



eLTER Preparatory Phase Project

eLTER RI Business and Sustainability Plan

Deliverable 4.5

31 March 2025

Editorial team:

Syed Ashraful Alam (UH, Finland)
Jaana Bäck (UH, Finland)
Ulf Mallast (UFZ, Germany)

Contributing team (alphabetic order):

Alexandra Tzvetkova (Pensoft, Bulgaria)
Alexandre Belleflamme (FZJ, Germany)
Anne Turbé (IIT, Israel)
Daniel Orenstein (IIT, Israel)
Johannes Peterseil (EAA, Austria)
Katarina Sladakovic (UH, Finland)
Mathilde Emery (CNRS, France)
Michael Mirtl (UFZ, Germany)
Steffen Zacharias (UFZ, Germany)
Terhi Rasilo (UH, Finland)
Thomas Dirnböck (EAA, Austria)



Prepared under contract from the European Commission
 Grant agreement No. 871126
 EU Horizon 2020 Coordination and Support action

Project acronym: **eLTER PPP**
 Project full title: eLTER Preparatory Phase Project
 Start of the project: Feb 2020
 Duration: 72 months
 Website: <https://elter-ri.eu/elter-ppp>

Deliverable title: eLTER RI Business and Sustainability Plan
 Deliverable n°: 4.5
 Nature of the deliverable: Report
 Dissemination level: Public

Citation: Alam SA, Bäck J, Mallast U (Eds.). 2025. eLTER RI Business and Sustainability Plan. Deliverable 4.5. EU Horizon 2020 eLTER PPP Project, Grant agreement No. 871126

Deliverable status:

| Version | Status | Date | Author(s) |
|---------|-----------------|-------------------------------|--|
| 0.1 | Draft | 21 March 2025 | Syed Ashraful Alam (UH, Finland), Jaana Bäck (UH, Finland), Ulf Mallast (UFZ, Germany) |
| 1.0 | Internal review | 25 March and 28 March 2025 | Nina Hobbhahn (UFZ, Germany), Herbert Haubold (EAA, Austria), |
| 1.1 | Final | 31 March 2025 | Herbert Haubold (EAA, Austria) |

The content of this deliverable does not necessarily reflect the official opinions of the European Commission or other institutions of the European Union.

Table of Contents

Preface.....4

Collaborative Approach to Crafting the Business Plan4

Summary of Business Plan Sections6

Valuation and Future Use of This Plan7

Annex.....8

Preface

This business plan outlines the vision, objectives, and strategic approach of the eLTER Research Infrastructure (eLTER RI), a European RI dedicated to long-term ecosystem, critical zone, and socio-ecological research. It provides a comprehensive framework for monitoring and studying environmental changes, biodiversity, and ecosystem processes across diverse landscapes. By integrating data from various research sites across Europe, eLTER RI supports scientists in understanding complex environmental interactions, predicting future changes, and developing sustainable management strategies. By fostering interdisciplinary collaboration and open data sharing, eLTER RI helps address global challenges such as climate change, biodiversity loss, and ecosystem degradation.

The main goal of eLTER RI is to provide a robust, integrated research infrastructure for long-term ecosystem, critical zone, and socio-ecological research across Europe. It aims to generate high-quality, standardised environmental data and scientific knowledge to understand ecosystem dynamics, assess environmental changes, and support sustainable management and policy making. In today's fast-evolving science landscape, partnerships between academia, industry, and government are key to innovation. eLTER RI serves as a hub, bridging research and applications to drive real-world solutions.

This infrastructure will serve a wide range of disciplines, including ecology, hydrology, climatology, soil science, biogeochemistry, geology and geomorphology, socio-ecological research etc., by providing access to world-class field sites and platforms, multi- and transdisciplinary data, equipment, specialised labs, and dedicated spaces for collaboration. By integrating these disciplines, eLTER RI provides comprehensive insights into ecosystem dynamics and supports informed decision-making for environmental sustainability.

This business plan is a comprehensive roadmap that outlines the objectives and strategy of eLTER, its user strategy including market trends and opportunities, governance and organisation, human resources and management, financial and funding framework, key performance indicators, and implementation- and risk management-plan. It highlights the infrastructure's potential to serve as a catalyst for groundbreaking research, provide measurable societal benefits, and ensure long-term financial viability. eLTER will not only enhance institutional research capabilities but also contribute to the broader academic and innovation ecosystem, making a lasting impact on science, industry, and society at large. Accordingly, this business plan is addressed to the relevant scientific communities, as well as to further stakeholders such as policy makers and funders.

This business plan was developed in 2024 in eLTER PPP and in collaboration with Gaia Consulting Oy (part of SWEKO), a leading consultancy specializing in research infrastructure planning and development. Selected through a rigorous process, Gaia Consulting Oy brings extensive expertise in guiding complex projects from concept to implementation. Their extensive industry experience ensures that the plan aligns with best practice while addressing the specific needs of eLTER RI. Through this partnership, we aim to create a comprehensive, data-driven, and actionable roadmap to support the successful establishment, long-term sustainability, and impact of eLTER RI.

Collaborative Approach to Crafting the Business Plan

In order to develop this business plan, eLTER PPP organised an open tender whereby the eLTER Business Plan and Socio-Economic Impact Analysis (SEIA) were outsourced to an external provider. The Call received four replies, and the selection was based on offered price and total quality score, which comprises overall quality of the offer, and competence and experience of the team.

Both tasks were assigned to Gaia Consulting Oy (later: part of SWECO), who was engaged through a structured and collaborative process. The material that was provided as a background for the work included SEIA Framework, Other RI's Business Plan, eLTER Interim Council¹ Materials, eLTER PPP Grant Agreement, eLTER PPP deliverables, eLTER PLUS Grant Agreement, eLTER ESFRI Roadmap proposal, and eLTER EnRich Grant Agreement. The work was structured such that a close exchange of plans, status of the work and outcomes were discussed in regular meetings, led by the GAIA team and participated by at least the coordinating beneficiaries (University of Helsinki – UH, and Israel Institute of Technology – IIT).

At the beginning, Gaia Consulting Oy presented a detailed work plan (Fig. 1) outlining the stages of the project, deliverables, and deadlines, ensuring a systematic approach to completing the task. This collaborative process enabled the company to gather the necessary information, refine the strategy, and tailor the business plan to meet the specific needs of the research infrastructure project.

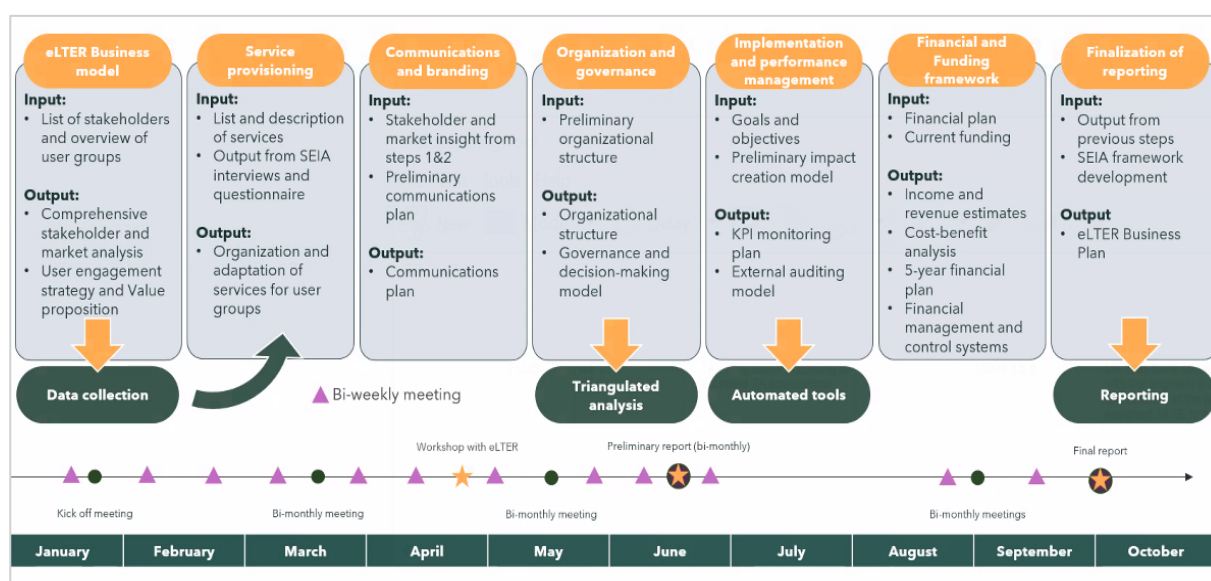


Figure 1. Work plan presented by Gaia Consulting Oy to execute the eLTER Business plan.

The GAIA team organised regular bi-weekly coordination meetings and bi-monthly progress discussions (Table 1) to ensure alignment with the project's goals and timelines. During these sessions, key stakeholders provided insights and feedback to guide the development of the plan. In addition, one broader workshop was organised where the GAIA team had prepared topics to be discussed in dedicated smaller groups. All these meetings were organised in virtual space. The outcomes and preliminary results were presented at the Consortium meeting in June 2024 (Sofia).

¹ The eLTER Interim Council (IC) is the decision making body of ministerial delegations in the eLTER ESFRI process.

Table 1. Date and types of meetings performed by Gaia Consulting Oy.

| Date | Type of Meeting |
|------------|--|
| 18/12/2023 | eLTER Business Plan and SEIA, Introductory meeting with Gaia |
| 24/01/2024 | Project kick-off meeting |
| 08/02/2024 | Bi-weekly coordination meeting |
| 22/02/2024 | Bi-weekly coordination meeting |
| 07/03/2024 | Bi-weekly coordination meeting |
| 20/03/2024 | Bi-monthly meeting |
| 04/04/2024 | Bi-weekly coordination meeting |
| 17/04/2024 | eLTER Business Plan and SEIA Workshop |
| 14/05/2024 | Bi-monthly meeting |
| 30/05/2024 | Bi-weekly coordination meeting |
| 06/06/2024 | eLTER Consortia Meeting in Sofia: Outcomes and preliminary results of Business Plan and SEIA presented |
| 17/06/2024 | Bi-weekly coordination meeting |
| 29/08/2024 | Bi-weekly coordination meeting |
| 24/09/2024 | Bi-weekly coordination meeting |
| 10/10/2024 | Bi-monthly meeting, Final reporting of Business Plan & SEIA |

Summary of Business Plan Sections

1. eLTER Objectives and Strategy

Focus: Setting the stage for the eLTER environment and reasons for its existence. eLTER is central to addressing the greatest scientific challenges of our time.

Highlights: Four connected grand challenges, which include (1) biodiversity loss & land-use change, (2) climate change and greenhouse gases, (3) eutrophication and pollution, and (4) environmental protection.

Considerations: eLTER has a solid reason for its existence.

2. User Strategy

Focus: Crystallise the core market promise and target audience. eLTER creates value through its services and innovation in targeted markets.

Highlights: Well developed eLTER RI Thematic Service Areas: (1) Data management & integration, (2) Optimised design & RI interoperability, (3) Technological innovation & developments, (4) Analysis tools & modelling, (5) Synthesis towards actionable knowledge, (6) Central analytics and observation, and (7) Head Office.

Considerations: eLTER should increase its understanding of the innovations it can help develop, especially in conjunction with the private sector.

3. Governance and organisation

Focus: Describes the functioning and structure of eLTER. Highlights the key components of eLTER as an organization.

Highlights: Well developed governance structure of the Operational Phase of eLTER RI. eLTER's distributed in-situ facilities provide three modes of access: Transnational Access, Remote Access and Virtual Access.

Considerations: eLTER is a complex entity and its solid governance will be critical.

4. Management and Human Resources

Focus: Describes eLTER's management structure. Explains how eLTER takes into consideration the Management and Human Resource perspectives.

Highlights: Employment regulations (e.g., mobility within eLTER RI, pension system) and financial management principles. Both the foreseen eLTER ERIC (European Research Infrastructure Consortium) and the Topic Centres that are not part of the ERIC, can provide in-kind or cash contributions.

Considerations: The distributed nature of eLTER RI and breadth of potential members calls for integrative policies on management and human resources.

5. Financial and Funding Framework

Focus: States the financial framework for the RI. Specifies the revenue streams and expenses for eLTER.

Highlights: Finalization of eLTER ERIC Membership Fees model. Country-specific anticipated Membership Fees.

Considerations: eLTER should prioritise financial commitments (e.g., Host (Premium) Contribution, Membership Fees etc.) from member states but also explore additional revenue streams from the private sector.

6. Implementation

Focus: Identified key actions towards operations. Provides a stepwise plan for the successful operationalization and monitoring of eLTER.

Highlight: Development of prioritized list of KPIs. Chapter 6 describes 10 most essential KPIs to monitor eLTER's performance.

Considerations: As eLTER is currently still developing and is complex in nature, it is important to review the need for updating both the KPIs and the implementation plan in the future.

Valuation and Future Use of This Plan

The eLTER RI business plan was prepared using the information available until October 2024. As such, it serves as a description of the status and aims to provide a comprehensive strategic framework for the establishment of eLTER ERIC, its development, and long-term sustainability. It provides a structured approach to decision-making, resource allocation, and operational execution. The plan's valuation lies in its ability to attract funding, align

stakeholders, and ensure eLTER RI remains a resilient and impactful research infrastructure. By addressing critical issues such as governance, financial sustainability, stakeholder collaboration, and risk management, the business plan plays a crucial role in shaping the future of eLTER RI as it moves towards becoming an ERIC. Future uses of the business plan include, e.g.:

- **Strategic Adaptation** – The plan serves as a dynamic document that can be updated to reflect evolving goals, market trends, and external conditions, to ensure continued relevance.
- **Funding and Investment** – The plan can be used to secure future funding by demonstrating financial viability, impact potential, and long-term sustainability to investors, funding agencies, and stakeholders.
- **Performance Monitoring** – The plan acts as a benchmark for measuring progress, with key performance indicators (KPIs) to track achievements and areas for improvement.
- **Operational Scaling** – The plan guides the expansion and refinement of business operations, ensuring sustainable growth and efficient resource allocation.
- **Stakeholder Engagement** – The plan serves to align and communicate objectives with policymakers, industry partners, and research communities, fostering long-term collaboration.

By leveraging this business plan, eLTER RI can position itself as a leading research infrastructure dedicated to long-term ecosystem, critical zone and socio-ecological research. The plan serves as a critical tool for maximising scientific contributions, securing sustainable funding, and enhancing the overall societal impact of the eLTER RI's research initiatives.

Annex

eLTER Business plan by Gaia Consulting Oy (part of SWEKO), dated October 2024.

eLTER Business Plan



| | |
|---------------------------|---|
| Sweco Finland Oy | Reg. No. 2661738-3 |
| Project Name | Business Plan and SEIA Framework |
| Project Number | 24300790 |
| Client | Helsingin Yliopisto |
| Author | Kirsi Pulkkinen, Millariia Wikman, Suvi Peltoniemi |
| Date | 2024-09-20 |
| Document reference | SWECO_eLTER Business Plan_2024.docx |

Table of contents

| | | |
|-----|---|----|
| 1 | eLTER Objectives and Strategy | 7 |
| 1.1 | Vision and Mission..... | 7 |
| 1.2 | Core Values | 8 |
| 1.3 | Landscape | 8 |
| 1.4 | Scientific Challenges and Gaps Addressed | 9 |
| 1.5 | Strategic Goals and Objectives of eLTER | 13 |
| 1.6 | eLTER Business Model | 15 |
| 1.7 | Societal Benefits and Horizon Europe Funding Strategy | 17 |
| 1.8 | Benefits for Members | 17 |
| 1.9 | Infrastructure Description | 20 |
| 2 | User Strategy..... | 23 |
| 2.1 | Value Proposition | 23 |
| 2.2 | eLTER User Community..... | 23 |
| 2.3 | Service Provisioning | 24 |
| 2.4 | Access to Data and Ecosystem Models | 27 |
| 2.5 | Market Trends and Opportunities | 29 |
| 2.6 | eLTER as a Platform for Innovation | 32 |
| 2.7 | eLTER Communication Strategy | 33 |
| 3 | Governance and Organization | 35 |
| 3.1 | eLTER ERIC Legal Entity | 35 |
| 3.2 | Host Organisations and Host Country | 35 |
| 3.3 | Members and Observers | 36 |
| 3.4 | Governance Model and Governance Bodies..... | 43 |
| 3.5 | Access to NRIs | 44 |
| 3.6 | The Transition Phase from Preparatory Phase to eLTER ERIC | 45 |
| 4 | Management and Human Resources | 46 |
| 4.1 | eLTER Management | 46 |
| 4.2 | Financial Management and Control Systems | 47 |
| 4.3 | Employment Regulations..... | 48 |
| 4.4 | Equality | 49 |
| 4.5 | Recruitment | 50 |
| 4.6 | Performance Monitoring Plan | 53 |
| 4.7 | Career Development and Training | 54 |
| 4.8 | Premises and Facilities..... | 55 |
| 5 | Financial and Funding Framework | 56 |
| 5.1 | Member and Host Country Contributions | 56 |
| 5.2 | Income and Revenue | 58 |
| 5.3 | Costs | 59 |

| | | |
|-------|---|----|
| 5.4 | Five-year Financial Plan | 61 |
| 5.5 | eLTER Financial Principles and Rules | 62 |
| 5.5.1 | Contribution Principles for eLTER Funding | 62 |
| 5.5.2 | Final provisions | 62 |
| 5.6 | Financial Sustainability | 63 |
| 6 | Implementation | 64 |
| 6.1 | Implementation Plan | 64 |
| 6.2 | Milestones | 65 |
| 6.3 | Key Performance Indicators | 65 |
| 6.4 | Risk Management Plan | 66 |
| | References | 76 |
| | Annex A. eLTER's Key Performance Indicators | 80 |

Glossary

| | |
|-----------------------------|--|
| ACTRIS | Aerosol, Clouds, and Trace Gases Research Infrastructure |
| AI | Artificial Intelligence |
| BOLD | Barcode of Life Data System |
| CBD | Convention on Biological Diversity |
| CS | Central Services |
| CDN | Central Data Node |
| DEIMS | Dynamic Ecological Information Management System |
| DG | Director General |
| EC | European Commission |
| ECBOL | European Barcoding Consortium |
| EIF | European Interoperability Framework |
| EOSC | European Open Science Cloud |
| ERA | European Research Area |
| ERIC | European Research Infrastructure Consortium |
| ESFRI | European Strategy Forum on Research Infrastructures |
| eLTER RI | The Integrated European Long-Term Ecosystem, critical zone and socio-ecological system Research Infrastructure |
| eLTER PPP | eLTER preparatory phase project |
| eLTER PLUS | eLTER Advanced Community project |
| eLTER site | eLTER-facility that is up to 10 km ² in size and includes one habitat type and form of land use |
| eLTSER platform | Modular eLTER-facility that consists of different sites located within an area with defined boundaries |
| eLTER Standard Observations | A set of prioritised variables, methods, and protocols that form the core of the eLTER projects |
| EPSAS | European Public Sector Accounting Standards |
| FAIR principles | FAIR data adhere to the principles of findability, accessibility, interoperability, and reusability |
| GDP | Gross Domestic Product |
| GA | General Assembly |
| GDPR | General Data Protection Regulation |
| GEO | Group on Earth Observations |
| GC | Grand Challenges |
| GBOL | German Barcode of Life Initiative |

| | |
|-------|--|
| GHG | Greenhouse Gas |
| ICOS | Integrated Carbon Observation System Research Infrastructure |
| ICSU | International Science Council |
| HC | Host Contribution |
| HPC | Host Premium Contribution |
| MoU | Memorandum of Understanding |
| NRI | National Research Infrastructure |
| NRC | US National Research Council |
| IPCC | Intergovernmental Panel on Climate Change |
| IPBES | The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services |
| ICT | Information Communication Technology |
| KPI | Key Performance Indicator |
| POP | Persistent Organic Pollutants |
| RI | Research Infrastructure |
| R&D | Research and Development |
| RPO | Research Performing Organization |
| SAB | Scientific and Ethical Advisory Board |
| SLA | Service Level Agreement |
| SDG | Sustainable Development Goals |
| TFEU | Treaty of the Functioning of the European Union |
| TSA | Thematic Service Area |
| VAT | Value Added Tax |
| VOC | Volatile Organic Compounds |
| UNECE | UN Economic Commission for Europe |
| WAILS | Whole Systems Approach to In-Situ Research on Life-supporting Systems |

1 eLTER Objectives and Strategy

1.1 Vision and Mission

Vision

The integrated European Long-Term Ecosystem, critical zone and socio-ecological Research Infrastructure (eLTER RI) responds to the challenge of understanding the complex interactions between people and nature over the long term. Environmental sustainability can only be achieved on the basis of the robust knowledge and empirical evidence needed to identify and mitigate human impacts on ecosystems. eLTER catalyses scientific discovery and insights through its state-of-the-art research infrastructure, collaborative working culture, and transdisciplinary expertise. This enables the development and application of evidence-based solutions for the wellbeing of current and future generations.

