public on innovation and sustainability topics.

In turn, the following illustration shows which actors are providing these types of services in the Danube River basin.

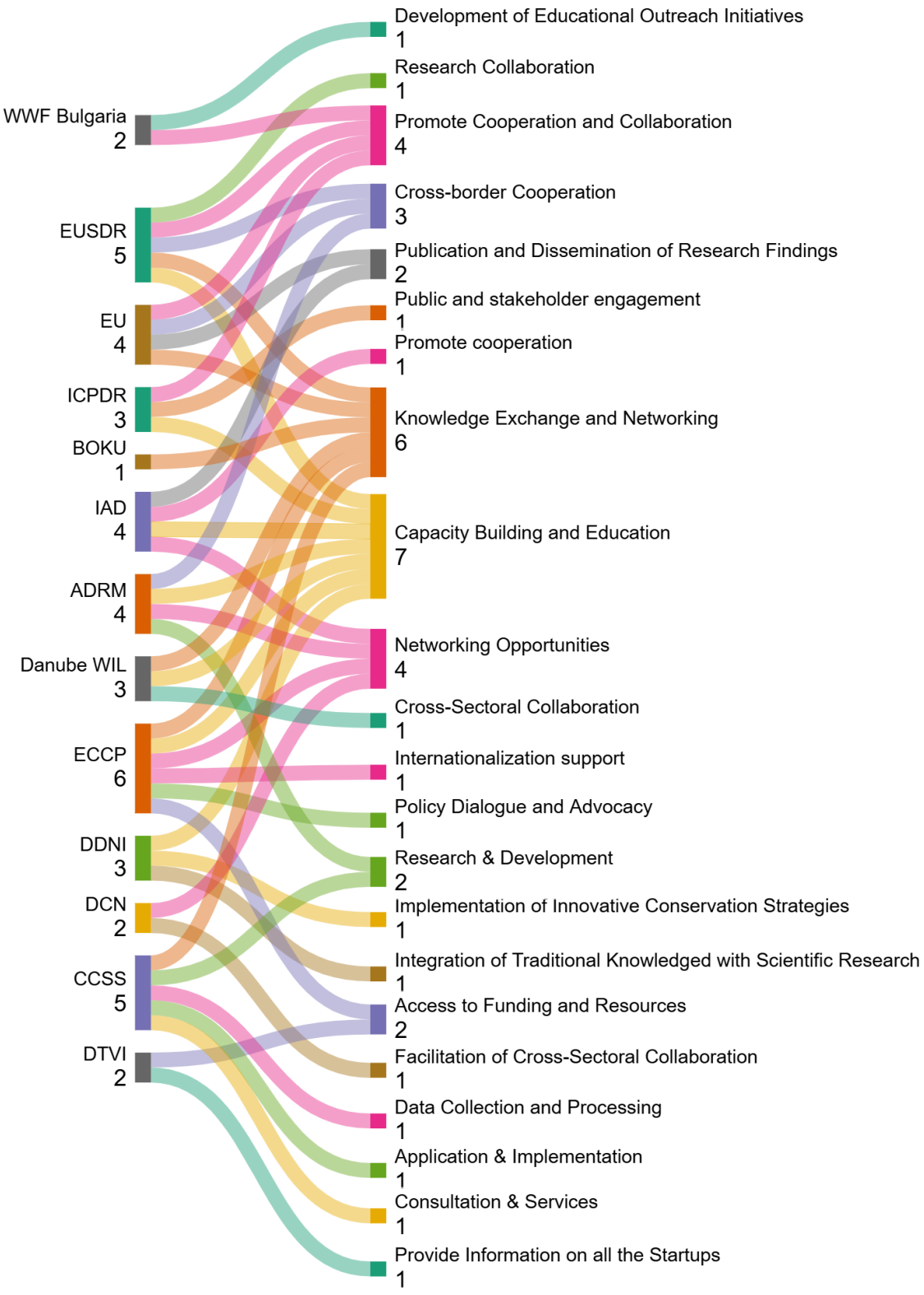

Figure 12 Innovation Ecosystem: Key Services and Actors (Various sources, as included in the database)

Conclusions and lessons learnt

This deliverable aimed at mapping the innovation ecosystem for environmental restoration in the Danube region, as well as at inventorying existing innovation support services. It is based on literature and web review, interviews with key experts and stakeholders as well as a survey distributed to Mission Ocean stakeholders.