Mission

The mission of eLTER is to facilitate high impact research and catalyse new insights about the compounded impacts of climate change, biodiversity loss, soil degradation, pollution, and unsustainable resource use on a range of European ecosystems and socio-ecological systems, representing the “critical zone” in which we live. With our distributed physical infrastructure and scientific expertise, we aspire to provide Europe and the world with the scientific capacity to improve our understanding of terrestrial, freshwater, and transitional water ecosystems. Combined with our socio-ecological approach to studying integrated human-nature systems and our commitment to integrating stakeholder knowledge, we provide a solid foundation to inform evidence-based policy making and management solutions for addressing current and emerging environmental challenges.

The pan-European, *in-situ* research infrastructure will serve multiple scientific communities with high-level central facilities and distributed, well-instrumented eLTER Sites and socio-ecological eLTER Platforms (henceforth called eLTER facilities). Optimised overall operation will coordinate between the central and national components and facilitate their integration under one coherent and sustainable Research Infrastructure (RI). Continent-wide, novel data services and products will result from combining harmonised standard observations at the sites with information from a wide range of other sources. These services will be accessible to a broad diversity of stakeholders from local to continental scales. As a fundamental component of eLTER’s identity, we will synergistically

collaborate with diverse ecosystem/environmental research infrastructures and networks across Europe and the world.

1.2 Core Values

Due to human activity, the planet has reached global environmental limits that deprive an increasing portion of humanity of their potential for sustainable livelihoods and need for a healthy environment. The eLTER RI community is committed to contributing to global efforts to mitigate and reverse global environmental degradation.

eLTER enables scientific research to confront and overcome global environmental challenges. The eLTER RI is built upon a wide diversity of cultures, stakeholder networks and scientific expertise representing more than 26 European countries. Its multi-cultural and transdisciplinary spirit is the core strength of the eLTER RI.

To maintain and amplify this core strength, eLTER RI is committed to:

- A fundamental holistic approach in investigating Life Supporting Systems
- Research integrity
- Enhancing inclusiveness, collaboration, and collective intelligence
- Policy relevant, stakeholder driven science and RI development
- Transparency and responsiveness
- Technological and social innovation
- Continuous self-assessment and improvement

1.3 Landscape

eLTER is one of eleven projects and landmarks on the European Strategy Forum on Research Infrastructures' (ESFRI) Roadmap for the environment domain. eLTER is tackling a broad spectrum of ecological challenges, based on observations that enable understanding ecosystems using an approach of ecological integrity, including the socio-ecological dimension. For this reason, eLTER has interconnections with several other domains of the ESFRI Roadmap, including Digit, Health & Food and Social & Cultural Innovation (See Table 1 below).

Table 1: Table showing the interconnections between eLTER RI and ESFRI Roadmap domains.

| | | |
|--|------------------------------|--|
| Integrated European Long-term Ecosystem, critical zone and socio-ecological Research Infrastructure (eLTER RI) | Digit | Open data resources and management for long-term ecosystem research Access to open data on ecosystems status and trends; creation of information clusters from multiple sources |
| | Health & Food | Long-term ecosystem research for health and food Compounded impacts of multiple drivers of ecosystem changes for climate, food security, health, and bioeconomy |
| | Social & Cultural Innovation | Social and cultural aspects of long-term ecosystem research Social and cultural aspects of human-environment interactions, to understand the effects of global, regional, and local changes on socio-ecological systems and their feedbacks to environment and society |

eLTER utilises the rapid advancement in Information and Communication Technology (ICT) for its cross-domain approach and has therefore strong linkages to the Digit domain. eLTER works closely with stakeholders – e.g. the Group on Earth Observations (GEO) – to find out how *in-situ* data obtained from ESFRI RIs can improve GEO data products. Artificial Intelligence (AI) and machine learning methods, applied in more powerful ICT platforms, are expanding the range of methods for evaluating ecosystem signals across different data streams. Digital RIs create new capabilities that allow analysis of high-throughput data, whether from genomics, Earth observation or *in-situ* sensors, and these also facilitate interaction between eLTER RI and other RIs. In addition, it responds to the Digital Twin challenge in Europe.¹

eLTER RI is connected to the Health & Food domain with common interests in ecosystem issues which can make its research relevant for agriculture, food, biotechnology, and bioenergy production. Solutions to these questions impact the environmental RIs as well as the AnaEE, MIRRI and EMPHASIS RIs.

A distinctive feature of eLTER RI is the extension of natural science research to the study of society-nature interaction, allowing integrated focus on ecological and socio-ecological interactions. This approach enables linking with other domains and disciplines for which the use of ecosystem services is relevant.

One specificity of eLTER is that it aims at integrating about 200 Category 1 & 2 eLTER Sites and 50 eLTER Platforms with socio-ecological research, representing major European natural and socio-ecological gradients. These facilities stem from the LTER Europe network², a pool of more than 550 Sites and Platforms in 26 countries. The eLTER Platforms have embedded tools to analyse features associated with societally relevant attributes, such as the study of competing land uses, the protection of recreational values or the conservation of drinking water.

1.4 Scientific Challenges and Gaps Addressed

Climate change, land-use change, soil degradation, pollution and biodiversity loss are major anthropogenic drivers behind many current environmental problems affecting the Earth's ecosystems. This largely results from human society living well beyond the carrying capacity of the planet and exerting ever more pressure on our natural environment with irreversible consequences³. At a global level, it is estimated that nearly two thirds of ecosystem services have been degraded in just fifty years⁴, and the additional stress imposed by climate change will require extraordinary adaptation that will vary depending on the geographical location of ecosystems.⁵ The UN 2030 Agenda for Sustainable Development encompasses 17 Sustainable Development Goals (SDGs), which are broken down in 169 associated targets⁶. As a prerequisite to fulfil these targets, European policy must take into account the socio-economic significance of an array of well-functioning ecosystem services. Several of the 169 targets explicitly mention the sensible utilisation of ecosystems (e.g.,

¹ ESFRI (2021). p. 124

² DEIMS (n.d.)

³ Richardson et al. (2023); Rockström et al. (2023)

⁴ Carpenter et al. (2009)

⁵ Mooney et al. (2009)

⁶ United Nations General Assembly (2015)

targets 6.6; 14.2; 15.1), and a considerable number of them are directly related to ecosystem services, including genetic diversity, water quality, sustainable tourism, the use of natural resources, and environmentally related health issues and risks. The eLTER RI will be an essential European asset by providing the information needed to work towards these targets. The aforementioned fundamental challenges for society, policy, science and research infrastructure etc. have been translated into various systems of Grand Challenges (GCs), each of them focusing on specific aspects. Given the broad scope, cross-disciplinary approach and multiple user communities, the eLTER RI is of relevance for most of the existing Grand Challenges classifications, even if the individual GCs are only partly covered. For this reason, eLTER decided not to develop yet another customisation of the Grand Challenges system but to anchor its role and contributions in well published and frequently used Grand Challenges classification systems.

To select the Grand Challenges, eLTER has used a customised approach, bringing together identified Grand Challenges from three existing classifications: The “EC”: European Commission’s Societal Challenges for Europe 2020⁷; the “NRC”: US National Research Council Grand Challenges in Environmental Sciences⁸; “ICSU”: ICSU Earth System Science for Global Sustainability: grand challenges⁹.¹⁰

Grand Challenges addressed by the eLTER RI

eLTER RI Challenge 1: Biodiversity loss and land use change

Biodiversity is declining globally due to drivers like habitat loss, pollution, and climate change, which threaten the ecosystem services that human societies rely upon, valued at an estimated \$125 trillion annually¹¹. Land use changes and its intensification, climate change, habitat degradation, loss and fragmentation, pollution, biological invasions, and overharvesting, are some of the primary drivers of biodiversity loss, impacting ecosystem functionality and service provision to society.

Land use change has accelerated due to increasing pressures caused by urbanization, agricultural intensification and natural resource use of renewable energy production. It has been estimated to be four times greater in its extent compared with previous estimates in long-term assessments for land change. According to Winkler et al (2021) land use change has altered almost 32% of land, or over 43 million km² of land of the global land area between 1960-2019. From the change types, 38% are single change events, which derive e.g. from agricultural expansion in developing countries of the global North. In contrast, 62% of the events are multiple change events, deriving e.g. from agricultural intensification in the developed countries of the Global North.¹²

⁷ EC (n.d.) a.

⁸ National Research Council (2001)

⁹ ICSU (2010)

¹⁰ Eight of the most relevant GCs were shortlisted from the frameworks based on which preliminary selection of four GCs of major relevance for the eLTER RI were formulated. These are reiterated in this document.

¹¹ Costanza et al. (2014)

¹² Winkler et al. (2021)

Policies and conventions, such as the EU Adaptation Strategy¹³, Soil Strategy for 2030¹⁴, Soil Monitoring Law¹⁵, Farm to Fork strategy¹⁶, The New Forest Strategy for 2030¹⁷, EU Nature Restoration Law¹⁸ and Biodiversity Strategy¹⁹, Habitats Directive, European Common Agricultural Policy and the Convention on Biological Diversity (CBD), have placed a priority to combat the biodiversity crisis. IPBES-IPCC Co-Sponsored Workshop report on biodiversity and climate change²⁰ identified several important policy gaps that eLTER RI, as a scientifically justified pan-European RI, can contribute to:

- 1) the explicit consideration of the interactions between biodiversity, climate, and society in policy decisions to maximise co-benefits and minimize trade-offs and mutually harmful effects for people and nature.
- 2) attaining desirable biodiversity-nature interactions through positive social tipping interventions such as rapid spreading of technologies, behaviours, and social norms.
- 3) understanding how the linkages between policy decisions and consequences unfold over time and their influence beyond specific spatial context.
- 4) understanding the differences in social-ecological contexts, when assessing viable solutions for climate mitigation, adaptation, and biodiversity conservation outcomes.
- 5) advancing social tipping interventions that modify the ways in which society and nature interact, can be helpful when facing unavoidable trade-offs in the biodiversity-climate-society nexus.²¹

The eLTER network contributes to addressing these issues through scientific advances at its *in-situ* facilities and cross-site, cross-platform analyses. Furthermore, eLTER provides unprecedented long-term, regular, standardised, and co-located measurement of key parameters, which allow the detection of phenomenon such as biodiversity loss, characterized by gradual change. eLTER network also facilitates a better understanding of the fundamentals of ecosystem resilience.

eLTER RI Challenge 2: Climate change and greenhouse gases

European ecosystems are increasingly threatened by climate change effects caused by the significant rise in greenhouse gases (GHGs) since industrialisation.²² Climate change impacts, such as droughts, floods, wildfires and heat waves effect ecosystems and their functioning.

The European aquatic ecosystems are faced with acidification and hydromorphological degradation and expect major shifts in freshwater biodiversity due to warming. The terrestrial ecosystems are facing shifts in spatial productivity and phenology partly linked with climate change. Soils, particularly in Mediterranean regions, are impacted by the interplay between

¹³ EC (2021)

¹⁴ EC (n.d.) b.

¹⁵ EC (2023)

¹⁶ EC (n.d.) c.

¹⁷ EC (n.d.) d.

¹⁸ EC (n.d.) e.

¹⁹ EC (n.d.) f.

²⁰ van Teeffelen et al. (2014)

²¹ Pörtner (2021)

²² EEA (2015), EEA (2017)

drought and extreme rainfall²³. Climate impacts on forests vary across Europe, with growth rates increasing in some areas due to higher carbon dioxide (CO₂) levels and longer growing seasons, while others face increased tree mortality and species shifts²⁴. Climate warming poses both gains and losses in the provision of ecosystem services for most European macro-regions with the exception of southern Europe, which witness mostly negative impacts for its ecosystem services.²⁵

To limit the experienced impacts of climate change, adaptation measures are needed. Without human adaptation, the projected changes such as sea level rise, the frequency and intensity of storms and coastal erosion will cause severe ecological and economic losses and further social challenges²⁶.

Mitigation of climate change is necessary to stop the atmosphere from warming. The extent of the effects of climate change depends on the Paris agreement 2015 mitigation goal aligned, global mitigation policies and their implementation. Mitigation efforts require a structural transition towards renewable energy and energy efficiency, regenerative agriculture and restoration of critical ecosystem and forests²⁷.

The eLTER network contributes to the enhancing of knowledge and development of policies to protect ecosystems against climate change and adaptation and mitigation options. A comprehensive understanding of the climate change impacts requires robust environmental research, monitoring, and a harmonised approach to measure biodiversity, ecosystem, and societal responses. This is what the eLTER network can provide.

eLTER RI Challenge 3: Eutrophication and pollution – Reactive nitrogen in the environment

Eutrophication and pollution, particularly the proliferation of reactive nitrogen in ecosystems through air pollution, are major environmental challenges that necessitate a comprehensive understanding through long-term ecosystem research, such as that proposed by the eLTER RI. Historically, reactive nitrogen was scarce, but human activities have significantly increased its presence, leading to various environmental issues, such as changes in biogeochemical processes affecting the sequestration and mobilisation of soil carbon²⁸, water quality degradation, de-oxygenation of waterways²⁹ and weakening of water quality and recreational value of marine environments³⁰, contributions to greenhouse gas emissions through the release of highly potent nitrous oxide (N₂O) to the atmosphere³¹ and effects on human health³². Moreover, excessive Nitrogen in ecosystems causes changes in species composition and losses of diversity³³.

Looking at other monitoring systems and RI's focusing on pollution, eLTER's activities facilitate an integrated perspective. The science related to the UN Air

²³ EEA (2017)

²⁴ Lindner et al. (2014); Pretzsch et al. (2014); Donohue et al. (2013); Zhu et al. (2016), Hlásny et al. (2011); Rigling et al. (2013)

²⁵ EEA (2017)

²⁶ EEA (2017)

²⁷ UNDP (2024)

²⁸ Wang et al. (2010)

²⁹ Camargo and Alonso (2006)

³⁰ de Wit et al. (2008)

³¹ IPCC (2013)

³² Gupta et al. (2000)

³³ Sutton et al, (2011)

Convention's monitoring facilities (ICP Forests, ICP Integrated Monitoring, and ICP Waters) played a significant role in reducing some of the major air pollutants affecting ecosystems in Europe. eLTER will gain from this work and use many of their already existing *in-situ* stations by complementing and extending their research towards the impacts of nitrogen on biodiversity, the land and water carbon sink, and ecosystem functioning. By providing a holistic approach, eLTER adds value to the outputs of more specialized RIs. Also other European RIs focus on airborne nitrogen. While ACTRIS focuses on atmospheric processes, eLTER complements this with ecosystem effects of air pollutants such as nitrogen. Where Danubius and EMBRC focus on marine and river pollution in general, eLTER's focus is on understanding the complex interaction of airborne eutrophication in the headwaters that impact the chemical and biological processes in rivers, lakes, and the coastal zone.

eLTER RI's "whole system approach facilitates the study of the N-cycle and its interactions with other biogeochemical cycles and biodiversity, within terrestrial and aquatic ecosystems. Furthermore, a distributed observation approach is required to chart the fate of reactive nitrogen from the atmosphere through terrestrial and freshwater ecosystems into estuaries and coastal waters. Increasing scientific understanding is critical for developing mitigation and adaptation strategies to address the negative impacts of reactive nitrogen on ecosystems and human health as well as the impact on the terrestrial and aquatic carbon sink caused by production and consumption of N. In liaison with the research partners from the UN Air Convention and other RIs, eLTER's long-term data will support the creation of urgently needed predictive models that forecast ecosystem processes and services to inform policymaking.

eLTER RI Challenge 4: Environmental protection, sustainable management of natural resources, water, soils, biodiversity & ecosystems

Complex environmental challenges like climate change, biodiversity loss, and pollution necessitate integrated, bottom-up approaches to complement top-down policy actions. Effective environmental protection and sustainable management of resources demand transdisciplinary research that bridges environmental, social, and economic domains. The sustainability literature acknowledges the importance of participatory governance, collaboration and trust between agencies and stakeholders, focus on local communities and their quality of life, and strengthening the linkage between ecological and socio-economic wellbeing.

eLTER has been strengthening the social-science and interdisciplinary aspects of the network, in particular through the development of its eLTER Platforms and by fostering collaboration between scientists and stakeholders, aiming to generate policy-relevant research and understand socio-ecological systems comprehensively. Formulation of collaborative tools for more effectively addressing contemporary environmental problems is unique among eLTER RI Challenges regarding RI needs.

1.5 Strategic Goals and Objectives of eLTER

eLTER RI aims to boost the development and uptake of innovative methods, tools and workflows for state-of-the-art ecosystems, critical zone and socio-ecological systems research in Europe, to create an integrated scientific

working environment for diverse communities of European scientists and serve a wide range of other users (stakeholders) beyond the actual research. eLTER defines four main strategic goals that capture the multifaceted dimensions of eLTER RI with each strategic goal, including several key objectives:

Goal 1: Facilitate innovative research for addressing grand societal challenges

The eLTER RI aims to increase the scientific capacity, efficiency, visibility, and attractiveness of the European Research Area (ERA), to support management and policy making for a sustainable future. It will seamlessly bring together researchers of ecosystem ecology and biodiversity, the critical zone, and socio-ecological systems to address grand societal challenges from a systemic perspective. eLTER RI will meet requirements from scientific, policy and business stakeholders in response to topical environmental policy questions across scales – from local to continental (e.g. ERA contributions to UN SDGs, IPBES and IPCC, and related EU and national policy frameworks). eLTER RI will develop and provide innovative research methods, which will be tested and implemented at its *in-situ* facilities distributed throughout Europe.

Goal 2: Design and operate a distributed and highly functional network of eLTER in-situ facilities across Europe

The eLTER RI aims to integrate existing and newly established eLTER Sites and eLTER Platforms into a pan-European, distributed research infrastructure supported by user-friendly centralised services. The RI will benefit the individual *in-situ* facilities and their teams through harmonised design and instrumentation, secured long-term funding and high-level collaborations. Reversely, these advancements will shape a network fit for addressing questions at the continental scale in a concerted manner. The distributed RI will serve a wide range of scientific disciplines and stakeholder groups. eLTER is specifically dedicated to achieving long-term sustainable operations and thereby collaborating closely and synergistically with environmental RIs and other initiatives nationally, in Europe and globally.

Goal 3: Create a unique and widely accessible service portfolio

The comprehensive eLTER RI service portfolio will be of direct scientific and societal relevance and serve multiple stakeholder categories. It will be elaborated in compliance with existing reference schemes such as European Open Science Cloud (EOSC) and co-designed by continuous screening of the usability and evaluating the feedback from users of the services. The eLTER Service Portal will be the one-stop gateway to all eLTER RI resources, supporting the collection of, and access to, harmonised data from eLTER *in-situ* facilities and access to other services provided by *in-situ* facilities and centrally. Options for co-developing tools and services in technical and strategic collaborations will be continuously explored with both external and internal users.

Goal 4: Promote collaboration, integration, and a conducive working culture

eLTER RI aspires to exemplary global citizenship with high ethical and environmental standards, which are reflected in its collaborative and inclusive working culture within the RI and between the RI and stakeholder communities. The RI will strive to establish productive and synergistic relations with other, related RIs across Europe and globally, to maximise the uptake of its services,

strengthen its policy impact, avoid redundancy, and make productive use of complementary services provided by Collaborating Infrastructures. Within the RI, eLTER will create a collaborative working culture through its integrative governance structure and will advance a transdisciplinary research framework encouraging cooperation between multiple disciplines and knowledge sources. As diversity is a core value and catalyst towards a stronger, more resilient, and more productive research community, eLTER will invest in the current and next generation of European scientists and strengthen the diversity of its research community. This will be done by adopting policies to encourage participation of diverse individuals, particularly from those communities that suffer from systemic bias and discrimination.³⁴

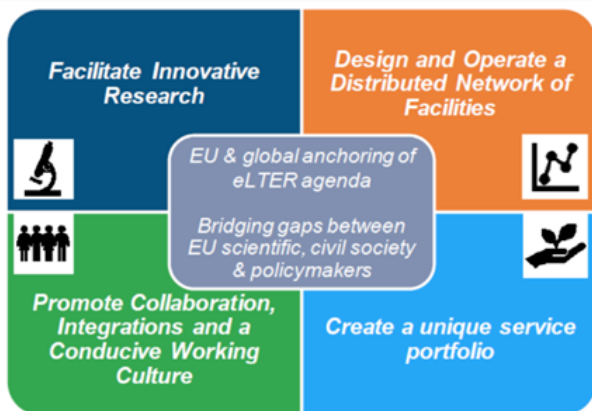


Figure 1: Overview of eLTER RI strategic goals. The four goals will contribute to two main achievements indicated in the centre.