The mapping presented in this deliverable includes the following components:

- An overview of the key concepts and definitions, with respect to innovation, innovation ecosystems and innovation support services;
- An overview of the types of innovation potentially occurring in ecosystem restoration practices, which can be distinguished as technological innovations, economic and financial innovations, governance structure and policy innovations, and social engagement innovations. For each type of innovation, examples from the Danube region are provided (taken from the best practices inventoried in D3.2);
- A mapping of the innovation ecosystem for environmental restoration in the Danube region, and in particular of the actors (ecosystem restoration and innovation communities), the available human and financial resources, including funding opportunities, and the enabling environment i.e. market and regulatory framework in place; and
- An overview of the catalogue of services supporting innovation, developed as part of Task 5.1 and available on the EcoDaLLi portal (https://portal.ecodalli.eu/wp5). This chapter also provides an overview of the main types of innovation support services in the region as well as the providers of such services.

Task 5.1 activities so far, as well as the results presented here, yielded valuable insights into the **effectiveness of current strategies and highlighted key areas for improvement in supporting innovation**, particularly within the context of ecosystem restoration in the Danube region.

The primary lessons learned include:

- **Stakeholder Alignment and Communication**: Ensuring alignment among all stakeholders from various sectors and EU MS is crucial. Effective communication channels must be established and maintained to facilitate coordination and collaboration. This alignment is essential for the successful implementation of innovation actions, as it ensures that diverse perspectives are considered and integrated into decision-making processes.

- **Policy Alignment for a Supportive Environment**: Harmonizing policies across different sectors and jurisdictions is fundamental to creating an environment conducive to innovation. A cohesive policy framework supports the implementation of innovative actions by reducing bureaucratic hurdles and creating a more predictable and stable environment for stakeholders to operate within.

- **Importance of Funding**: Adequate funding is a critical factor in supporting and sustaining innovation. Financial resources are necessary to develop and scale innovative solutions, particularly in the field of ecosystem restoration. Ensuring that sufficient and appropriate funding mechanisms are in place is essential for the continuous advancement of innovation initiatives.

- **Sustainable and Simplified Funding Procedures**: The procedures for accessing and utilizing funding should be streamlined and sustainable to support ongoing innovation

activities. Simplified processes reduce administrative burdens and make it easier for stakeholders to secure the necessary resources for their projects, thereby fostering a more dynamic and responsive innovation ecosystem.

- **Involvement of the Private Sector**: Engaging the private sector is vital for enhancing innovation in ecosystem restoration. They hold vast resources, both financial and technological, that can be mobilized to enhance the effectiveness of restoration efforts. Below are some specific strategies to involve the private sector:

    - **Creating a green exchange market** consisting of a financial platform designed for the trading of environmental assets or credits. The objective is to encourage investment in environmental protection and ecosystem restoration. Through the exchange on the market, companies can either offset the environmental impact of their operations or actively invest in conservation and restoration projects, aligning with sustainable business models. While the idea of developing such market is still not widely developed, some examples exists on the establishment of such markets exist in Europe, notably the Luxembourg Green Exchange Market[44]. This market was established in 2016 and is the first global platform solely dedicated to green bonds[45]. The Luxembourg Green Exchange market help asset managers and issuers gain visibility and support for their sustainability efforts, while investors benefit from easy, unrestricted access to labeled sustainable instruments, enhanced comparability, and high transparency.