1.6 eLTER Business Model

eLTER RI is designed to deliver high impact research and catalyse new insights about the compounded impacts of climate change, biodiversity loss, soil degradation, pollution, and unsustainable resource use in terrestrial, freshwater, and transitional water ecosystems.

The main challenge that eLTER helps to solve is environmental degradation driven by biodiversity loss and land use change, climate change and pollution. The main focus domain with greatest impact for eLTER's work is land use (including themes such as bioeconomy and urbanization) (see Chapter on eLTER's market trends and opportunities). The below business model canvas (Figure 2) describes how eLTER RI aims to achieve its mission by describing its key partners, activities, value proposition, customer relationships and segments, channels, resources, costs, and revenue streams.

³⁴ Nikolaidis et al. (2021)

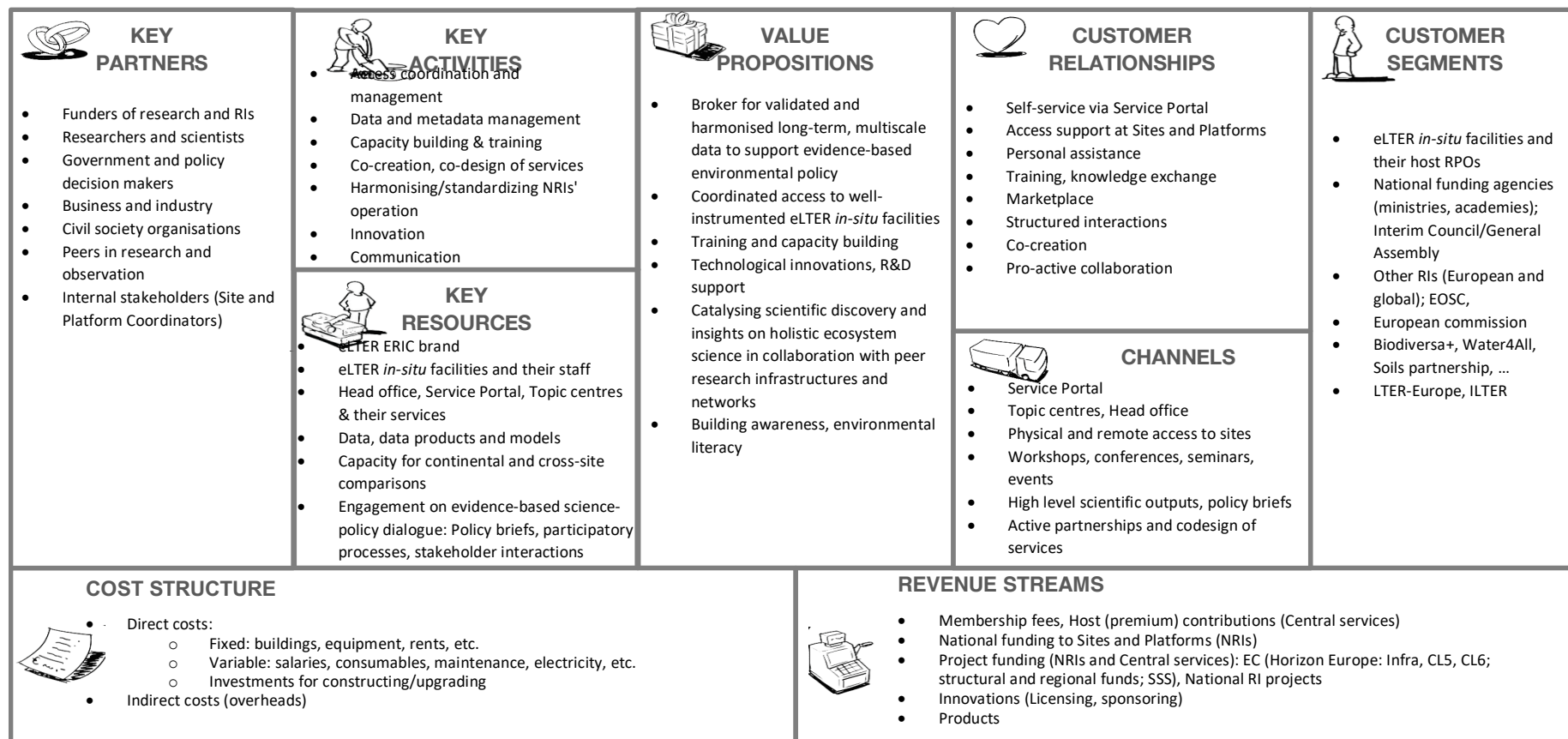


Figure 2: eLTER's business model canvas.

1.7 Societal Benefits and Horizon Europe Funding Strategy

The eLTER RI will research trends in ecosystem structures and functions, matter fluxes, energy fluxes and biodiversity changes and link them with human resource use and other activities as possible drivers in the long term. It will contribute to the knowledge and understanding needed by policy and management for informed decision making regarding the long-term safeguarding and effective management of European ecosystem services (Natura 2000, Water Framework Directive, etc.).

Through building the eLTER RI, the quality of urgently needed information on ecosystems and ecosystem services will be increased and be provided in a more cost-efficient way compared to previous, non-standardised attempts. This streamlining process involves the bundling of research activities; standard design components for an effective use of multiple sites by various research communities; and multiple facility use.

A study by Hughes et al.³⁵ has demonstrated that long-term ecosystem studies, in comparison to the funding they need, possess a disproportionately high capacity to inform policy makers regarding pressing environmental issues. In the medium term, eLTER will foster positive impacts on e.g. human health, land use changes, climate resilience, protection from environmental hazards, and sustainable use of natural resources.

1.8 Benefits for Members

eLTER RI offers multiple benefits for members regarding site and platform operations, physical research infrastructure, data services, training and funding (see Table 2 below). Most important identified benefits include expansion of site access to new users, anchoring eLTER in ESFRI results to pave way for the inclusion of sites, their instrumentation and operation in strategic planning by institutions and funding agencies and distribution of ecosystem research infrastructure based on scientific requirements. They also include standardisation and harmonisation planning, collaboration of communities to advance multidisciplinary research, comprehensive collection of systematic datasets, encouraging multi-site research and researchers from diverse disciplines and countries as well as data integration and interoperability. Other identified most important benefits are an open access service portal with improved user-friendly interface, joint training activities and knowledge sharing as well as provision of sound decision basis for cost-effective ecosystem research infrastructure development. The table below provides an overview of the identified benefits.

Table 2: Significant benefits of eLTER RI for members.

| Areas of impact | Current situation and challenges | Added value by the eLTER RI |
|---|--|--|
| Site & platforms operations – Level of | Sites sometimes underused and depending on current users | Site access will be expanded to new users via Transnational Access, Remote Access and Virtual Access |

³⁵ Hughes et al., (2017)

| | | |
|--|--|---|
| coordinators and operating institutions | | Increased level of knowledge and skills through eLTER training of the Site and Platform Coordinators and technicians |
| | Site funding reliant on projects and temporary agreements | eLTER RI will enable secure funding for sites as they will be considered in the mid- and long-term strategic planning by institutions and funding shareholders |
| | Sites are detached from the local/regional communities due to focussing only on natural scientific research | Socio-ecological research methods and data availability will encourage and support the engagement of sites with local society |
| Physical research infrastructure and access – National level | National fragmented site networks and site distribution is not purposefully designed to address European-scale issues | eLTER RI provides coverage of European environmental zones and ecosystem types by the distribution of ecosystem research infrastructure across Europe based on scientific requirements with scale-explicit, nested design according to the properties of varying landscapes and ecosystem types |
| | Standardisation efforts restricted to national programmes, disciplines, domains or discontinued projects | eLTER RI ensures use of harmonised protocols and standardised equipment across domains and countries, and encourages involvement of private sector to foster innovations |
| | Lack of coordination and information exchange can inhibit collaboration on inter- and transdisciplinary questions and hinder benefits from shared facilities across infrastructures. | eLTER supports collaboration of scientific communities with a clear division of tasks, service provisioning and handover points, facilitating multidisciplinary research, and providing access to shared facilities in response to societal grand challenges |
| | Poorly coordinated research approaches with inefficient use of resources | Co-location of RIs improves coordination across the Sites and thus ensures sustainable use of available resource use |
| Physical research infrastructure and access – European Research Area | Random representation of properly equipped sites across major ecosystem types due to fragmented ecosystem research networks and projects. | Proper coverage of European environmental zones and ecosystem types in a constantly streamlined ecosystem research infrastructure, well integrated with related environmental RIs and building on major investments of preceding programmes |
| | Fragmented and unharmonized knowledge provision of the state and functions of critical ecosystem services | eLTER RI provides a comprehensive collection of systematic datasets on critical parameters describing ecosystem structures, functions, processes and services in major European environmental |

| | | |
|---|---|--|
| | | zones and ecosystem types and for addressing the global grand challenges |
| | Existing permanently operated facilities offer heterogeneous sets of services and are not consistently documented | Services of eLTER Sites/Platforms are well categorised research facilities are harmonised and well documented. |
| | No systematic access to infrastructure. Trans-national access only available sporadically | eLTER Sites offer consistent process for access and a single point of contact that encourages multi-site research. |
| Physical research infrastructure and access – Global ecosystem research | Limited partnerships for international collaborations | High attractivity for international collaborations with networks such as TERN (Australia), NEON (USA); ability to take up an international leadership role |
| | Misaligned global initiatives | Coordinated European RI with potential to lead global networks |
| | Limited and poorly accessible data | eLTER RI will provide improved access to harmonised and interoperable long-term data through an open access data portal with improved user-friendly interface |
| | Only a few sites with efficient real-time data collection of critical ecosystem parameters | eLTER RI carries out real-time data collection |
| Training and other services | Staff training arranged locally when needed | eLTER RI organises joint training activities and enables knowledge sharing to specialists and to all career levels (technicians, RI managers, students, professors etc.) |
| | Limited involvement of SMEs in technology development; fragmented and restricted to few sites | eLTER Business Plan will pave the way for SMEs in European-wide marketplaces opening for developing new measurement technologies and benefit from their application and marketing |
| Costs and funding: Costs | Redundant focus of national site networks on identical environmental zones and ecosystem types, whereas other ecosystems are under-represented | Cost-efficient division of tasks between countries and environmental zones |
| Costs and funding: Funding | Multiple competing environmental RIs with varying representation and foci across countries, partly due to a lack of documentation, dialogue and division of tasks | A quantitative overview of <i>in-situ</i> ecosystem research sites, European design and clarified interactions with Collaborating Infrastructures provide policy bodies with a sound decision basis to establish long-range plans for the further development of a concerted ecosystem |

| | | |
|--|---|--|
| | | research infrastructure of pan-European and global interest |
| | National sites and networks often funded via short-term projects and research consortia | Inclusion of Sites in eLTER RI, which is embedded in European and global scale RI design and planning provides a sustainable basis of funding and embedded in European and global scale RI design and planning |

1.9 Infrastructure Description

eLTER is a state-of-the-art distributed research infrastructure that aims to facilitate high impact research and catalyse new insights about the compounded impacts of climate change, biodiversity loss, soil degradation, pollution, and unsustainable resource use in terrestrial, freshwater, and transitional water ecosystems. eLTER provides researchers with access to c.a. 200 Category 1 and 2 eLTER Sites and 50 eLTER Platforms across Europe and biogeographical regions. In addition to the distributed network of Sites and Platforms, eLTER provides centralised services for diverse stakeholder groups through the Head Office and Topic Centres, providing significant added value for its Members.

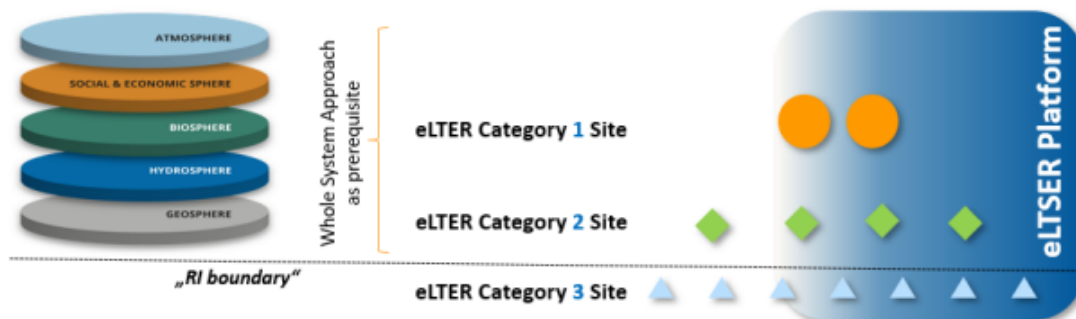


Figure 3: eLTER's whole system approach.

eLTER Sites: eLTER Sites are specific geographic locations and small-scale ecosystem research sites typically dedicated to long-term socio-ecological research on human environment interactions at the regional or landscape scale. They are of limited size (up to 10 km²) and comprise of mainly one habitat type and form of land use³⁶. There are two categories of sites which implement a whole system approach, covering all spheres of the system. Category 1 Sites implement the most advanced (prime) methods in at least two of the spheres in the Whole System research, while Category 2 Sites are required to follow the basic methods in observations. The eLTER Site categorization is also designed to address the heterogeneous site conditions, incl. varying habitats and terrain properties. The staged specification of categories responds to the need to be as

³⁶ eLTER (n.d.) a.

concrete as possible but leave space for customising in applying categories to a wide range of structural and organisational settings.

Table 3: Mandatory criteria for eLTER Sites of Category 1 (SCat-1) and Category 2 (SCat-2).³⁷

| Mandatory criteria for eLTER Sites | SCat-1 | SCat-2 |
|--|--------|--------|
| Observational design covering the whole system (WAILS) | X | X |
| All system spheres covered with Standard Observations basic method | X | X |
| Specialisation: for at least two spheres the Standard Observations prime method applied | X | |
| Secured capacity for Transnational (physical) Access, Remote Access | X | |
| Guaranteeing Virtual Access (i.e. open access to data) | X | X |
| All-year access guaranteed (road infrastructure or other infrastructure) | X | (X) |
| Roles populated: Site coordinator, data manager, and responsible director in ROP | X | X |
| Full documentation in the eLTER site registry and nationally acknowledged | X | X |
| Long-term operation: <u>Past</u> operation since ≥10yrs and <u>future</u> in accordance with eLTER RI planning | X | X |

eLTSE Platforms: eLTSE Platforms facilitate research on interactions and feedback between the environment and society. Similar to eLTER Sites, they are divided into two categories based on requirements for following standard observation criteria. eLTSE Platform is a modular facility that consists of one or more eLTER Sites which are located in an area with defined boundaries. Besides this physical component, eLTSE Platforms provide multiple services like the networking of actor groups (e.g. research, local stakeholders), data management, communication and representation (management component). The elements of eLTSE Platforms represent the main habitats, land use forms and practices relevant for the broader region (up to 10000 km²) and cover all scales and levels relevant for eLTSE (from local to landscape).³⁸ The size of the platform must be suitable for capturing human-environment interactions at the landscape scale in a holistic way.

There are four fundamental characteristics of eLTSE Platforms:

- 1) Spatially explicit living laboratories for transdisciplinary, long-term, socio-ecological research and for implementing Whole Systems research approach.
- 2) Harness scientific research on human-environment interactions for addressing environmental challenges and facilitating sustainability transitions.
- 3) Research conducted at the regional scale using diverse disciplinary, interdisciplinary, and transdisciplinary approaches in tight coordination with local and regional stakeholders.

³⁷ Mirtl et al. (2023)

³⁸ eLTER (n.d.) a.

4) Supported by long-term environmental, social and economic data.

Head Office: The Head Office serves as the administrative and coordination centre of eLTER. It is responsible for implementing the decisions of the General Assembly, coordinating the eLTER RI activities at the European level when it comes to strategy building, concepts, implementation plans, and operations. The Head Office promotes the RI at the European and international level and provides a focal point of expertise for strategic development and operation of RI functions.

Service Portal: The eLTER Service Portal is a functional unit of the eLTER Head Office, and a digital gateway that provides access to eLTER services and resources. It acts as a one-stop-shop for researchers and other users of services. The Service Portal connects users to the right services and serves as a contact point for the RI. In addition, it provides a web access point for data, information, and communication within the RI as well as site registration.

Topic Centres: Topic Centres are European level centres providing added value services. Within eLTER they are hosted by different European institutions and will deliver services in the areas of data management, optimised design and RI interoperability, technological innovation modelling, synthesis towards actionable knowledge, as well as networking among researchers.³⁹

³⁹ eLTER (2017)

2 User Strategy

2.1 Value Proposition

eLTER is an essential contribution to world-wide efforts to better understand ecosystems. Through research and observation, eLTER seeks to improve our knowledge of the structure and functions of ecosystems and their long-term response to environmental, societal and economic drivers. eLTER enables world-class ecosystem research by a well-connected, extensive community of experts, supported by advanced sites and facilities, shared and easily accessible data and capacity building programmes. Based on the identified value generation, six distinct value propositions have been formulated (Table 4).

Table 4: eLTER's value propositions.

| eLTER's value propositions |
|---|
| Broker for validated and harmonised long-term, multiscale data to support evidence-based environmental policy |
| Coordinated access to well-instrumented eLTER <i>in-situ</i> facilities |
| Training and capacity building |
| Technological innovations, R&D support |
| Catalysing scientific discovery and insights on holistic ecosystem science in collaboration with peer research infrastructures and networks |
| Building awareness, environmental literacy |

2.2 eLTER User Community

Multiple scientific user communities will benefit from the eLTER RI. The wide disciplinary array is reflected by the over 160 signatory research institutes of the eLTER RI Science Case, from 27 countries. The anticipated number of eLTER RI users in its early years are c.a. 2500 assuming support and sites in 19 countries currently participating in the Interim Council (formal decision-making body in Preparatory Phase).

The scientific users of eLTER RI are likely to be active in a wide range of fields⁴⁰: traditional ecosystem research (89%); biodiversity research (74%);

⁴⁰ numbers in brackets are the % of LTER-Europe national networks who expect eLTER RI to fully provide the national research capacity

catchment scale hydrological research (58%); biogeochemical cycles research (47%); socio-ecological research (26%); critical zone research (11%).

Ecological and environmental research communities will be the main users of eLTER RI, and in most countries, they have already established close collaboration with the national long-term ecosystem research site networks. The user community will grow with the development of harmonised data and access structures and with the efficient links to related European (e.g. other ESFRIs) and global (e.g. GEO, IPBES) organisations.

Table 5: Results of a survey of European LTER networks received from 10 countries (Belgium, Finland, France, Germany, Greece, Serbia, Spain, Sweden, Switzerland, and the United Kingdom).

| By origin of user | Estimated number of users | % |
|---|---------------------------|-------|
| Users from lead country (Germany) | 93 | 11% |
| Users from other EU countries | 675 | 79% |
| Users from non-EU countries | 82 | 10% |
| By type of user | | |
| Academia (university, research institute) | 647 | 76.1% |
| Business/industry (Commercial) | 35 | 4.1% |
| Public service; local or regional authority; Governmental | 167 | 19.6% |
| Other | 1 | 0.1% |
| By Activity (some users may be in more than one category) | | |
| Reporting on environmental change | 561 | 34% |
| Research to understand ecosystem processes | 548 | 33% |
| Research on human impacts on ecosystems | 311 | 19% |
| Developing new technologies & methods for ecosystem research and monitoring | 219 | 13% |

2.3 Service Provisioning

eLTER RI provides access to ca. 250 sites and platforms. Data gathered on these sites is integrated with a wide range of other data from sources, such as remote sensing and official statistics. eLTER service portfolio is built to promote the core activities and service of its stakeholder groups, from scientific research to policy and industry. eLTER's services span across six Thematic Service Areas (TSAs). In addition to these six areas, the Head office provides central strategic and coordination activities.⁴¹ The table below summarises the eLTER Thematic Service Areas and elaborates on some of the key benefits generated by the services.