    - **Establishing a voluntary carbon market to offset carbon footprints** where companies can buy and sell carbon credits, similar to the trading of goods in traditional markets. This allows businesses to offset their emissions by investing in projects that reduce or capture greenhouse gases. Unlike the compliance carbon market which is created as a result of policy or regulatory requirement, the buying and selling in the voluntary market is on a voluntary basis. While compliance markets are restricted to certain regions, voluntary carbon credits offer much greater flexibility, operating without the geographic limitations imposed by national governments or political unions[46]. The current supply of voluntary carbon credits comes mostly from private entities that develop carbon projects, or governments that develop programs certified by carbon standards that generate emission reductions and/or removals[47].
      Participation in such a voluntary market not only enhances a company's reputation in a business environment increasingly focused on sustainability, but also demonstrates a commitment to climate goals and efforts to reduce carbon footprints. It also addresses the growing expectations from employees and customers for companies to take responsibility for their environmental impact. Additionally, by engaging in these markets, companies can gain valuable experience that may reduce future compliance costs as carbon regulations become more stringent. Ultimately, voluntary carbon markets create a win-win platform by bringing together companies developing green technologies and carbon-reduction projects with businesses seeking to invest in lower emissions, fostering collaboration and mutual benefit.

[44] https://www.bilinvestmentinsights.com/wp-content/uploads/2020/06/8pager_LGX_2019_May_web-1.pdf
[45] https://unfccc.int/climate-action/momentum-for-change/financing-for-climate-friendly-investment/luxembourg-green-exchange
[46] https://www.spglobal.com/commodityinsights/en/market-insights/blogs/energy-transition/061021-voluntary-carbon-markets-pricing-participants-trading-corsia-credits
[47] https://climatepromise.undp.org/news-and-stories/what-are-carbon-markets-and-why-are-they-important

- **Promoting Corporate Social Responsibility (CSR) initiatives** that encourages companies to integrate sustainable practices within their core operations, driving direct and indirect investments in environmental protection and restoration. Lessons learned underscore the value of aligning CSR with tangible environmental goals, as companies increasingly recognize the dual benefit of enhancing their reputation while actively contributing to sustainability. Effective CSR initiatives can amplify ecosystem restoration efforts by fostering collaboration, raising awareness, and establishing a shared commitment to ecological stewardship.

These lessons learnt and associated recommendations will be crucial in guiding further work on all aspects of WP5, and namely: (i) the development of the toolbox supporting innovation in the region (Task 5.1); (ii) further training and capacity building (Task 5.2); and (iii) upscaling innovation in ecosystem restoration (Task 5.3). In addition, they will also be useful for drafting the Danube Innovation Action Plan, developed as part of WP7 and the final product of the EcoDaLLi project.

Annexes

Annex I: Interview Guidance for Danube experts and stakeholders in the domain of general innovation

EcoDaLLi

The current biodiversity and restoration targets are ambitious and considerable efforts will be needed to ensure that they can be met, with considerable attention often focusing on a variety of innovative solutions, which then even more often face significant obstacles before they can be upscaled to the level where they can make significant contributions to the agreed targets. It is this particular intersection that we want to focus on, to identify what do various key actors define as innovation and what kinds of levers and barriers currently limit their usefulness, including potential policy bottlenecks and finding possible solutions to those.

The main objective of EcoDaLLi is to **centralise Danube governance structures in terms of innovative solutions for improved ecological restoration, protection and preservation of the Danube basin and its Delta** by **fostering a stronger innovation ecosystem** within a well-connected Practices Living Lab System, supported by a digital Portal, completely linked to the Mission Implementation Platform. Fostering a stronger innovation system in the region is the objective of Work Package 5 of the project.

The purpose of this questionnaire is to gather information on the current innovation ecosystem in the Danube region, specifically concerning efforts to restore the Danube ecosystem. It will concentrate on the different actors' involved in the innovation process (through innovation support services, funding, innovating, etc.) that support this innovation ecosystem.

Section 1 – Organization and connection to innovation

1. Could you introduce yourself and the organization you work for?

2. Can you describe the role your organization plays in the innovation process?

Note for the interviewer: please guide the interviewee through the possible roles listed below:

•	Innovator = individual or entity that introduces new ideas
	Promoter/ supporter = entity providing services supporting innovation, or involved in the promotion of innovation
•	Implementer = someone/an organisation that develop the idea, puts plans into practice
•	Research/Innovation company
•	Regulatory/Funding Body
•	Consultant
•	Other, please specify: …
•	None

3. Is your organization specialized in particular type(s) of innovation (see types below), or in specific fields/ sectors?

Note for the interviewer: please guide the interviewee through the types of innovation listed below:

·1	Technological = Development & implementation of a new product/service to solve a problem
·2	Economic & financial = New processes related to spending/funding/financial instruments
·3	Social = Novel solution that aims to transform existing social practices/institutions, being social in its ends and means
·4	Policy = Novel processes/tools/practices/policy forms that are used in policy development & implementation.
·5	Other, please specify: …

4. Can you provide some concrete examples of innovation processes your organization have been involved in?

Section 2 – Danube Innovation Ecosystem

1. Who are the primary stakeholders and innovators involved in Innovation Actions and/or processes in the Danube Region? (This includes government agencies, environmental organizations, research institutions, local communities, and any other relevant actors driving innovation in this area).

2. How does stakeholders interact to introduce innovation in ecosystem restoration in the Danube region? Would you label them as a proper innovation community, or efforts to support innovation in the region are rather uncoordinated and/or isolated initiatives?

3. Based on your experience, does the innovation community (or entities supporting and promoting innovation) in the Danube region connect to stakeholders from different fields and sectors wanting to innovate their processes?

4. In your opinion, is the current innovation community (or entities supporting and promoting innovation) effective in driving innovation in the Danube Region?

5. What existing resources, such as funding, expertise, infrastructure and natural assets, are available to foster innovation in the Danube region?

6. What factors contribute to creating an innovation-friendly environment in the Danube Region (This includes policy frameworks, regulatory support, public-private partnerships, community engagement, collaboration between the different stakeholders, etc.).

Section 3 – existing services supporting innovation

1. In general, what support services currently exist to facilitate innovation in the Danube region (these may include technical assistance, funding mechanisms, capacity building programmes, knowledge sharing platforms and networking opportunities)?

2. Have these services been used for ecosystem restoration practice projects and/or can these services and mechanisms be applied to ecosystem restoration? Can you provide contact information on the actors/organisations providing these services?

3. Does your organization offer innovation support services? If so, can you describe them?

4. Have these services been used for ecosystem restoration practices projects, and/or can these services and mechanisms be applied to ecosystem restoration?

5. How effective are the existing support services in fostering innovation in the Danube Region? Can you illustrate the answer with a real-life example?

6. What gaps or areas for improvement are identified in the current support infrastructure?

Section 4 – Conclusion

1. In conclusion, considering the actors, support services, and environment for innovation in the Danube Region, what steps can be taken to improve innovation? What are the opportunities, levers, and obstacles to innovation in the Danube region (policy changes, improved infrastructure, better connections between the various stakeholders, etc.)?

2. How can stakeholders use resources better, fill support gaps, and create an environment that enables more innovation actions in the Region?

3. Would you like to add any additional information or comments? (This includes contact information for non-identified stakeholders, and other useful information)

Annex II: Interview Guidance for Danube experts and stakeholders working in the domain of ecosystem restoration

EcoDaLLi

The current biodiversity and restoration targets are ambitious and considerable efforts will be needed to ensure that they can be met, with considerable attention often focusing on a variety of innovative solutions, which then even more often face significant obstacles before they can be upscaled to the level where they can make significant contributions to the agreed targets. It is this particular intersection that we want to focus on, to identify what do various key actors define as innovation and what kinds of levers and barriers currently limit their usefulness, including potential policy bottlenecks and finding possible solutions to those.