⁴¹ eLTER (n.d) b.

Table 6: eLTER RI Thematic Service Areas.

| eLTER Thematic Service Areas, (TSAs) | Description of the Thematic Service Areas | Examples of the benefits generated by the Thematic Service Areas |
|---|---|---|
| Data management & integration | These services will include both acquisition of data from the field site network, cataloguing of sites and related data, and the dissemination of quality assured data products through data portals and web services in a FAIR manner. They will encompass services to support Sites and Platform Coordinators in submitting their data and services that open eLTER RI data to a wide community of users. | <ul style="list-style-type: none"> • Making long-term <i>in-situ</i> data available • Making reliable, standardised, and continuous data available • Making available tools for data management plan • Making available data streams (Standard observations) – drive decision support systems • Enables assessment of ecosystem status and trends, incl. biodiversity |
| Optimised Design & RI Interoperability | The services in this set relate to the specification of the RI site network and its interoperability with other RIs, maximising potential for cross-RI research support (e.g. through multidisciplinary data sets). They will include specifying requirements for new measurements and protocols across the network and expertise on calibration of Standard Observations. These proposed services, which are mainly aimed at supporting existing and potential eLTER RI sites, would be part of support for site design in how best to configure sensors and facilities at sites including maintenance and calibration procedures. | <ul style="list-style-type: none"> • Provision of guidelines on integrating different research infrastructures (standard obs. Protocols etc) and developing new standards for the existing ones. • Provision of Co-location (standardisation). • Making the RI landscape comprehensible to funders/shareholders and elaborate eLTER's role. • Providing best practices for integrating RIs. |
| Technological Innovation and Developments | These services will be aimed at the commercial sector and other organisations that will benefit from the eLTER RI as a testbed for new sensors and observation technologies. Through these services eLTER RI will seek to collaboratively increase the technological capabilities of the RI through research and development of new commercial and open-source technologies in environmental monitoring. | <ul style="list-style-type: none"> • Test and validate new instrumentation and methodologies • Co-design of instrumentation to identify use cases for industry • Commercial use of data • Cooperation with other European projects |
| Analysis tools and Modelling | This suite of services will bring together the capabilities to develop new analytical methods and modelling techniques for extending the use of eLTER Standard Observations either through statistical interpolation, | <ul style="list-style-type: none"> • Generating products on models, remote sensing and <i>in-situ</i> data. • Create value through offering a basis for decision making |

| | | |
|--|---|---|
| | combination with other contextual data (e.g. with remotely sensed data) or as driving data for process models to produce forecast data (e.g. through combination with climate scenario data). | <ul style="list-style-type: none"> • Create high value products at various spatial scales relating to numerous thematic layers. • Generation of forecasts, scenarios and long-term predictions • Provision of the whole system approach models (WAILS) • Integrating data from several sources, supporting interoperability with other RIs. |
| Synthesis towards actionable knowledge | These eLTER services will provide a platform through which to develop solutions for complex environmental problems. This can be achieved by integrating the cross-disciplinary expertise gathered in eLTER with social sciences and decision-making processes. The services in this cluster will aim to provide an integrative framework for research in sustainability science, based on eLTER RI's network of eLTER Sites and eLTER Platforms. The implementation of these services will directly address the challenge of bridging the frequent gap between data acquisition and the actionable knowledge required for pursuing sustainable development using a whole system approach. | <ul style="list-style-type: none"> • Generation of common assessment work, including in human-nature interactions, to enable policy recommendations. • Support nexus management strategies and generation of knowledge base |
| Central analytics and observation | These services will address two aspects that complement eLTER's Standard Observation and the Whole System Approach. First, certain analyses (eDNA, hydrochemistry, etc.) could be delivered through central laboratories that operate according to eLTER standardised protocols. Second, some data may be obtained through centrally organised campaigns (e.g. geophysics or aircraft-/drone campaigns) at eLTER Sites. | <ul style="list-style-type: none"> • Internal service for sites that provide standard observations, such as calibration laboratory comparisons, and laboratory analysis, geophysical campaign or remote sensing analysis |
| Head Office | Head Office (HO) services include both outward facing services such as access to field sites for external researchers and internal services such as managing the RI communications strategy and related web sites. | <ul style="list-style-type: none"> • Covers all administrative matters of eLTER ERIC |

2.4 Access to Data and Ecosystem Models

The core aim of eLTER is to provide stakeholders with an integrated access to high quality data and data products, which rely on Sites and Platforms covering the main ecosystems across Europe, their functioning and services. The unique selling point of eLTER is the provision of data encompassing all “spheres” constituting the ecosystems (atmosphere, hydrosphere, geosphere, biosphere, socio-econosphere), thus enabling a whole systems approach (WAILS). Another key contribution of eLTER is that it combines ongoing harmonised observations performed based on clearly defined protocols – the eLTER Standard Observations – with a rich database of legacy data going back in time up to several decades. These data are further combined with models (mechanistic and statistical models, artificial intelligence tools) through different methodologies (AI-based model-data fusion, data assimilation, model parametrization and calibration, etc.) and other data sources (e.g., remote sensing data) to obtain added value data products. These data products provide a solid data basis for further synthesis towards actionable knowledge and a reliable and consistent basis for decision-making for different stakeholder groups (e.g., policymakers, industry, civil society).

Two Topic Centres manage the process of production and publication of eLTER data and data products through several central services:

1. The Topic Centre on Data Management and Integration is responsible for (i) the catalogue and registration of all sites and platforms, (ii) the discovery and access to Standard Observation data, legacy and relevant contextual data, (iii) the application of quality assurance, storage and archiving eLTER Standard Observation data, as well as (iv) the provision of metadata for the documented entities.
2. The Topic Centre on Analysis Tools and Modelling (i) provides a catalogue of models and tools suitable for further processing and analysis of eLTER data, (ii) produces gap-free data products relying on Standard Observation and legacy data at different scales (from site to continental scale), (iii) supports the development of stakeholder-specific data products relying on eLTER data, and (iv) supports the simulation of scenarios assessing the impacts of anthropogenic and environmental changes on ecosystem functioning and services.

Data harmonisation

Integrated and interoperable usage of the data and data products is only possible with a standardised metadata description and a unified format. In collaboration with experts from all spheres in ecosystem sciences, eLTER has defined Standard Observation protocols, which specify not only the measurement and processing methods, but also the metadata, the quality control, the unit, the (time) aggregation, the format, etc. for each of the observed variables. This ensures the release of standardised and interoperable data. In a similar way, eLTER has specified the requirements for high level data products. This harmonisation is crucial as it ensures semantic interoperability, which is especially important for biodiversity and sociological data, where the data are often interpretations from collected evidence, i.e. unstructured data. In the eLTER context, the eLTER Vocabulary service and the Central Catalogue will function as a catalogue where different types of data will be listed and registered, allowing the searching of data resulting from different kinds of

measuring processes (sensors, laboratory analyses, remote sensing, etc.) by using unambiguous expressions.

Data quality

On a first level, data quality is checked at site/platform level following the specifications in the Standard Observation protocols. For legacy data, the Quality Control procedure of the respective national network is kept. On a second level, the Topic Centre on Data Management and Integration is responsible for the final Quality Assurance of the data and data products before their publication. The Quality Assurance follows the guidelines of the new European Interoperability Framework, which suggests that high-quality data should meet the user's needs in terms of accuracy, completeness, consistency, timeliness, accessibility, compliance, and understandability⁴². This also ensures the data and data products follow the recommendations of the FAIR data principles. To achieve these high-quality goals, eLTER data management practices rely on principles such as data governance, data stewardship, and data quality management outlined and documented by data management plans.

Ensuring visibility and open access to eLTER data and data products

Making its data and data products publicly accessible in a user-friendly and efficient way is a core objective of eLTER. Standard Observation and legacy data as well as processed data products are accessible through different portals according to the agreements made with the national eLTER networks. eLTER complies to the best practices on open access and FAIR data provision of ecosystem data to publish datasets ranging from raw data to high-level data products.⁴³ All published data and data products include detailed metadata, information on the applied processing and Quality Assurance/Quality Control methods, as well as information on provenance and ownership of the data. As data products and their workflow documentation must be reproducible, the raw data and processes leading to the data product will be transparent and citable with a persistent identifier. This also enables tracking data usage and gaining credit to the data publisher (institution and/or researcher).

The Central Data Node is complemented by two additional components: (i) DEIMS-SDR, providing metadata on the eLTER facilities (e.g. sites and platforms) as well as on the observation context (e.g. locations and sensors), and (ii) the Central Catalogue, the catalogue containing metadata on all datasets, models, tools, etc. provided by eLTER and providing a single point for discovery and access. These platforms store the information (data, metadata) in a standardised machine-readable manner, using recognized semantic description methods, so that they can be easily accessed, e.g., via an application programming interface.

Added value data products

In the eLTER stakeholder community and world-wide, there is a strong need for added value data products related to the past, current and future state of ecosystems and their functioning (e.g. provision of ecosystem services, their role in the Earth system). These data products, which rely on the eLTER Site and eLTER Platform legacy and concurrent data, range from gap filled time series (Level 2) to high-level data products (Level 3) on all relevant spatial scales, ranging from site scale over catchment scale to continental scale. These

⁴² European Union, (2017)

⁴³ All published data are compliant with the General Data Protection Regulation rules, which is particularly relevant for socio-economic data.

data products allow for further analysis of processes, interactions, and feedback, especially also between the “spheres”, in the context of global warming and environmental and anthropogenic induced changes and pressures on ecosystem functions and services. Thus, these high-level data products provide the information and data basis for synthesis towards actionable knowledge, communication, and decision support.

These added value data products are produced with analysis tools and models (e.g., statistical tools, mechanistic models, AI applications). The data products elaborated by the reference services of the Topic Centre on Analysis Tools and Modelling are considered to be released open access and FAIR via the eLTER Cyberinfrastructure and comply with the aforementioned requirements regarding metadata and format. For the customised data products, their release mode will depend on the agreement with the respective stakeholder. Data products building on eLTER data and complying to the eLTER specifications for data publication (metadata, Quality Assurance/Quality Control format, etc.) can get an “eLTER label” ensuring their quality and reliability. As mentioned above, the models and tools are also considered to be made publicly available, which would allow their further usage and development.

2.5 Market Trends and Opportunities

eLTER’s market is described through three market areas that derive from the grand challenges addressed in chapter 1.4. The identified market areas link to the grand challenges with the most economic potential and where eLTER contributes to identifying and developing relevant solutions. In addition, eLTER operations crosscut three domains that represent the channels through which eLTER’s operations provide value.

Science domain: eLTER will provide scientists open and reliable access to integrated, standardised observations and to the Sites and Platforms that are offering physical and remote access to perform high-quality site-specific research, and upscale their research to continental scale; this way branding the eLTER RI as a provider of unique resources for advancing science.

Public policy domain: eLTER will provide the governmental stakeholders high quality data on the efficiency and impact of environmental regulation imposed on climate change mitigation, pollution and biodiversity loss, in order to verify and communicate the impacts of measures imposed by the environmental legislation. Future services of eLTER in the public policy domain will include Policy Briefs, Boundary Objects and Policy Forums. Knowledge-based scientific products can be broadly utilised in policy making.

Innovation and business domain: eLTER data products and digital tools can be used for market-oriented applications and decision-making processes. eLTER will provide the industry stakeholders robust and high-quality data and data products on the efficiency and impact of environmental regulation. The generation of high-quality scientific knowledge generates opportunities to create data driven applications and the concentration of expertise can spur new innovations that require large, complex and long-term-data sets, including sensors and software. Spin-off companies may directly benefit from eLTER data products to apply e.g. in environmental monitoring, prediction, modelling or foresight.

Market area 1: Biodiversity loss and land use change

Biodiversity is currently declining at an unprecedented rate. This encompasses all aspects of biodiversity, from the level of genetic diversity⁴⁴, to species, communities, functional diversity and ecosystems. Several potential drivers are implicated, including habitat loss, intensification of land use, pollution, biological invasions, overexploitation and climate change⁴⁵.

Biodiversity holds significant economic value especially in the form of ecosystem services. Costanza et al.⁴⁶ estimated the value of the total global ecosystem services in 2011 to be \$125 trillion/year, and by the year 2021 this value was estimated to be \$150 trillion annually.⁴⁷ At current rates, the world economy could see annual Gross Domestic Product (GDP) decline of \$2.7 trillion by the year 2030⁴⁸.

Human operations are a key driver of biodiversity loss. Four value chains – food, energy, infrastructure and fashion - have been identified to contribute to over 90% of man-made pressure on biodiversity⁴⁹.

eLTER will focus on standardised set of parameters and protocols for biodiversity observations, to enable a holistic approach to biodiversity assessment⁵⁰. In a network approach, tools and data flow pathways need to be provided to ensure timely integration of the data needed to detect patterns and trends in both biodiversity and pressures acting on biodiversity. Co-location of measurements (particularly at eLTER Category 1 sites and Category 2 sites) relating to ecosystem functions and services, land use and abiotic pressures on biodiversity maximises the potential application and informative value of these data.

Market area 2: Climate change and greenhouse gases

European ecosystems are threatened increasingly by a range of impacts stemming from climate change. Driven primarily by the use of fossil fuels, the atmospheric concentrations of greenhouse gases, carbon dioxide, methane and nitrous oxide have all increased since the onset of industrialisation due to human activity.

The carbon dioxide caused by human activities is the largest climate change contributor. The share of carbon dioxide in the atmosphere had risen by 2020 by 48% above the pre-industrial level (before 1750). Human activities also emit other greenhouse gases.⁵¹ The key contributing sectors by share of global greenhouse gas emissions are energy (includes transport, energy use in industry and buildings (73,2%), agriculture, forestry and land use (18,4%), industry (5.2%) and waste (3,2%).⁵²

Global warming poses substantial risks to natural and human systems with implications to the global economy. Studies indicate that the cost of climate change is estimated to level between 1-7% of GDP.⁵³ Researchers estimated

⁴⁴ e.g. Balint et al. (2011)

⁴⁵ e.g. Jaureguiberry et al. (2022)

⁴⁶ Costanza et al. (2014)

⁴⁷ Kurth et al., (2021)

⁴⁸ World Bank (2021)

⁴⁹ Kurth et al., (2021)

⁵⁰ Zacharias, S. et al. (2021)

⁵¹ EC (n.d.) g.

⁵² Ritchie, H. (2020)

⁵³ Fujimori et al., (2023)

that between 2000-2019 the climate-change attributed costs of extreme weather events averaged to \$ 143 billion annually. The global costs of climate change related damages are expected to be between \$ 1.7 trillion to 3.1 trillion annually by 2050, including damages for property, agriculture, infrastructure and human health.⁵⁴

There is a clear need for an eLTER RI that substantially enhances pan-European networking of instrumented field sites for monitoring and research needs, supplemented by a wider ensemble of observation sites that capture spatial patterns of responses of biodiversity, biogeochemical cycles, state of ecosystems, and ecosystem services to climate change.

It will be highly desirable to co-locate these sites with those Collaborating Infrastructures that are dedicated to monitoring specific elements of the environmental system, e.g. ICOS sites with respect to carbon fluxes or UN Air Convention ecosystem monitoring sites with their focus on air pollution effects. High temporal resolution measurements made at local to catchment scales will be vital for the development of a clearer understanding of the ecological process linkages behind climate change.

The long-time series and the large spatial extents covered by the eLTER RI will provide much of the fundamental understanding of macroscale relationships between climate and ecosystems. Research programmes will benefit from intelligent spatial integration of data, - a prerequisite for the development of appropriate management and action plans.

Market area 3: Pollution

Pollution refers to the discharge of harmful materials in our environment. By origin, pollution can be natural or created by human activities.⁵⁵ Environmental pollution refers to pollution in air, water, soil, noise, light and others. Developments in urban life and technology have resulted in release of hazardous waste from industrial sites, such as plastics, heavy metals, acid rain or the burning of fossil fuels, but also increased light pollution and noise in the cities.⁵⁶

Pollution can cause an alarming number of premature deaths and wreak havoc on both human and planetary health. Costs associated with environmental chemical exposures worldwide alone may exceed 10% of the global gross domestic product, according to a new study from Harvard T.H. Chan School of Public Health and EHESP School of Public Health in France.⁵⁷ The authors said current calculations substantially underestimate the economic costs associated with preventable environmental risk factors.

Uncovering the impacts of eutrophication by nitrogen and phosphorus as well as toxic pollutants ranging from heavy metals to persistent organic pollutants (POP), volatile organic compounds (VOC) and endocrine disruptor substances is core business for the majority of existing LTER sites (e.g. context of the UNECE International Co-operative Programmes on Forests, Water, Vegetation and Integrated Monitoring). In many cases only long-term monitoring within a full ecosystem research framework can reveal biogeochemical substance

⁵⁴ Bennett, P. (2023)

⁵⁵ National Geographic (n.d.)

⁵⁶ Gaur, N. et al. (2024)

⁵⁷ IISD (2023)

behaviour in the natural environment, such as the unpredicted high mobility of lead in forest ecosystems.

2.6 eLTER as a Platform for Innovation

eLTER strives for innovation and new technologies required for discipline-integrated ecosystem research. Thus, collaboration between eLTER and its partners is necessary to accelerate the European Research Area in ecosystem research to global excellence and science-based, viable product and service innovations. This requires collaboration and potentially co-research with company partners in various sectors. The ability of eLTER to function as a desired scientific partner to companies with innovation potential is also linked to eLTER's ability to strengthen its socio-economic impact and the search for solutions to grand challenges.

The evolving eLTER RI provides an unprecedented opportunity to overcome the limitations imposed by temporal and spatial scales of existing biodiversity observations. Integration of biological time series with large-scale assessments, coupled with additional information from e.g. regional climate and land-use models within complex spatio-temporal models is made possible by statistical advances and increased computational power. Such combinations will allow eLTER to analyse the variation and trends in biodiversity at the European scale.

In the following, a few examples of how eLTER as a provider of long-term socio-ecological data could serve as a platform for innovation are outlined. Particular potential is foreseen in the realms of artificial intelligence (AI), loss-modelling and neural networks, including software and data products and services which can bring benefits for businesses at national and EU levels.

Environmental Monitoring and Management:

- **AI-driven Early Warning Systems:** Development of early warning systems for environmental threats such as floods, wildfires, and pollution. These systems can analyse vast amounts of historical and real-time data to predict and mitigate potential disasters.⁵⁸
- **Remote Sensing and Image Analysis:** Promotion of AI enhanced processing of remote sensing data to monitor changes in land use, vegetation cover, and water bodies. This includes per-pixel analysis, object detection, and semantic understanding to provide detailed environmental insights.⁵⁹

Loss-Modelling:

- **Natural Disaster Impact Assessment:** Development of systems for modelling the potential impacts of natural disasters on socio-ecological systems. This includes predicting economic losses, infrastructure damage, and ecological impacts.⁶⁰

⁵⁸ Wani, A. et al. (2024)

⁵⁹ Wani, A. et al. (2024)

⁶⁰ Chen, L. et al (2023)

- **Insurance and Risk Management:** Development of AI-driven loss-modelling that can assist insurance companies in assessing risks and determining premiums based on historical data and predictive analytics.⁶¹

Neural Networks for Predictive Analytics:

- **Agricultural Productivity:** Support the creation of AI and neural networks which can predict crop yields and optimize farming practices by analysing long-term data on weather patterns, soil health, and other ecological factors.⁶²

2.7 eLTER Communication Strategy

The eLTER communication strategy aims to establish a deep understanding of eLTER's vision and mission, to inspire the formation of an eLTER community and to motivate researchers and stakeholders to join this community and participate in its activities. In order to have a long-term impact on science in Europe and worldwide, eLTER needs to strategically engage a wide range of users in the co-creation, development and application of eLTER services and facilities.

The chosen approach for eLTER's Dissemination, Exploitation and Communication activities is in the form of an open and inclusive communication of eLTER's progress and achievements, in a manner which informs, educates, and relates with the target audiences.

Key objectives of eLTER communication:

- To create awareness of eLTER's vision, mission, and strategic goals;
- To inform a broad range of audiences about the ongoing eLTER activities;
- To establish the eLTER RI brand as a relevant, trustworthy, and cooperative entity;
- To engage a wide range of users from a variety of domains in the use and continuous development and co-creation of eLTER services and facilities, and thus
- To have significant and long-term value for science in Europe and worldwide.

eLTER RI has four identified communication target groups to whom its communication is specifically intended:

1. **Decision and policy makers, ESFRI, and funding organisations** - includes decision- and policy makers at all levels, ranging from local and regional authorities and national policy makers to European policy makers and agencies, and global agencies and intergovernmental organisations.
2. **Scientific users and eLTER community** - includes researchers and science stakeholders who will be the main direct users of eLTER RI services.

⁶¹ Chen, L. et al (2023)

⁶² Fan, Z. et al (2023)

3. **Peers in research and observation and environmental RIs** - includes related *in-situ* and remote monitoring and observation networks and organisations and related research infrastructures in the environmental domain, including European scale e-infrastructures and e-infrastructure initiatives like the European Open Science Cloud.
4. **Public, business, and industry** - includes civil society organisations and the public ranging from citizen science organisations, environmental NGOs, land and forest owners' organisations to the wider public, as well as businesses and industry interested in using services of the eLTER RI or contributing to innovation and cooperation.

eLTER will use a wide range of communication channels and means of dissemination to ensure its messages reach its stakeholders. These include:

- the eLTER website: the central platform for dissemination of information to all its key communication target groups and any other interested parties
- eLTER newsletter: produced regularly describes and promotes new services, scientific publications using data from eLTER or its component networks, meetings, outreach events, and upcoming events and training
- Media and social media: Traditional media (print and online) is used to engage civil society, decision-making bodies, and industry, to raise awareness of eLTER and its objectives, and to disseminate information and scientific findings. Different social media channels are used for different purposes, including eLTER X and Facebook to promote news, information, and scientific findings from eLTER and its partners while providing space for discussion about eLTER and its activities
- Scientific publications and articles in scientific media: eLTER data, products, and services will form the basis of countless scientific publications and articles in scientific media to disseminate scientific knowledge and information about eLTER and its facilities and services
- Promotional branded materials: a range of printed and digital promotional materials as well as practical promotional gifts branded with the eLTER logo convey consistent core messages and increase brand recognition of the eLTER RI
- Events and training: eLTER organises a range of events and training in physical, virtual, and hybrid format to inform, update, and engage its internal and external stakeholders. In addition to organising events, eLTER participates in various events ranging from scientific conferences to stakeholder workshops and meetings to increase visibility, understanding, and support of the RI and its activities and services by its users, members, and other stakeholders

3 Governance and Organization

3.1 eLTER ERIC Legal Entity

The eLTER RI will become a European Research Infrastructure Consortium (ERIC). eLTER ERIC is an entity established under Union law and possesses legal status from the effective date of the Commission decision establishing it. It is recognized as a legal entity with extensive legal capacity in all Member States, without the need for national transposition or legal instruments. Additionally, eLTER as an ERIC must be acknowledged by its host country, which strengthens its role in the broader research policy landscapes and it has the ability to enter into agreements with other legal entities.

The legal framework for an ERIC is designed to facilitate the establishment and operation of research infrastructures of European interest, involving multiple European countries. The ERIC Regulation, based on Article 1872 of the Treaty on the Functioning of the European Union (TFEU), provides a common legal framework. As an ERIC eLTER is a legal entity with legal personality and full legal capacity recognized in all EU Member States. Its internal structure is flexible, allowing members to define membership rights, obligations, and the bodies of the ERIC in their statutes. The liability of ERIC members is generally limited to their respective contributions.

As an ERIC eLTER may benefit from exemptions from VAT and excise duties on purchases in all EU Member States, and it can adopt procurement procedures respecting transparency, non-discrimination, and competition. The ERIC framework is primarily intended for new research infrastructures but can also be used by existing infrastructures that choose to change their legal status to become an ERIC. It is important to note that the ERIC is suitable only for high-profile research infrastructures with a European dimension, which also can provide eLTER a credible advantage in a highly competitive funding environment.

3.2 Host Organisations and Host Country

For the Central Services of the distributed eLTER RI, host organisations will be selected based on calls for applications. The components of the Central Services (CS) include the Head Office including the Service Portal, Topic Centres and potential other units. The Central Services of the eLTER RI can be established in different legal formats in a physical or virtual format. The host selection process includes the following steps:

1. Call for host applications
2. File management, eligibility and plausibility checking
3. Evaluation of the applications and hearing of candidate host organisations or host consortia
4. Suggestion of host institutions to the eLTER Interim Council for approval

Place of establishment of the Central Services

1. **Physical location:** Both independent and linked legal entities (e.g. a subsidiary company) could be established on the host applicant's premises or on their own premises.
2. **Virtual approaches:** eLTER services could entirely or partly be installed virtually and use cloud services operated by host organisations or by third parties, e.g. in the framework of the EOSC services hub.

The selection process of eLTER Host Country is expected to be formally completed in 2025. Currently, the preliminary Head Office is hosted by the Helmholtz Centre for Environmental Research, UFZ in Germany.

Table 7: Tentative timeline and key steps for the host selection process.⁶³

| | |
|-------|---|
| 06/24 | Approval of the Host Selection process by the eLTER Interim Council |
| 06/24 | eLTER Central Facilities concepts and (technical) specifications complete regarding the first call |
| 06/24 | eLTER call text for host applications is approved by IC_07 |
| 09/24 | First call published for host applications starts for Data Management Topic Centre and Head Office with deadline 11/24 |
| 02/25 | Applications of first call evaluated and of candidate host organisations hearings completed |
| 06/25 | Tentative: First Host institutions suggested to and approved by Interim Council (exact date depends on the timing of the respective meeting) |
| 09/25 | Tentative: Head Office and Data Management Topic Centre implementation and SLA (Service Level Agreement) coordination starts (during the ERIC founding process) |
| 03/25 | Tentative: Second call is issued for further topic centres – Call will again be open for six weeks |
| 8/25 | Tentative: Applications of second call evaluated and of candidate host organisations hearings completed |

3.3 Members and Observers

eLTER ERIC has three categories of participants: members, permanent observers, and observers from four entity groups:

- Member states of the European Union

⁶³ Haubold et. al (2021)

- Associated countries to the European Union
- Third countries other than associated countries
- Intergovernmental organisations

Each category of participants has unique features, as displayed in the table below (Table 8).

Table 8: Members, permanent observers and observers.

| | Members | Permanent observers | Observers |
|--------------------------|--|---|--|
| Conditions for admission | Entities willing to become members of eLTER ERIC may apply for membership. | An entity that foresees a lasting participation in eLTER ERIC, but that for domestic reasons is not in a position to become a member, may be granted the status of permanent observer. | Entities willing to contribute to eLTER ERIC but are not yet in a position to join as members, may apply for observer status. |
| | The admission of entities as new members shall be subject to the approval by the General Assembly. | The admission of entities as new permanent observers shall be subject to the approval by the General Assembly. | The admission or re-admission of observers shall be subject to the approval by the General Assembly. |
| Duration | Unlimited | Unlimited | An observer may be admitted for a limited period of time. |
| | | | The General Assembly, on request of the observer, may extend that initial period once for a one-year extension. |
| | | | In exceptional cases the General Assembly may accept more than one extension of an observer status. |
| | | | At the end of the maximum period of time, observers shall become either members or permanent observers. |

| | | | |
|---------------|---|---|---|
| Rights | The right to participate through its representatives in and vote at the General Assembly | The right to attend the General Assembly without a vote | The right to attend the General Assembly without a vote |
| | The right for its research community to participate in eLTER ERIC events and activities, such as workshops, conferences, training courses | The right for its research community to participate in eLTER ERIC events and activities, such as workshops, conferences, training courses as identified by the General Assembly | The right for its research community to participate in eLTER ERIC events and activities, such as workshops, conferences, training courses as identified by the General Assembly |
| | The right for its research community to have access to support from eLTER ERIC and the Topic Centres of the distributed research infrastructure for its eLTER Facilities (eLTER Sites and eLTSER Platforms) | The right for its research community to have access to support from eLTER ERIC and the Topic Centres of the distributed research infrastructure for its eLTER Facilities (eLTER Sites and eLTSER Platforms) | The right for its research community to have access to support from eLTER ERIC and the Topic Centres of the distributed research infrastructure for its eLTER Facilities (eLTER Sites and eLTSER Platforms) |
| | Elect and be elected for the governance bodies of eLTER ERIC through its representatives | Elect and be elected for the governance bodies of eLTER ERIC through its representatives | |
| | Host eLTER Topic Centres | Host eLTER Topic Centres | Can't host eLTER Topic Centres due to temporary participation |
| | Participate in the development of strategies and policies of eLTER ERIC | | |
| | Purchase goods and services to be provided in-kind for the official and | | |

| | | | |
|--------------------|---|---|---|
| | exclusive use of eLTER ERIC which are solely for the non-economic activities | | |
| Obligations | Provide the annual contribution | The same as members, except the obligation to empower its representatives with the full authority to vote on all issues raised during a meeting of the General Assembly | The same as members, except the obligation to empower its representatives with the full authority to vote on all issues raised during a meeting of the General Assembly |
| | Appoint one or more representing entities | | |
| | Appoint 1-2 official representatives for the General Assembly and indicate the representative who has voting rights on behalf of the Member | | |
| | Empower its representatives with the full authority to vote on all issues raised during a meeting of the General Assembly | | |
| | Commit to perform/contribute to eLTER ERIC tasks and activities | | |
| | Promote the adoption of relevant eLTER standards within its national eLTER community | | |
| | Promote uptake of services among researchers and scientific communities in the member state | | |
| | Facilitate integration into national and other relevant infrastructures | | |

| | | | |
|------------------------|--|---|---|
| | <p>Provide the necessary technical infrastructure and resources for their eLTER Facilities and Topic Centres</p> <p>Commit to a minimum term of five years of membership</p> <p>Run National Facilities of enough quality to provide services to eLTER</p> <p>Keep confidentiality of the information to which the Members and their representing entities may have access when the information shared is declared as confidential or internal information</p> <p>Promote the adoption and maintenance of the quality standards and standard operation procedures of eLTER ERIC in their contributing eLTER Facilities</p> | | |
| Membership fees | Annual contributions as to be specified in Annex II to the Statutes (budget, contributions) | Same membership fee as for members | Lower fees than for members and permanent observers |
| | | Annual contributions as to be specified in Annex II to the Statutes (budget, contributions) | Annual contributions as to be specified in Annex II to the Statutes (budget, contributions) |
| Withdrawal | No withdrawal within the first 5 years after the establishment of eLTER ERIC, | No withdrawal within the first 5 years after the establishment of eLTER ERIC, | Observers may withdraw at the end of a financial year. |

| | | | |
|------------------|--|--|--|
| | afterwards, members may withdraw at the end of a financial year. | afterwards, permanent observers may withdraw at the end of a financial year. | |
| Liability | The members, permanent observers and observers are not jointly liable for the debts of eLTER ERIC. | | |
| | The members' financial liability for the debts of eLTER ERIC shall be limited to their respective annual contribution. | The permanent observers' liability for the debts of eLTER ERIC shall be limited to their respective annual contribution. | The observers' liability for the debts of eLTER ERIC shall be limited to their respective annual contribution. |

3.4 Governance Model and Governance Bodies

The organisation of eLTER has been designed to best service the ambitions of the eLTER RI user community. The eLTER RI will be built on the foundations of a standardised and coordinated network of the NRIs with the added value of strategic design and centralised governance of service provision from the Head Office and Topic Centres. This structure is fundamental to ensuring that the existing characteristics of the NRIs are respected and maintained, and that they are utilised fully in realising the ambitions of the eLTER RI. A legal entity (eLTER ERIC) will be set up to operate the eLTER RI and coordinate activities of the main building blocks: NRIs and Central Services.

The governance structure of this legal entity comprises the main triangle of the Head Office as the secretariat and Director General, the eLTER General Assembly and the Research Infrastructure Committee. The Director General leads the Head Office in accordance with decisions made by the General Assembly. Representatives of the funding bodies constitute the GA, which oversees strategic decision making and overall budgeting. Heads of Topic Centres and representatives of the eLTER NRIs form the RI Committee, which serves as the link between Central Services, the NRI and RI governance. Strategic decision-making is supported by the external Scientific and Ethical Advisory Board(s) (SAB). Figure 4 shows an overview how different physical RI elements are linked to each other and to the users. Figure 4 shows the planned organisational structure of the operative RI and its governance bodies. The management roles and required skills are further discussed below in chapter 4.1.

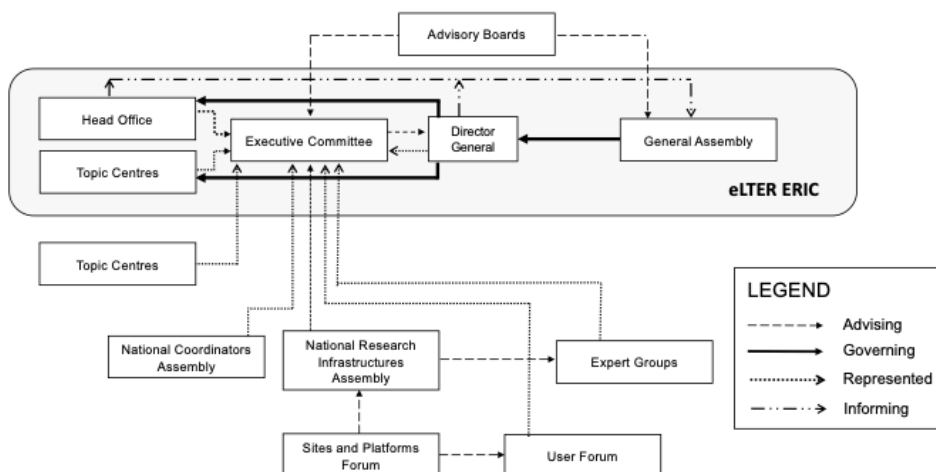


Figure 4: Governance structure of the Operative Phase eLTER RI. Boxes with names presented in a plural format denote a collection of similar structural elements. Each of them has the same position and interrelations within the eLTER RI. Therefore, in these cases, only one box is presented in the graphic to increase clarity. Lines show only a selection of the major foreseen interactions, but not all of them while arrows show the major, but not the only directions of interactions. This simplification was done for the sake of legibility.

To accomplish the two design goals – supporting excellent science by access to comprehensive environmental information and geographical coverage – a

hierarchical and modular structure of site categories was developed. It provides the organisational and structural framework of eLTER NRIs. The creation and provision of data embedded in a systems context, which implies intensive and long-term observation at selected sites, was balanced with the challenge to achieve wide-scale systematic coverage of the major European terrestrial and aquatic environments and socio-ecological zones.

This requires a set of observatories designed for highest operational excellence (“highly instrumented sites”) or novel platforms for inter- and transdisciplinary teams (“socio-ecological research”). These elements are combined with sites providing sufficient spatial coverage, linked through harmonised standard observations with the more cost intensive elements. This allows for up- and downscaling of information.

The integrated eLTER RI’s hierarchical design assumes an increasing number of facilities towards the bottom of the following hierarchy:

1. Regional multi- and transdisciplinary case study areas (eLTSER Platforms), comprising multiple, spatially nested smaller scale elements.
2. Two categories of smaller scale ecosystem research sites (eLTER Sites): categories 1 and 2.

3.5 Access to NRIs

The eLTER distributed *in-situ* facilities provide three modes of access: Transnational Access, Remote Access and Virtual Access. These modes are supported by the European Commission access funding scheme. The roles of the user and site staff differ between each access type and considers different roles for users and for the site staff, as shown in the table.

The Access Scheme is following the European Commission policies and open to any user. Experience has shown that most of the users are from scientific researchers and are very often at an early stage in their careers. The Access Scheme is, however, also open to users from other groups, including business and industry, civil society and the wider public.⁶⁴

⁶⁴ eLTER (n.d.) c.

Table 9: Description of access types.

| | Transnational Access | Remote Access | Virtual Access |
|--|---|---|--|
| Access characteristics | Physical access to one or more sites by users | Site staff performs site-based measurements on behalf of user | User accesses site data only |
| Role of users | Users perform their own on-site measurements or experiments | Users define protocols for observations and experiments to be performed at the site(s) by local staff | Users download data from sites, in the future using the eLTER Service Portal |
| Role of site staff | Explains the facilities and supervises users' activities | Performs work on users' behalf and sends results and/or specimens to the users. | Currently, data and metadata are held locally. In the future, Standard Observations are uploaded to eLTER's IT infrastructure along with a metadata file |
| Funded (providing the availability of external funds) | Travel costs and accommodation of users, running costs for the site to support the visitors | Running costs and working time of site staff. | |

3.6 The Transition Phase from Preparatory Phase to eLTER ERIC

eLTER will be registered as a legal entity right after the Preparatory Phase Project (PPP) to avoid any legitimacy gaps or loss of momentum. To mitigate this risk, implementing a lighter structure will be explored preceding the ultimate legal entity, such as a Memorandum of understanding (MoU), if necessary. The PPP manages the Preparation Phase, including establishment of interim governance bodies (high level strategic decision-making body prioritising engagement of the shareholders), and coordination of the Implementation Phase before handing it over to the legal entity. The interim governance bodies reflect the governance structures of the chosen legal entity and enable smooth establishment of post-PPP governance.

4 Management and Human Resources

4.1 eLTER Management

As a distributed research infrastructure, the eLTER RI requires an organisational structure that allows for local autonomy while ensuring coordination and consistency across all actions. This regards essential aspects such as stakeholder engagement, data management, funding and resources allocation, and performance evaluation.

The eLTER ERIC will be the legal entity encompassing the central elements of the eLTER RI. It will be responsible for the strategic focus of eLTER, provide oversight, accountability, and long-term orientation. With its General Assembly and the Director General, it operates the main decision-making authorities. The governance model and structures of eLTER are discussed in more detail in chapter 3.4 above.

As a distributed RI some operations and components will be part of eLTER ERIC and others outside of it, functioning under the authority of each host organisation. The eLTER ERIC will collaborate closely with the distributed parts of the research infrastructure to achieve a coherent research infrastructure, which operates towards common goals and maximises the impact of the services.

eLTER management roles and required skills

Director General

The Director General is responsible for the fulfilment of the decisions of the General Assembly. The Director General proposes new items to be decided by the General Assembly, for instance, adaptations of the financial or strategic planning. The Director General is accountable for the adequate financial management of the RI and oversees the preparation of the annual financial and activity reports. The Director General represents the RI externally and is the primary contact point for all parties outside of the RI. Accordingly, he/she is the legal representative of the RI.

Head of Topic Centre

The specifics of this role depend on the way in which each eLTER Topic Centre will be organised, especially whether they are inside or outside of the ERIC. Regardless of this, the Head of each Topic Centre will report to the eLTER Head Office on the services provided. They will assume responsibility for

ensuring continuous operational efficiency, responsiveness, and effective communication, all of which will be clarified in specific Service Level Agreements.

National Coordinator

The National Coordinators assume an ambassadorial responsibility towards the eLTER ERIC, effectively bridging the gap between (1) their respective National Research Infrastructures and (2) the broader eLTER RI related landscape. They engage in proactive information gathering, diligently collecting insights and feedback from the diverse array of sites and platforms. This holistic approach encompasses essential matters such as service requisites, ongoing research priorities, the evolution of national scientific and technical capacities, recent achievements, ongoing projects, as well as any challenges encountered during operations.

Site or Platform Coordinator

The primary responsibility of the Site or Platform Coordinator is to ensure that the facility delivers the needed data and services as agreed with the eLTER ERIC. They oversee the ongoing research, observation, and analyses centred around ecosystem functioning on a day-to-day basis. They work on a local scale reporting to the host institutions of the site or platform and interact with the European scale of eLTER in line with eLTER concerted policies and collaborative strategic planning.

4.2 Financial Management and Control Systems

The goal of the financial management in eLTER ERIC is to run operations on a non-economic basis, efficiently and according to the adopted budget. Full transparency is applied on financial matters of eLTER. eLTER will be run according to the Host legislation on accounting standards and principles. The eLTER General Assembly decides on the RI strategic orientation, policies, and objectives.