This survey is conducted as part of the Horizon Europe project EcoDaLLi (https://ecodalli.eu/) which is funded to support the European Commission's Mission on "Restoring our Ocean and Waters by 2030".

The main objective of EcoDaLLi is to **centralise Danube governance structures in terms of innovative solutions for improved ecological restoration, protection and preservation of the Danube basin and its Delta** by **fostering a stronger innovation ecosystem** within a well-connected Practices Living Lab System, supported by a digital Portal, completely linked to the Mission Implementation Platform.

Fostering a stronger innovation ecosystem is the objective of Work Package 5, which includes three Tasks:

- Task 5.1: Inventory of the **services supporting the transfer of innovation;**
- Task 5.2: Setting up of trainings to **strengthen the capacity of the relevant stakeholders;** and
- Task 5.3: **Paving the way to upscaling** of innovation in the Danube basin.

The purpose of this questionnaire is to gather information on the current innovation ecosystem in the Danube region, specifically concerning efforts to restore the Danube ecosystem. It will concentrate on the different actors involved in the innovation process (through innovation support services, funding, innovating, etc.) that support this innovation ecosystem.

Section 1 – Organization and connection to innovation

1. Could you introduce yourself and the organization you work for?

2. Which types of innovative activities has your organization worked on, in the course of your work in the last years? Can you describe these innovative activities?

Note for the interviewer: please guide the interviewee through the types of innovation listed below:

• 1	Technological = Development & implementation of a new product/service to solve a problem
• 2	Economic & financial = New processes related to spending/funding/financial instruments
• 3	Social = Novel solution that aims to transform existing social practices/institutions, being social in its ends and means

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• 4	Policy = Novel processes/tools/practices/policy forms that are used in policy development & implementation.
• 5	I have not been involved in any innovative activity
• 6	Other, please specify: …

3. Can you describe the role your organization plays in the innovation process?

Note for the interviewer: please guide the interviewee through the possible roles listed below:

•	Innovator = individual or entity that introduces new ideas
•	Implementer = someone/an organisation that develop the idea, puts plans into practice
•	Research/Innovation company
•	Regulatory/Funding Body
•	Consultant
•	Other, please specify: …
•	None

Section 2 – Innovation for ecosystem restoration in the Danube region

1. Among the stakeholders involved in ecosystem restoration in the Danube region, who are the primary stakeholders involved in, or driving innovation in the sector? (This includes government agencies, environmental organizations, research institutions, local communities, and any other relevant actors driving innovation in this area).

2. How does stakeholders interact to introduce innovation in ecosystem restoration in the Danube region? Would you label them as a proper innovation community, or innovation efforts in ecosystem restoration are rather uncoordinated and/or isolated initiatives?

3. What are the impacts of innovation on restoring the Danube ecosystem?

4. What existing resources, such as funding, expertise, infrastructure and natural assets, are available to support innovation in ecosystem restoration initiatives along the Danube?

5. What factors contribute to an enabling environment for innovation in ecosystem restoration in the Danube region? This may include policy frameworks, regulatory support, public-private partnerships, community engagement, and stakeholder collaboration.

Section 3 – existing services supporting innovation

1. Does your organization offer innovation support services for ecosystem restoration? If so, can you describe them?

2. In general, what support services currently exist to facilitate innovation for ecosystem restoration in the Danube River? Can you provide concrete examples on these services? Which organizations are providing these services? Can you provide their contact information?

3. Based on your experience, how effective are the existing support services in fostering innovation for ecosystem restoration initiatives in the Danube River? Can you illustrate the answer with a real-life example?

4. What gaps or areas for improvement are identified in the current support infrastructure?

Section 4 – Conclusion

4. In conclusion, given the actors, support services and environment for innovation in restoring the Danube ecosystem, what measures can be taken to improve innovation in restoring the Danube ecosystem? What are the opportunities, levers and obstacles for promoting innovation to improve the Danube ecosystem?

5. How can stakeholders make better use of resources, fill gaps in support and create an environment conducive to progress in preserving the river and its ecosystems?