The financial management of eLTER ERIC shall be governed by the Statutes, Financial Principles, based on International and European Public Sector Accounting Standards, and any regulations drawn up by the eLTER ERIC General Assembly and in accordance with relevant European and German legislation.

Financial Planning of eLTER ERIC and eLTER

The financial period of the eLTER ERIC shall be five consecutive calendar years (budgetary cycles). Each Central Service (whether part of eLTER ERIC or not) and NRIs consortium shall provide specific work programs and related financial plans for the 5 years. A 5-year eLTER Financial Plan shall establish the general framework for the detailed annual budget of eLTER ERIC based on the work programs and related financial plans provided by each Central Service (whether part of eLTER ERIC or not) for the 5 years.

The 5-year financial plan shall set the level of the Host Premium Contributions and Host Contributions that the Hosting Countries agree to provide as well as the level of Membership Contributions that the Members, Permanent Observers and Observers agree to pay. The 5-year Financial Plan must be supported by a

description of the objectives and activities of eLTER for the period concerned. The Director General proposes the five-year Financial Plan of eLTER and eLTER ERIC to the General Assembly, in consultation with the Financial Committee. The General Assembly approves the five-year Financial Plan for eLTER ERIC.

A Financial Committee shall be established by the General Assembly to support matters related to the management of the financial planning of eLTER ERIC.

Financial Management Principles

- eLTER ERIC is a non-economic (non-profit) organisation and eLTER NRIs are operated nationally.
- eLTER ERIC shall be subject to the requirements of the law, accounting standards and principles of the country where it has its statutory seat as regards preparation, filing, auditing and publication of accounts.
- The eLTER Service Portal and Topic Centres may be part of eLTER ERIC or linked to it through cooperation agreements between the ERIC and the Host Institutions of the Central Services.
- Cooperation agreements between eLTER ERIC and the Host Institutions of the Central Services set out the rights and responsibilities of eLTER ERIC and the Central Services' Host Institutions and govern the funding in order to ensure proper operation and running of eLTER.
- eLTER Central Services shall respect the legislation and accounting procedures of their Hosting Countries.
- All items of expenditure and revenue of eLTER ERIC shall be included in the annual budget to be drawn up for each year of the financial period.
- The revenues and expenditures of eLTER ERIC shown in eLTER ERIC budget shall be in balance over the long term.
- The budget shall be established and implemented, and the accounts presented in compliance with the principle of transparency.
- The General Assembly shall ensure that eLTER ERIC resources are used in accordance with the principles of sound financial management and only for purposes as laid down under the Statutes.
- Any external funding or contribution shall be used only for the purpose it has been dedicated for in the framework of the eLTER work plan.

4.3 Employment Regulations

Mobility within eLTER RI

Mobility within the RI is an important factor in the training and skills development of new generations of researchers, technicians, and data professionals, but also in developing the operational capacity of the RI. This is done by sharing expertise and knowledge among members having different focus areas or potentially hosting co-located sites with other RIs. Those persons visiting elements of RIs receive training and technical support, and have the opportunity to acquire new skills e.g., in the use of advanced technologies, data analysis and quality control or specific administrative matters. Facilitating mobility within career paths is also essential for securing the right people at the right place at the right moment, following the principles of equality, diversity, and inclusiveness. One way for eLTER to provide opportunities to learn new skills

and support professional growth would be an organised and managed staff exchange programme covering the whole RI. Through an exchange programme, personnel can gain a wide knowledge of eLTER activities. Furthermore, they can also better plan their future and career paths and train themselves as professional RI experts. The details of the exchange programme will be developed in future updates to this document.

Pensions in eLTER ERIC

One of the obstacles to effective researchers' mobility in Europe, including RI's managers and operators, is the fragmentation of the pension systems and limited transferability of pension rights across countries. To address this obstacle, the European Commission established a European pension fund for research organisations and their employees called RESAVER21. RESAVER facilitates mobility across the EU providing an attractive solution to securing transferability and accumulation of pension rights across countries and employers. It is an interesting scheme that could be considered for the ERIC.

Spreading information about opportunities

Advancing career development opportunities is of limited value if information about them is not easily and widely available. While work is underway to establish a wider network of those responsible for communications at national level, the Head Office has only limited capacity to keep updated with the activities of the numerous institutions involved in eLTER. It is important that eLTER connected institutions inform the Head Office about available new employment or training opportunities, thus ensuring that comprehensive and current information is available to be spread to the wider research community.

4.4 Equality

Equal treatment is a key principle of an effective human resources policy and any discrimination based on gender identity, ethnicity, disability, race, or religion should be prohibited, in line with Article 21 of the European Union Charter of Fundamental Rights. eLTER is by nature international, consisting of people from many countries. While this diversity is a strength, it is also in the interest of the RI to facilitate mobility so that people can choose their working place based on their expertise. The requirements for any position should be set so that they are available for everyone equally regardless of nationality, according to applicable national legislation and other rules. In addition, eLTER will actively work to develop access schemes that allow equal participation of different people in all life situations to be able to work at the RI facilities. There will be certain exceptions, for instance Transnational Access programmes to eLTER Sites focussing on early career scientists. Such targeted programmes are set up for the purpose of fostering certain groups, but not for the purpose of discriminating against others.

eLTER RI is committed to gender equality and the elimination of gender bias, explicit and unconscious, within all aspects of eLTER RI administration, projects, and day-to-day operations. eLTER is prominent and visible at the European scale, and therefore can give an example to others. eLTER is committed to equality and actively addressing social and other biases and forms of discrimination.-This commitment extends beyond traditional binary gender definitions to include biases and discrimination against trans- and non-binary individuals as defined by our Gender Equality Plan.

eLTER RI recognises that structural and systemic biases produce gender inequality throughout the scientific and academic communities. Maximising diversity of staff and perspectives is important for building a resilient RI. eLTER RI is therefore committed to remedying inequality within and beyond the RI. To do so, the RI will implement a series of administrative, policy and educational measures to directly address and alleviate gender bias and its outcomes. These include explicit statement of objectives, adoption of EU gender equality guidelines regarding gender representation, and implementation of educational programming for our RI community of researchers and the broader stakeholder community. Our recruitment processes will strive to meet explicit equality and gender-balanced employment targets, to compensate for the impact of systemic discrimination in the broader scientific and academic communities. More concretely, human resources practices should integrate the aim for equality in gender representation within eLTER RI administration at all administrative levels, and work towards equal representation in leadership positions in all eLTER funded collaborative projects (following the EU aspiration to maintain a maximum differential of ca. 40–60% representation). eLTER's dedicated Ombudsperson oversees and promotes equity within the RI and actively works towards increasing awareness of both open and unconscious inequality and biases.

4.5 Recruitment

Both for ERIC and the distributed parts of the RI, personnel can be provided as in-kind or cash contributions.

ERIC staff are subject to the employment legal framework of the Member States where they work. eLTER ERIC shall have its own staff rules, which will define the conditions of employment and recruitment in more detail. These rules will follow the legislation of the country where people are working and will define for example the following kind of items: employment contracts, trial period, terminating employment, training, and personal development, working hours, holiday, absences (e.g., family leave, temporary childcare leave), salary, benefits, allowances, and occupational health.

Employment contracts that are valid indefinitely should be used as much as possible in order to provide job security and motivate people to commit to the RI for longer periods. Outsourcing should be used only for routine and supportive activities like for example IT-help, handling invoice routines and payroll etc.

A potential interim solution (Assessment on the Implementation of the ERIC Regulation, 2021) for the lack of EU-based contracts with the same applicable labour rules and regulations in every Member State could be to define a specific template. Through an agreement between the countries participating in an ERIC, this would allow for a reference contract and for standard employment conditions. These would still be implemented within the national legal frames. However, the potential standard part of the employment is relatively limited (e.g., to the definition of careers and description of the functions) to avoid conflicts with the national regulations. Nevertheless, the ERIC should strive to offer the same employment conditions across countries to the greatest possible extent. For more details regarding this matter, see chapter "Recommendations for the distributed parts" below.

Head Office

eLTER is a large and highly distributed research infrastructure and therefore the leadership, management and organisational structure play an especially important role. As an RI eLTER must respond to the diverse requirements and needs posed by researchers, other national stakeholders, national and regional governments, and funding agencies as well as European bodies, such as ESFRI (the European Strategy Forum on Research Infrastructures) and the European Commission. For example, eLTER RI should respond to the long-term needs of the research community, link new scientific knowledge and innovation, and collaborate with industry in relevant sectors. In addition, eLTER is as an RI expected to have an impact on society and employment. This requires that all elements of the eLTER RI are well organised and sufficiently resourced with skilled staff. The Head Office must be able to answer the coordination and integration needs necessary for eLTER to become a coherent European RI providing its services efficiently and to meet expectations by the different stakeholders⁶⁵. During the implementation and operation phases, the required Head Office workforce consists of⁶⁶:

- Qualified senior management specialists and operations officers with backgrounds in RI administration & management, organisational skills and experience in programme/project management and monitoring.
- Specialists in project management
- Specialists in systems engineering and data management.
- Specialists in web design and user interface development, and visualisation.
- Specialists in communications and PR, in outreach and dissemination, and liaisons and partnership portfolio management.
- Financial experts to deal with budgetary issues and account management.
- Experts on constitutional, employment and tax issues of the ERIC seat country laws, regulations, and rules.
- The operational phase includes the Director General or Board of Directors of the eLTER ERIC, who should be qualified and merited senior expert(s) in pertinent fields in an executive role, responsible for eLTER scientific development, strategy, relations, and partnerships, administration, and finances, and experienced in leading organisations and/or distributed networks or RIs.

Service Portal part of ERIC

The Service Portal will be inside of the ERIC legal entity and is the entry point for all eLTER RI services for users. It provides functions like data discovery, visualisation and download of data through various eLTER cyberinfrastructure components. It is the main access point for information and communication

⁶⁵ Barov, B. et al. (2021)

⁶⁶ Alam, SA (2021)

within the RI and to the external users. The requirements for Service Portal personnel include expertise in agile project management, programming, systems engineering, data and database management, web design and user interface development, visualisation, and general data science expertise. Expertise in producing data products to inform policy will also be required.

Topic Centres as part of the ERIC

In addition to the Head Office and Service Portal, the Central Services include several Topic Centres. The composition and services of Topic Centres are listed in the service catalogue and further specified in the Service Portfolio. The Topic Centres provides important services to users through the Service Portal, which are outlined in section 2.3. The Topic Centres can be composed of one or several nodes hosted by different research performing organisations (RPO⁶⁷). The Topic Centres can be hosted in more than one country. Some Topic Centres might not be part of the eLTER ERIC, yet they follow the joint strategy and objectives of the eLTER RI.

The needed skill set per Topic Centre will vary and depend on their legal status as part of the ERIC, part of an RPO, a consortium or an own legal entity.

While the exact needs of the Central Services are currently being specified, some general capacities and roles required can be foreseen. These include (but are not necessarily limited to):

- Roles within project management
- Roles within data management
- Technicians
- Modellers
- Managers/Primary investigators
- Administrators
- Leadership roles

Recruitment in other parts of the eLTER RI than ERIC

Recruitment in the Topic Centres happens either via national RPOs according to their procedures or in case of a consortium or own legal entity according to its procedures.

Topic Centres

As noted above in “Topic Centres part of ERIC” the status of Topic Centres as being within or without the ERIC remains to be determined. This document will be updated as this is clarified.

National Research Infrastructure (NRI)

Recruitment at the Sites and Platforms (i.e. in the NRIs) happens via national RPOs according to their procedures.

⁶⁷ Research Performing Organizations refer to universities, technology research organizations and other research organizations which actively conduct research activities and actively engage in the creation of new knowledge.

Recommendations for the distributed parts

One of the key goals of personnel planning and recruitment is to sustain the RI with motivated and committed personnel in the long term. Whenever possible, positions in eLTER, whether full time or part time, should be provided through a transparent recruitment process giving equal chances for everyone to apply.

A balance between senior and junior staff is crucially needed, so that in case of a change, expertise and knowledge is not lost but transferred. eLTER will also benefit from having professionals working under contracts which are valid indefinitely to encourage continuity of expertise, while competitive salaries help to hire the best possible expertise to eLTER. However, personnel working in the distributed parts of the RI, which are not part of the eLTER ERIC, will follow their own organisations' recruitment policies and conditions of employment will vary within eLTER depending on the national legislations and rules. Examples of the labour laws and codes in different countries that may vary are employment acts, collective agreements, regulations on annual leave and working hours, employee pension regulations, and legislation on privacy etc. However, as described above, depending on the degree to which employment conditions can be harmonised between countries within the ERIC, national variation in these areas will also occur within the ERIC.

4.6 Performance Monitoring Plan

The Performance Monitoring Plan for the eLTER Research Infrastructure provides a systematic assessment of the effectiveness of its operations and research outcomes, and of identifying and implementing enhancements where necessary. This plan sets out a comprehensive framework for monitoring performance, including the identification and tracking of key performance indicators (KPIs) across a range of areas, such as Data, Dissemination, Economic, International Cooperation, Science and Training. The plan establishes clear, quantitative baselines and targets for these KPIs, ensuring consistent monitoring of performance over time. The data collection methods are defined in detail to guarantee the reliability and validity of the information gathered, while data quality assurance processes are in place to maintain integrity. The plan includes comprehensive analysis and reporting mechanisms to facilitate clear communication of performance insights to stakeholders. Regular reviews and evaluations allow for the identification of best practices and lessons learned, fostering a culture of continuous improvement. The plan also incorporates stakeholder engagement, ensuring that diverse perspectives are considered and that feedback is incorporated into decision-making processes. By addressing potential challenges and implementing mitigation strategies, the plan remains adaptable and responsive to the evolving needs of the eLTER RI.

The Socio-economic Impact Assessment (SEIA) is part of eLTER's regular performance monitoring. eLTER's SEIA framework provides a coherent and systematic method to examine both the current and the future state of eLTER's impact, focusing on analysing progress on eLTER's defined impact pathways both on the academic and broader socio-economic arenas. In this way the SEIA ensures systematic measures and support to strengthen the created outcomes and impacts related to eLTER's goals and objectives. In SEIA, the data collection is organized in several separate surveys and other data collection methods with distinct timelines.

The eLTER General Assembly will approve the annual Performance Monitoring report. In 5 years intervals an external evaluation will be performed and a report produced for the General Assembly.

4.7 Career Development and Training

Career development for research infrastructure professionals

eLTER will foster career development for professionals working within the RI and identify any specific needs for support. For RI professionals working at the interface of technical site and platform operations, research, and management there is typically no clear job profile or career path. An unfortunate consequence of this is that such professionals are often not sufficiently acknowledged by the broader scientific community, which results in relatively few individuals being interested in pursuing such a career path. The RI (through the Sites and Platforms Forum, SPF) will investigate enabling training certificates, and promote the use of more standardised and widely acknowledged job descriptions that would be comparable between distributed environmental RIs. Particularly for early career researchers, who may be looking beyond more widely recognised career paths in academia, this would be advantageous. This is accentuated especially viewed over the long term and would demonstrate that it is possible to advance such careers within eLTER. Making the RI attractive for career development is essential for the development of a successful RI that is sustainable over the long term. By both importing and developing expertise, the risk of spreading available resources too thinly and avoiding an over-reliance on a few key individuals is minimised. A further benefit of enhancing the status of persons working at the research and operational interface is to help retain existing talent within the RI, where individuals may otherwise feel obliged to move to academia or industry to advance their careers.

Developing training and educational programmes

As the RI aims to engage talented professionals to provide the best possible services for its users, it needs to provide training possibilities and competitive career opportunities for those who want to specialise in managing and operating an RI. In addition to gaining new skills, the experience of shared training serves to bring the community together, increasing the understanding of RI operations, but also fostering personal connections across countries. The shared training of early career scientists and technicians would also serve to embed the values of eLTER across the whole RI and be a means to make up for the still inadequate recognition within the community of job profiles situated at the science-operations interface.

During the transition from preparation to implementation, it is especially important to identify any urgent training needs and avoid situations where new operations reveal a lack of required competences. In the implementation phase, a specific training programme for the eLTER staff, as well as training for early career scientists and technicians in eLTER relevant fields will be developed based on the needs of the RI as a whole. This would serve the dual function of internal development and advertising careers in the RI to the wider community. Targeted training programs also have an important role to play in advancing the careers of female RI scientists, who are facing a broader, often unequal, job market.

The development of training and education programmes is covered in more detail in eLTER's Capacity Building Strategy, where a key distinction is made between building capacity (e.g., through training) internally and externally. The internal part is intended to cover those working in Central Services and national NRIs while the external part is aimed at users and stakeholders of the RI.

4.8 Premises and Facilities

It seems probable that the eLTER ERIC Head Office will be located at the Helmholtz Centre for Environmental Research - UFZ in Leipzig, Germany. The UFZ is one of the foremost research institutions globally in the field of environmental research, with a high degree of social recognition⁶⁸. The UFZ is a Helmholtz Centre with an excellent connection to the entire research landscape in Germany and across Europe, which will undoubtedly benefit eLTER.

The eLTER ERIC Head Office facility comprises several fully equipped offices, a larger office that can be used as a meeting room, and access to larger video-conference ready meeting and conference rooms at the same premises.

The specific premises and facilities of the eLTER Topic Centre are not yet known, but they will meet the generally high standards required by the eLTER ERIC and its users.

⁶⁸ Helmholtz Centre for Environmental Research (n.d.) Our Vision.

5 Financial and Funding Framework

5.1 Member and Host Country Contributions

The Membership Fee will be provided in cash to support the operations. By the decision of the Interim Council (later the General Assembly), Membership Fee shall be allocated to all Central Services.

The Interim Council will decide the principles of Membership Fee in Autumn 2024. The anticipated eLTER ERIC Membership Fee model consists of the following components (percentages will be defined later):

1. Site and Platform number -based fee = dividing a share of the Membership Fee among Members based on the number and category of Sites and Platforms. The Site and Platform number -based fee increases linearly with additional Sites or Platforms as follows:
 - a. Site Category 1 (most intensive category) will be charged at full price,
 - b. Site Category 2 (less intensive category) will receive a 50% discount of the full price,
 - c. The Platforms' discount will be defined later,
 - d. Additional discounts may be applied later (e.g. related to co-location with other ERICs).
2. GDP share = dividing a share of the Membership Fee using Member-specific percentage share of total GDP of all Members. The reference used here is the average GDP over the last known period of 5 years before the constitution of the ERIC (e.g., 2019–2023), thereafter always the last 5 years before each assessment. The data for the GDP estimates of EU member countries can be obtained from Eurostat, and for other countries, from the World Bank.
3. Equal share = dividing a share of the of the Membership Fee equally among Members.

Membership Fee for the Permanent Observers is suggested to be the same as for Full members, and for temporary Observers a fixed fee equal to half the median of the Membership Fee (countries only).

Possible Membership Fee for intergovernmental organisations will be computed as a lump sum, which should be agreed on the basis of the 5-year rule (including a possible revision at the end of a 5-year cycle), plus a fee based on the possible number and type of the Sites and/or Platforms it hosts.

[Median membership fee for 12 and 19 countries]

The Table 10 showcases IC Members and the country commitments to NRI in two scenarios (12 and 19 countries). The Host (premium) contribution here is assumed to be 50% of the income, and the rest is paid by Membership fees according to the principle: Equal share 30%, GDP 45% and Site number/category 25% (NOTE: this principle has not yet been adopted by the IC / August 2024).

Table 10: eLTER Interim Council Members and country commitments to NRI in 12 or 19 country scenarios.

| Country | Membership, role in Interim Council | Anticipated commitments to operate the eLTER NRI (no of sites) | Anticipated Membership fee, k€/a (12 countries) | Anticipated Membership fee, k€/a (19 countries) |
|------------------------|-------------------------------------|--|---|---|
| Austria | Member, Vice chair | | | |
| Bulgaria | Member | | | |
| Czech Republic | Member | | | |
| Finland | Member | | | |
| France | Member | | | |
| Germany | Member | | | |
| Greece | Member | | | |
| Israel | Member | | | |
| Italy | Member | | | |
| Latvia | Member | | | |
| Netherlands | Member | | | |
| Portugal | Member | | | |
| Romania | Member | | | |
| Slovak Republic | Member | | | |
| Slovenia | Member | | | |
| Spain | Member | | | |
| Sweden | Member, Chair | | | |
| Switzerland | Member | | | |

| | | | | |
|----|--------|--|--|--|
| UK | Member | | | |
|----|--------|--|--|--|

5.2 Income and Revenue

The revenues of eLTER ERIC consist of:

- Host Premium Contributions
- eLTER ERIC Membership Contributions
- Third party contributions and grants
- Surplus revenues carried forward from previous years, and
- Any other income (e.g., user fees, interest, and donations)

The Members (and their research performing organisations) will be responsible for funding the construction, upgrading and operations of the National Research Infrastructure (NRI), i.e. the Sites and Platforms, to match the Standard Observations and site labelling criteria. Members will also share the costs of Central services together with the Hosts according to the adopted principles (see above). Hosting is distributed among several Host countries.