6. Would you like to add any additional information or comments? (This includes contact information for non-identified stakeholders, and other useful information).

Annex III – Scoping questionnaire for Danube stakeholders, prepared and distributed as part of Task 5.2

1. What type of organisation do you work for?

ONE POSSIBLE ANSWER

•	Academic/research institution	•	Consumer association
•	Company/business organisation	•	Environmental organisation
•	Public authority	•	Non-governmental organisation
•	Business association	•	Other

2. What is your area of expertise?

ONE POSSIBLE ANSWER

•	Natural scientist	•	Engineer
•	Social scientist	•	Industry professional
•	Politician	•	Other
•	Economist		

3. How familiar are you with innovation in ecosystem restoration?

ONE POSSIBLE ANSWER

•	I have never heard of it	•	I have been involved in some projects dealing with innovative restoration practices or other forms of innovation in ecosystem restoration
•	I have heard of it at recent conferences/ through colleagues/ other	•	Innovation in ecosystem restoration is the core of my daily work

4. Based on your experience and/or knowledge, which types of innovation are relevant for ecosystem restoration measures and practices?

SEVERAL POSSIBLE ANSWER

•	Technological = Development & implementation of a new product/service to solve a problem
•	Economic & financial = New processes related to spending/funding/financial instruments

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•	Social = Novel solution that aims to transform existing social practices/institutions, being social in its ends and means
•	Policy = Novel processes/tools/practices/policy forms that are used in policy development & implementation.
•	None of the above
•	I do not know

5. In your opinion, what are the main challenges towards the spreading of innovation for ecosystem restoration in the Danube area?

SEVERAL ANSWERS POSSIBLE

•	Lack of knowledge and/or data	•	Lack of technological infrastructure (hard/soft/org-ware)
•	Lack of training	•	Lack of supporting services and mechanisms (e.g. incubators, info points, etc.)
•	Lack of human resources	•	Lack of funding opportunities
•	Lack of required competencies and skills	•	Other
•	Lack of transversal/multidisciplinary approach	•	I don't know
•	Work in silos		

Selected innovative ecosystem restoration projects in the Danube region, inventoried as part of WP3 (D3.2)

Type of innovation	Project	Location	Types of intervention	Innovative aspects
Technological innovation	Traisen – LIFE+ project	Upper Danube – Austria	Transform the lower reaches of the Traisen river, near the Danube power plant in Altenwörth, into a diverse floodplain landscape	No river course was restored, but it was a new river course that was created in the floodplain. In addition, large quantities of excavated material were necessary for the riverbed to be shaped in an ecologically functional manner.
Technological innovation	DanubeSediment – Danube Transnational Programme 2014-2020	Danube as a whole	Collection of sediment transport data in the Danube River and tributaries and production of a Danube-wide sediment balance. Drafting of the Danube Sediment Guidance: recommendations for reducing the impact of a disturbed sediment balance (feeding into the Danube River Management Plan and the Danube Flood Risk Management Plan)	Broad participatory process. The project was successful in bringing various experts from different European countries together to discuss these river-relevant topics. As a result, the first detailed study on sediment transport in the Danube was developed. The specifics of the project subject require close transboundary cooperation and expert exchange.
Social engagement innovation	Connecting Nature – EU Horizon 2020	Middle Danube – Sarajevo	Creation of a urban garden in a state-run Children's Home which is located next door to a Centre for Healthy Ageing. A core feature of the exemplar is to promote and encourage intergenerational learning through the joint design, management and maintenance of the garden.	Strong social focus: Cross-generation networking, social cohesion, creating cooperation with various stakeholders, inclusion of marginalised groups, Community involvement in NBS implementation. Focus on stewardship and participatory scoping for financing options.
Social engagement innovation	CLEVER Cities – EU Horizon 2020	Middle Danube – Belgrade	Transform the area around a historic railway track into a linear park.	A wide urban innovation partnership was established. An online platform for information exchange was created.
Technological innovation	IDES – Danube Transnational Programme 2014-2020	Lower Danube – Romania and Bulgaria	Development and implementation of an integrated transnational approach based on ecosystem services, to manage the quality of the Danube river and generate mutually beneficial solutions for multifunctional flood zones and not compromises	IDES tool for ecosystem services evaluation IDES Danube was applied in five areas, as a result, the effect of water quality management scenarios on relevant Ecosystem services was assessed to derive an optimized concept

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Technological innovation	GRENDEL project – Danube Transnational Programme	Danube as a whole ?	The project supported the Danube vessel fleet operators and their public counterparts in modernisation of the sector.	Production of an Innovative Technological Database
Technological innovation	Ecological restoration in the Danube Delta	Danube Delta - Romania	Restoration of two agricultural polders: Babina (2200ha) and Cernovca (1580ha) located in the Danube Delta. Dikes and canals built to drain the polders were opened and connected to the Danube. Restoration of the hydrological regime	the diversification of the natural resources available to the local community was also pursued.
Governance structure innovation	TID(Y)UP – Danube Transnational Programme 2014-2020	Middle Danube – Hungary, Austria, Serbia, Romania, and Ukraine	Tisza-Danube integrated action plan to eliminate plastic pollution of rivers: a set of integrated actions, consulting and providing tools for relevant stakeholders and initiating long-term trans-border and intersectoral cooperation with the aim of monitoring and eliminating the plastic pollution.	The reported novelty of Tid(y)Up project is that it provides tools, data and the assessment of various used methodology for understanding of the sources, nature and risks of contamination flows; and delivers practical examples of possible actions and legislative solutions both on local and transnational level. Developed procedure and appliance for mapping of microplastic litter
Technological innovation	NetworkNature – EU Horizon 2020	Upper/ Middle Danube	Collecting and connecting NbS – and in particular: Synthesize & strengthen the NBS evidence base by gathering experiences, knowledge, tools and services from over 30 Horizon 2020 projects. Engage existing stakeholders & expand the NBS community to new sectors and target audiences Ensure NBS science informs the policy agenda and vice versa. Accelerate the uptake of NBS across science, business, policy and practice	It could be very interesting for EcoDaLLi
Technological innovation	Fish-friendly Hydroelectric Turbines	Lower Danube – Romania	Several hydroelectric facilities along the Danube and its tributaries have adopted specialized turbines designed to minimize the impact on fish populations. These turbines feature modified blade designs and intake structures that	Innovative turbine design Collaborative research efforts between engineering firms, fisheries experts, and conservation organizations have led to the development and deployment of these fish-friendly turbines

			reduce fish mortality rates and improve fish passage.	
Governance structure innovation	NEVERMORE Project	Danube Delta and Black Sea	New Enabling Visions and tools for End-useRs and stakeholders thanks to a common MOdeling appRoach towards a climatE neutral and resilient society	Interdisciplinary co-production of knowledge development of integrated methods necessary to support decision-making in the transition to the necessary transformation pathways, participation of stakeholders in climate science and policy by: Downscaling algorithms for climate data/ Cross-sectoral methodology for modelling CC impacts, risks/A&M effects/ Open-source-code IAM.
Policy innovation	Integrated Territorial Instrument Danube Delta	Danube Delta and Black Sea	The instrument is dedicated to implement the Danube Delta Integrated Development Strategy 2030 and it is accessed through the Danube Delta Community Development Association. The role of the association is to prioritize the projects that will be promoted to obtain financing from the ESI funds and issues compliance (relevance) notification with SIDD DD, which will be carried out by the technical staff under the leadership of the ITI coordinator and the President of the ADI-ITI Board of Directors.	A platform that connects stakeholders and funding opportunities: the project aims to enable the strategic and financial support for integrated development of the area. Projects grouped in 5 investment pillars (Environment, Economy, Connectivity, Public Services and Administrative Capacity) are planned for the economic, social, and environmental development of the Danube Delta.