A variable income for both the NRI and Central Services may also originate from third-party funding (Horizon Europe, Biodiversa+ etc.), industry or other sources, but in the funding model this is not accounted for as the ERIC funding has to be secured by Hosts and Members in the long run.

The budgets of eLTER Central Services include the eLTER ERIC Head Office and Topic Centres (that can be in or out of eLTER ERIC). The planned eLTER ERIC budget is currently under the decision-making power of the eLTER Interim Council (IC) and later in the operational phase under the eLTER ERIC General Assembly (GA). The budgets of those Topic Centres that are potentially outside of eLTER ERIC are defined between the Hosts and eLTER ERIC General Assembly.

Detailed income and revenue numbers are currently being collected (see also the chapter below).

Adopted Funding Model for eLTER RI

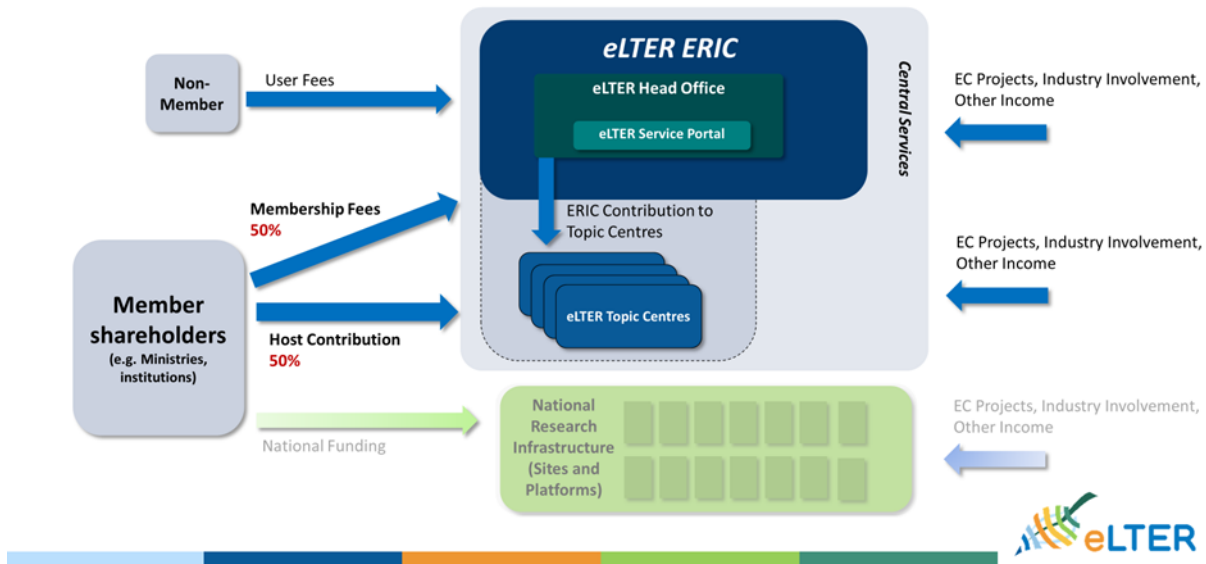


Figure 5: The adopted Funding Model for eLTER ERIC.⁶⁹

5.3 Costs

The eLTER ERIC income is needed to cover expenses related to personnel, including the salaries of mandatory staff (e.g. the Director General) and other costs, including consumables, staff travel, meetings, outreach, services (including e.g., legal, accounting, auditing, marketing, recruitment, and subcontracting), and equipment (software, licences etc.).

Work is ongoing to define the costs. The current cost calculations are based on the functional specifications and indicative cost assessments for each service; however, these are at this stage uncertain due to several reasons. The main uncertainties are related to:

Pending decision on hosting: the personnel costs are heavily dependent on e.g., the extent of the service, the host organisation's existing capacity and the country. In the calculations presented here, we used the annual mean salary costs of countries listed in each of the scenarios (salary data from Horizon Europe⁷⁰). This method assumes that the hosting would be evenly distributed among Members, which may not be the case in reality. Once the host decisions are made, this uncertainty will be significantly reduced. This leads to higher costs in the scenario with fewer countries (assuming that the wealthier countries would be joining in earlier, and several lower income countries would only be joining in later).

Costs depending on the number of users and scale/extent of needed services: the number of eLTER Sites and eLTER Platforms that need the services will affect the costs (e.g., site labelling, data management, analytical and technical

⁶⁹ Blue arrows are revenues to Central Services (Head Office, Service Portal, Topic Centres) and green arrows are revenues for National Research Infrastructures (NRI). The NRI costs and funding are not included in the central eLTER RI Funding Model. EC = European Commission.

⁷⁰ Qlik (n.d.)

services). This uncertainty is also reflecting the unknown extent of potential external users of eLTER data products and other services. In addition, the services may be provided in full or with an adjusted extent. The estimates of tentative numbers of eLTER Sites and eLTSE Platforms were obtained from results of the Site screening in 2023.

Table 11: Cost estimates (k€/year) for two adopted scenarios differing in number of Member countries, specified for each Thematic Service Area (TSA). Costs include both personnel and other costs. The below table provides costs per Thematic Service area in scenarios for 12 Members and for 19 Members.⁷¹

| THEMATIC SERVICE AREA | 12 MEMBERS ⁷² , TOTAL COSTS K€/A | 19 MEMBERS ⁷³ , TOTAL COSTS K€/A | PERSONNEL REQUIREMENTS, FTE |
|---|--|--|--------------------------------|
| TSA01 data management & integration | 2415 | 2327 | 16.6 |
| TSA02 optimised design & RI interoperability | 903 | 844 | 11.2 |
| TSA03 technological innovation and developments | 840 | 840 | 0.0 |
| TSA04 analysis tools and modelling | 1864 | 1801 | 11.9 |
| TSA05 synthesis towards actionable knowledge | 326 | 314 | 2.1 |
| TSA06 central analytics and observation | 823 | 788 | 6.5 |
| TSA07 head office | 1965 | 1896 | 13.0 |
| Total | 9135 | 8812 | 61.3 |

⁷¹ Note: At this point, the Topic Centres are not yet defined, and they remain to be co-designed among the potential hosts. Some TSAs will likely be split into several Topic Centres which will affect their costs

⁷² 12 Members Countries: Austria, Czech Republic, Finland, France, Germany, Greece, Israel, Italy, Latvia, Portugal, Sweden, Switzerland

⁷³ 19 Members Countries: Austria, Bulgaria, Czech Republic, Finland, France, Germany, Greece, Israel, Italy, Latvia, Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom

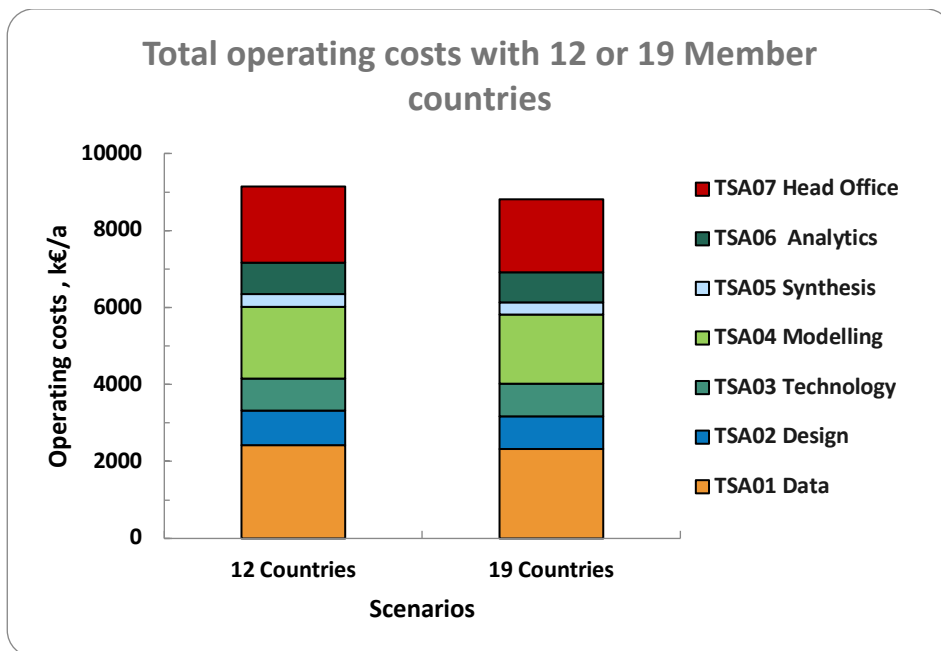


Figure 6: Total operating costs (k€/year) in the two anticipated scenarios, divided between all Thematic Service Areas (TSAs).⁷⁴

5.4 Five-year Financial Plan

Financial planning provides a comprehensive evaluation of the eLTER ERIC future financial state by reporting future cash flows based on the estimated expenditures (costs) and revenues. The 5-year Financial Plan provides insights on the eLTER ERIC finances over the medium-term and establishes Members', Permanent Observers', and Observers' (if any) commitments to the eLTER RI operation in the years of the considered budgetary cycle.

In particular, the first 5-year Financial Plan reports the indicative plan of expenditures and revenues related to eLTER ERIC for the years 2026-2030. Expenditures and revenues related to other parts of the whole eLTER RI are out of the scope of this 5-year financial plan, namely: NRIs, i.e. the Sites and Platforms, and Topic Centres that are not operated as part of the eLTER ERIC except for the part to be supported by eLTER ERIC contribution.

As regards the expenditures, the 5-year financial plan includes only the costs that will be incurred to operate the eLTER RI during the considered period. Investment and implementation costs occurring in the same period 2026-2030 to construct the NRIs and implement the activities are excluded from this first 5-year Financial Plan.

⁷⁴ TSA01: Data management & integration; TSA02: Optimised Design & RI Interoperability; TSA03: Technological Innovation and Developments; TSA04: Analysis Tools and Modelling; TSA05: Synthesis towards actionable knowledge; TSA06: Central analytics and observation; TSA07: Head Office.

5.5 eLTER Financial Principles and Rules

The Financial Principles detail the norms for funding the whole of eLTER and the contributions from Member, Permanent Observer and Observer States to eLTER ERIC, and lay down all other arrangements relating to eLTER ERIC finances, budget and accounting standards, including details regarding preparation, filing, auditing and publication of accounts.

5.5.1 Contribution Principles for eLTER Funding

- Resourcing of the NRIs is organised nationally.
- The Countries hosting the eLTER Central Services (Head Office, Topic Centres) shall be responsible for financing 100% of their construction.
- The operations of the eLTER Central Services are partially funded by the Central Services' Hosting Countries and partially by Members, Permanent Observers and Observers through Membership Contributions to eLTER ERIC.
- eLTER ERIC Members, Permanent Observers and Observers shall provide Annual Contributions to eLTER ERIC according to the principles affirmed in the eLTER Statutes and based on the method of calculation agreed upon and provided in Sections 5.1 (Member and Host Country Contributions) and 5.2 (Income and Revenue).
- Annual Contributions can consist of Host Premium Contributions, Host Contributions and Membership Contributions.
- The Host Premium Contribution is the support provided to eLTER ERIC by Members and Permanent Observers for the functioning of Central Services as part of eLTER ERIC and hosted in their own country.
- The Host Contribution is the support provided to eLTER ERIC by ERIC Members and Permanent Observers for the functioning of Central Services units not part of eLTER ERIC and hosted in their own country.
- Membership Contributions is the cash contribution to eLTER ERIC from all Members, Permanent Observers and Observers, which shall be used by eLTER ERIC to contribute to funding the Central Services' annual operation costs.
- General principles regarding the funding of user access to Central Services and specific services provided by NRIs will be established during eLTER Implementation, following the recommendations included in eLTER PPP Deliverables D3.4 (eLTER RI Access and service policy) and D4.3 (eLTER RI funding model and global cost estimates).

eLTER has also defined contribution principles for Central Services included in eLTER ERIC and contribution principles not included in eLTER ERIC.

5.5.2 Final provisions

- Amendments to the Financial Principles and Rules: These Financial Principles and Rules may be amended by a decision of the General Assembly.
- Entry into Force: These Financial Principles and Rules shall become effective by the decision of the General Assembly.

5.6 Financial Sustainability

The eLTER ERIC operations will be ensured by the Members' commitments, in specified budgetary cycles. This provides the eLTER ERIC with medium-term funding continuity to support the operations planned for each budgetary cycle. A significant Host Premium, partly in cash and partly in-kind, is an important and fixed dimension (see above the Host (premium) contribution suggestions) of the budget.

At the time of writing this, the Interim Council (IC) has 19 Members that are committed to contribute to the preparatory phase and have their NRI in place. The countries that will eventually commit to eLTER ERIC are known when the Statutes are finally adopted, likely early 2026. Membership fees, paid by the eLTER Members, form the foundation for financial sustainability and continuity of eLTER's core activities.

6 Implementation

6.1 Implementation Plan

Seven strategic activities have been identified for eLTER for the following three years between 2025 and 2027 (see Table 12). The implementation plan considers the key focus areas of development actions to ensure successful operations starting from the year 2026.

Table 12: Implementation plan with key strategic activities.

| Strategic activity | Description | Implementation actions |
|--|---|---|
| Calling for hosts | For the Central Services of the distributed eLTER RI, host organisations will be selected in a competitive way based upon a call for applications | <ul style="list-style-type: none"> • Concept development • Open call for hosts |
| Integration of Topic Centres and countries | Encourage countries to engage in eLTER and secure commitment of countries | <ul style="list-style-type: none"> • Secure 3 countries onboard • Market benefits of RI memberships to other countries |
| Head office (HO) construction | Ongoing process to define Head Office obligations and secure commitment of HO host country | <ul style="list-style-type: none"> • Clarification of HO obligations • Secure commitment of HO host country (Germany) |
| Topic Centre construction | The construction and setting up of topic centres with clear boundaries and obligations defined in the service level agreements (SLA) | <ul style="list-style-type: none"> • Definition of the service level agreement between each Topic Centre and HO which specify boundaries and obligations • Define legal construction of Topic Centres |
| NRI set-up | Setting up of national services (NRIs), which perform research and observations and deliver eLTER data, and can be physically, remotely, and virtually accessed by users through the service portal | <ul style="list-style-type: none"> • Standard Observation description and costing • Labelling process for Sites and Platforms |
| Legal entity management | Governance structure in place already in 2024. Within 1.5 years the first round of | <ul style="list-style-type: none"> • Negotiation round with commission |

| | | |
|--------------------------|---|--|
| Service portal (ramp-up) | negotiations | |
| | Ramp-up over the coming years. Services in place within 2 years' time | <ul style="list-style-type: none"> • Prioritisation of services • Provision of open data |

6.2 Milestones

The below timeline demonstrates the progression of eLTER's implementation and operation phases and their key milestones from 2024 to 2035.

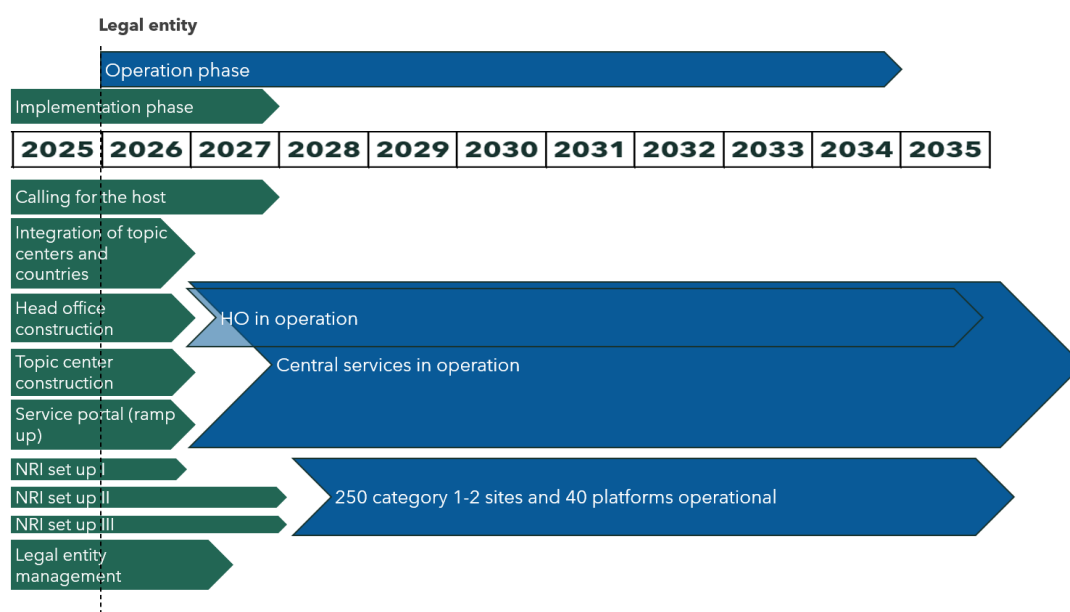


Figure 7: Milestones.

6.3 Key Performance Indicators

eLTER has developed a set of key performance indicators (KPIs) best suited to monitor the success of eLTER RI implementation, operation, and progress towards its stated objectives. The KPIs are not only an indispensable management tool to monitor progress, enable evidence-based decision-making and aid in the development of future strategies, they will also be useful to help eLTER RI communicate its results and achievements successfully, contributing to its own financial sustainability, increasing transparency, and evaluating socio-economic return⁷⁵.

⁷⁵ Kolar et al. (2019)

| KPI # | KPI | Evidenced by |
|--------|--|---|
| KPI 1 | Increase in the number of operational sites fulfilling all requirements of labelling at each level (eLTSER Platform, eLTER Category 1, 2 or 3 Sites) | Head Office and Topic Centres databases |
| KPI 2 | Number and increase of policy advisory initiatives at local, regional, national and European level | International Science press, bibliometric analysis, European Commission databases Narrative to be included by sites, platforms and/or national nodes in annual reports |
| KPI 3 | Satisfaction of service users per type | Narrative based on information obtained through a questionnaire that the Service Portal proposes to service users |
| KPI 4 | Number of patents, methodologies and start-ups created by eLTER users and partners using products or expertise gained from eLTER RI | Number of patents from eLTER partners. Concerns patent applications, patent granted. Number of new methodologies, prototypes or developed designs based on scientific publications. |
| KPI 5 | Number of co-located sites: a site that is a part of multiple RIs | RI database. Includes percentage per site categories (eLTSER Platforms, eLTER Category 1, 2, 3 Sites) |
| KPI 6 | Number of publications based on the research performed using facilities/resources of the RI | Bibliometric analysis from WoS and Scopus, International Science press. Number of proceedings papers, book chapters, books, technical reports and datasets directly gathered from users of the RI. Task can be automatised using citation to datasets/site IDs, using consistent keywords |
| KPI 7 | Number of visitors at RI and users of the services, and partition of international users | Databases from RI and Topic Centres. Sorted by type (scientific, student, public, stakeholders and SME), nationality |
| KPI 8 | Quantitative description of habitats diversity across eLTER Sites and eLTSER Platforms. | Number of habitats and increase in representativity of habitats across eLTER Sites and eLTSER Platforms. |
| KPI 9 | Number and description of training programs provided by the RI | Databases from RI |
| KPI 10 | Number of accesses to eLTER RI data via eLTER Cyberinfrastructure (from a total of ca 1000 users as calculated in the user study of the eLTER H2020 project) | Service Portal databases, number of downloads of open data, and data requests by research profiles |

Table 13: Prioritized list of eLTER's Key Performance Indicators.

6.4 Risk Management Plan

The nature of eLTER RI, physically distributed, and its mission, to serve multiple scientific communities with high-level central facilities and distributed, well-

instrumented eLTER Sites and socio-ecological eLTSE Platforms, make it essential to plan ahead for as many threats and uncertainties as possible. That is why risk management is important to the success of eLTER RI and requires the definition of roles, responsibilities, tools and strategies to mitigate potential risks. The Risk Management Plan (RMP) defines how risks associated with eLTER RI will be identified, analysed, monitored, and managed, for both the implementation and the operation phases of eLTER RI. The risks currently identified in the RMP are divided into 5 areas, such as Scientific, Technical, Political, Managerial and Financial risks. The various situations the eLTER community has faced, during the Preparatory Phase Project of eLTER RI, led eLTER to tackle specific risks, such as COVID-19 related risks, BREXIT related risks, and Ukraine War related risks. Below is an extract of the Risk Inventory (as listed in Deliverable 2.4)

Technical risks

Table 14: Analysis of Technical risks in eLTER. Priority level explanations: 18-20: Extremely high probability/impact; 12-16: high probability/impact; 6-10: moderate probability/impact; 0-5: low probability/impact.

| Short name | Priority level | Mitigation |
|---|----------------|---|
| Failure to implement services | 15 | Monitor implementation of services and perform progress assessment and reports. Monitoring can be made by introducing dedicated user-feedback reports. Progress results can be showcased for the Research Infrastructure services during the Preparatory Phase Project. |
| Inefficient data workflow | 12 | Survey both the National and Central Facilities to understand the issue in the workflow and provide solutions on how to minimize mismatches between the National and Central Facilities. |
| Lack of maturity of tools and technology | 12 | The Service Portfolio planning has to take this into account (maturity questions) and the Host Selection process needs to require a realistic and feasible implementation plan where the applicant has to indicate the potential deficiencies of the technology, and how the host applicant will reach the maturity, if not yet there. Selecting a mature tool and tech is preferable but if the planned tool or tech isn't mature, a back-up plan should be suggested as well. |
| Failure of internal support and service provision | 10 | Determine why the group is having difficulties in getting the activities up and running and provide support to try to get things operational. As a last resort, relaunch the Central Services host selection process. Identify where there is a gap in capacity and determine how the capacity need could be met, i.e. increase in personnel, resources, support. |
| Inefficient user interface | 10 | Implement a user feedback option so that the user can notify if their request is not being met. The user interface should have an infrastructure that is scalable so that it is easy to allocate more resources if needed. |

| | | |
|--|---|--|
| Failure in Sites and Platforms access | 8 | Perform an assessment of National Research Infrastructures; Provide common access rules; Draft access agreements with facilities; Disseminate and market the access opportunities to both site owners and site users; Design an online proposal submission service; Organize demonstration sites for the Research Infrastructure access services during the Preparatory Phase Project. |
| Failure in technology access | 8 | As soon as possible, investigate alternative technologies that could be used instead and if possible, have a period of time where the previous technology can be run at the same time as the new technology to compare. |
| Delayed website development | 8 | Scheduling regular check-ups so the web content doesn't become outdated. If delays arise, determine if there is additional support that can be used to keep the web content updated and/or prioritize what website developments are most important. |
| Thematic Centres lack support | 8 | Identify where there is a gap in capacity and determine how the capacity need could be met, i.e. increase in personnel, resources, support. |
| Failure in representative set of sites | 6 | Work on trade-off between quality and representativity requirements vs existing facilities and national expectations. Plan recruitment and upgrade of sites according to scientific goals, representativity studies and shared guidelines for technical requirements. Regularly revise the modular and phase wise implementation plan where the sites and platforms are implemented in three steps. |
| Insufficient website provider | 4 | If the website provider can't handle the portal, an alternative option may be needed. Before transitioning to a new web provider, a detailed analysis of the website needs should be made and matched with the current provider. If the needs still can't be met after discussing with the current provider, alternative options that meet the needs should be explored. |

Scientific risks

Table 15: Analysis of Scientific risks in eLTER.

| Short name | Priority level | Mitigation |
|---------------------------------------|----------------|--|
| Lack of culturally diverse engagement | 20 | By ensuring efficient and transparent information flow, consultation and governance the different user groups are duly represented. The scientific strategy should be formulated through Scientific Advisory Board and Preparatory Phase Project Coordination Office and should align to the needs of the user communities. |
| Unable to provide services to users | 20 | If there is a failure in providing services to users the services should be scaled to match users' capacity, priorities and needs, and costs. This issue could be country specific and related to related financial-funding risk, so targeted mitigation measures may be needed. An evaluation of the service and the cost should be made, to find out about service uptake (via simple uptake statistics and service |

| | | |
|--|----|---|
| | | feedback). Based on the findings, changes to the service may need to be made and a more reasonable price that the user can afford may need to be set. |
| Delays in the service provision | 16 | Identifying the bottleneck in the service provision and who is responsible for causing the delay. Work with the responsible persons to come up with possible ways to move it forward. Ensure an efficient communication to avoid delays; involve the ministerial delegation from eLTER and host side beforehand to make them aware of the service provisioning plan and ensure their support; prepare the process and involve all stakeholders early on. |
| Failure to secure active involvement of the key user communities. | 15 | Early identification of the key stakeholders, user communities and their needs is critical. Create an attractive and high-quality service provision, and clearly articulate the benefits of participation either as an operator or as a user. |
| Ineffective data harmonization among National Research Infrastructures | 15 | First determine who should perform the harmonization work (i.e. centrally or end-user) and come up with a plan that is efficient both in timing and in implementation. Harmonization can be improved by ensuring that National Research Infrastructures are submitting data in a standardised way. |
| Failure to achieve consensus | 15 | A discussion should be taken to try to achieve consensus on the key concepts and convince National Research Infrastructures of the need to deliver data according to the agreements. If this still doesn't lead to consensus, the issue should be taken to the eLTER Interim Council. |
| Lack of visibility among targeted user groups | 12 | Identify which user group and which information is missing. Identify through continuous feedback how existing services and eLTER in general is perceived. This could be done through a survey to the user community. Once this information is identified, advertise and communicate the services to the targeted group(s). Evaluate why there is a failure to obtain Transnational, Remote or Virtual Access requests and based on this information market the services of eLTER in an appropriate way for the specific target groups. |
| Discontinuity in data collection | 10 | When data discontinuity occurs, modelling as a tool to fill in gaps or looking for other data that could provide a context for the missing data should be made. The problem for the data discontinuity should be investigated and the risk assessed for the likelihood that the discontinuity could happen again. If the risk is high, consider what measures need to be taken to reduce the risk (e.g. sensor replacement). |
| Failure to demonstrate scientific impact | 10 | To ensure a clear scientific focus, the formulation of clear scientific strategy should be made during the Preparatory Phase Project in consultation with the experts and user communities. The eLTER science case should be updated and engage users to check the attractiveness of the eLTER Research Infrastructure for new science opportunities. Activities include improving communication, discussing with the Scientific Advisory Board to refine the scientific agenda, and actively developing efficient integration of scientific strategies with close-by Research Infrastructures. |

| | | |
|--|----|---|
| | | Scientific impact also means to improve the communication towards decision makers and to bring in eLTER services and ensure an improved uptake from the higher level (decision makers), which in turn would guide the scientific focus of many stakeholders towards eLTER and essentially increase its scientific impact. |
| Loss of continental representativity | 10 | It is difficult to mitigate if there is a loss of continental representativity and therefore eLTER needs to ensure this won't happen by having continued dialogue with the National Facilities to try to mitigate any potential loss before it occurs. Regarding the dropping out of facilities, the dialogue must be extended to the National Coordinators and Ministries to ensure a long-term funding/commitment. |
| National Research Infrastructures or Facilities stop operating | 9 | Before single facilities drop out, it must be ensured that the impact regarding habitat coverage or specific Standard Observation coverage is not badly impacted. If it is the case, eLTER must start a dialogue with the National Network and the respective Ministry to either establish a new facility, find a new host or increase the funds from Ministries to ensure the continuation of the facility. |
| Lacking innovation in services | 9 | Encourage discussion and seminars within eLTER on new methodologies and decide at a programmatic level if the new method is appropriate, i.e. improvement to efficiency and ability to continue data continuity and comparability. There is a risk to lose data continuity and comparability, if the focus is only on innovative solutions and new methods, rather than including also previous methods used. |
| Unorganised eLTER science communities | 8 | Compile information on organizational best practices from other countries within eLTER network that have had success with connecting to their scientific communities. Identify the reason there is a lack of organization and try to apply suggested best practices. |
| Lack of impact leads to loss of interest | 8 | The RI facilitates the creation of joint European-level publications, suitable for publication in high impact journals. Leading LTER partners should create and distribute proposals for such publications. Publications in high impact journals are also important for other reasons, such as increasing the visibility of eLTER in the international research community. |
| Risk of errors in comparing long term measurement data obtained with different equipment | 8 | Work on the harmonisation of standard observations is underway and should be continued and strengthened. Long-term, a joint European-level procurement of equipment for participants in the RI would be desirable (and may also offer economic benefits). |
| Consensual governance structure | 6 | Accompany and support National Coordinators if needed in the related national transitions from their current network-style internal organization to organised National Research Infrastructure and develop options for an integrated governance structure. Ensure the support of the Ministries, which takes into account a national strategy for site development and site construction. |
| Impact of eLTER is insufficiently communicated | 6 | Gather publications and reports that have used the eLTER data over time to show the relevance and impact on the website, at meetings and in reporting. Create an efficient way that eLTER publications and reports can be collected and make sure that the community is aware of how cite eLTER properly so that it is easy to find publications with a search. Minting of Digital Object Identifiers (DOIs) is essential to ensure proper referencing. |

| | | |
|--|---|---|
| Lacking interest from the private sector | 4 | The risk is minimised by having a service dedicated to private sector collaboration, thus engaging with the private sector from the beginning rather than as an afterthought. There is scope to expand efforts to foster collaboration at a later date if required e.g. by attending private sector events to advertise eLTER as a partner. |
|--|---|---|

Financial risks

Table 16: Analysis of Financial risks in eLTER.

| Short name | Priority level | Mitigation |
|---|----------------|--|
| Failure to secure the financial and operational commitments | 15 | Build up trust and transparency in working culture. Run a credible Interim Council process and provide well thought documents and plans for Interim Council consideration. Maintain the momentum with the Interim Council by timely delivering founding documents; creating an attractive and high-quality service provision, and clearly articulating the benefits of participation either as an operator or as a user. |
| Underestimation of real implementation costs | 12 | Establish concept for minimum viable Research Infrastructure to have a clear picture of the minimum resources needed. Remember the National Research Infrastructure phases that allow us to process in stepwise manner. The requirements for Central Services should be concluded as soon as possible to be able to estimate the costs for them and to open the host selection call to get the bids for their implementation. The minimum Standard Observations should be established as soon as possible. The awareness about the cost estimation tool among the National Research Infrastructures should be further strengthened. (Update and revise the business plan regularly; revise the cost assessment and the funding model; expenditure check, actively seek for cost efficiency in e.g. procurements and operations Research Infrastructure-wide and with Collaborating Infrastructures) |
| Instability of funding | 12 | Secure funding for a determined period of time, known in advance, to limit the risk of funding instability. Have regular checking loops and meetings on the subject. The leading LTER Europe countries should work on joint European-level research project proposals. Make a very clear Implementation Plan with phases for National Research Infrastructures and taking into account the Central Services plans (if available). The implementation plan should show how countries can join the eLTER Research Infrastructure in stepwise manner, first one or few sites and later with more sites to complement their National and European coverage. The Central Services host selection process should emphasize the required long term financial commitments to implement and operate the Central Services. Finally, high quality services and large user community attracts sustainable national funding. These should be in the key role in securing the funding: user-driven services. Keep up with the Preparatory Phase Project plan and make the eLTER Research Infrastructure case strong and engage users early showing its benefits and providing services that can be implemented as low hanging fruits. |

| | | |
|---|---|--|
| Financial complexities due to the high number of partners | 8 | Start financial planning as early as possible, put the options available on the agenda for discussion in the Interim Council. Engage a financial working group nominated by the council to work on the suggestions for solutions. |
| The funding available in the Preparatory Phase Project for the Partners is not enough ⁷⁶ | 8 | Emphasize and make clear the long-term vision and benefits of establishing a sustainable eLTER Research Infrastructure. Keep the work streamlined, efficient, and avoid duplicate and unnecessary work. Seek together additional funding from Horizon Europe framework programme to eLTER activities. Try to influence the framework programme in a coordinated way through National Coordinators and work package leads and institutions. |

Managerial risks

Table 17: Analysis of Managerial risks in eLTER.

| Short name | Priority level | Mitigation |
|---|----------------|---|
| Delays in implementation of the Central Services | 20 | Invest in the Central Services host selection process and keep the process well controlled and the Interim Council well informed. Once selection is done, keep the candidate applicants well informed and closely engaged in the Research Infrastructure planning. Require high quality implementation plans and clear commitments. Make realistic Implementation Plan of the whole Research Infrastructure taking into account the plans provided in the Central Services host applications. The root is in the Service Portfolio, it needs to be first well clarified and approved by the Interim Council before the host selection process can be initiated. |
| Over-dependence on key individuals | 16 | Disseminate the plans and strategies among the consortium in an efficient manner. This enables any partner to tell the same message. Develop a deputee system for the key roles. Strengthen the engagement across the overall consortium. Adopt a management plan feasible in regard to the complexity of the enterprise, train new Human Resources capacity and make engagement broader on strategic issues. Involve in Research Infrastructure staff training and distribute information about organised trainings. |
| Not enough Central Services agreements concluded | 16 | Identify the minimum viable level of required Central Services and make an effort beforehand to avoid the delay in making the contracts. The contract making with the Central Services is also dependent of the establishment of the ERIC (the legal entity responsible for making the contracts with the Central Services' hosts). Focus on establishing the ERIC in time. Invest in good management for the Central Services host selection process and consequent engagement process. |
| Some work is delayed to a degree that milestones likely | 15 | Guarantee efficient and appropriate project management; check the on time delivering of achievements, regular follow-ups and monitoring. Identify and tackle the delays early in time. Create a |

⁷⁶ This particular risk is being faced as we progress through the Preparatory Phase Project, and as a mitigation, a sub-group of the eLTER PPP Consortium has submitted, early 2023, the eLTER EnRich project to the Horizon Europe 2023-2024 Work Programme. eLTER EnRich has been accepted by the EU, and should in the first trimester of 2024. The project will bring in more financial relief to partners, as well as additional expertise from selected new partners.

| | | |
|---|----|---|
| cannot be reached in time, or deliverables cannot be delivered in time, owing to late, low quality or missing work by a participant. | | working culture that is based on openness, transparency and trust so that people are not afraid of informing about their uncertainties and troubles in achieving the goals early. Get more talents to engage in the work. |
| Failure to manage change from networking to formalised sustainable Research Infrastructure | 12 | Communicate clearly and efficiently the Research Infrastructure vision, mission and goals, and the benefits of having the eLTER Research Infrastructure. Communicate clearly that the Research Infrastructure is open to be joined at any time also after the establishment of the ERIC. Accompany and support National Coordinators when needed in the related national transitions from their current network-style internal organization to organised National Research Infrastructure; develop and communicate early enough the options for an integrated governance structure. |
| Underestimation or inability to recruit the needed expertise and human resources | 12 | Efficiently disseminate the Research Infrastructure vision, mission and goals. Raise awareness and clearly communicate among the partner organizations about the plans and what is needed. Engage in Research Infrastructure staff training and distribute information about organised trainings. Promote the opportunity within eLTER to create job and encourage career path diversity, especially engage with the next generation of eLTER scientists: bring young scientists and strategic talents from participant institutions to learn about eLTER and foster active engagements; promote dedicated sessions about mid-term job opportunities created by Research Infrastructures (specifically eLTER Research Infrastructure) amongst participant institutions. Provide detailed information as to what capabilities and skills are needed to fulfil the work that has to be done, the coordination could advise, if needed, the organization recruiting staff |
| Inability of key shareholders to provide in a timely manner the necessary information and feedback for developing the founding and policy documents | 12 | Maintain regular information flow, communicate the vision, mission and goals, and the benefits of establishing a sustainable eLTER Research Infrastructure. Develop engagement strategies. |
| Issues related to coordination | 12 | Hold several hearing meetings on a regular basis (every semester for instance) to check on the people involved in the projects, see if they have blockages or anything preventing them to do the work as planned, also have hearings of the coordination team. Create and make the best usage of innovative collaboration platforms and communication tools, encourage and train the projects to use communication and collaborative tools. Last resort: apply sanctions if the work is not delivered by partner. |
| Not enough agreements signed with the National Facilities | 10 | Communicate the benefits of eLTER. Secure enough members for the eLTER ERIC. Integrate the process with the Central Services contract agreement when the Research Performing Organization have both facilities; define a clear plan of negotiation for the rest of the Research Performing Organizations |
| Spreading the available resources, | 9 | Emphasize and make clear the long-term vision and benefits of establishing a sustainable eLTER Research Infrastructure. Keep |

| | | |
|--|---|---|
| and especially human resources too thinly | | the work streamlined, efficient, and avoid duplicate and unnecessary work. Guarantee efficient and appropriate management; check the on timely delivery of achievements and information, revise human resources planning according to the needs. |
| National eLTER consortia and national stakeholders are not interactive with eLTER (ERIC) | 8 | Program national assembly and national consortia events with eLTER ERIC to keep the communication fluid between both levels of the integrated Research Infrastructure. |
| Failure to establish trust | 8 | Mitigation of the risk of not obtaining or losing the trust of a participant or partner: 1) monitor the level of engagement in the project or in the Interim Council; 2) assess the presence or absence of the following qualities in the partnership: a) reliability and dependability, b) transparency, c) competency, d) sincerity, authenticity, congruency, e) fairness, f) openness and vulnerability; in order to discover what is lacking in the relationship and find ways to build or restore trust. Then open the conversation between parties, between coordination and participants or institution for instance (if applied to the PP). Issues related to diminution or loss of trust can only be resolved by addressing them in an open, calm and diplomatic discussion. |
| Not enough collaboration agreements concluded with key partnerships (liaisons) | 6 | Participate actively in the international arena, seek out partnerships and create concrete means for collaborations and identifying service provision |

Political risks

Table 18: Analysis of Political risks in eLTER.

| Short name | Priority level | Mitigation |
|---|----------------|--|
| Difficulties in making eLTER a priority for national stakeholders | 20 | Communicate clearly the long-term vision and benefits and demonstrate added value of establishing a sustainable eLTER Research Infrastructure and the scientific and societal impacts with exemplary successful cases. Monitor the support of shareholders through the involvement of representatives in the governance structure. Maintain engagement. Provide professional and credible organizational framework to work with (invest in timely information flow, process management, develop and maintain transparent governance and management procedures). Verify and strengthen the impact of harmonization with National Priorities and the cost-efficiency of integrating eLTER to their national priorities. Strive to get eLTER on the national roadmaps by supporting the National Coordinators in their efforts; celebrate the successes so |

| | | |
|---|----|---|
| | | that others get inspiration. Getting on the national roadmaps is one key component of moderating this risk. |
| Failure to start the ERIC right after the Preparatory Phase Project i.e. enter into a critical gap (“valley of death”) after the Preparatory Phase Project. ⁷⁷ | 15 | Efficiently coordinate and deliver the Preparatory Phase Project to feed decision points to the Council in timely manner. Invest in managing efficiently the Interim Council process. Focus and aim to get at least the ERIC STEP 1 phase submitted to the European Commission by the end of the Preparatory Phase Project. |
| Germany steps back as host country to the Head Office | 10 | Though this risk is not only Political but also Financial and Managerial, most of the mitigation measures we can anticipate lie within the political and collaboration scope. At project level, the Coordination team shall encourage National Coordinators and RPOs to take part in the conversation of Central Service Hosts. If needed, bilateral meetings with specific countries to help them see the benefits and relevance of hosting eLTER Central Services. The Interim Council Chairperson shall also raise the issue at a coming meeting, to ensure that National Delegates are aware of the state of discussions. All mitigation actions shall aim at facilitating the process, and should be carefully thought through, so that the situation does not worsen. Should this risk be confirmed, the General Executive Team and the eLTER ESFRI Coordinator should do everything they can to ensure that another partner is ready to take over. This includes, but is not limited to, transfer of knowledge, of tools, and of updated information on all expected developments. |
| Failure to make the socioecological case | 8 | Integration of the LTSEER approach as the 4th Grand Challenge; integration of socioecological questions and approaches as a prerequisite to platform –type sites in design; integration of socio-ecological requirements in site costs and Topic Centres (specifically MAT-Topic Centre). Training for LTSEER platform staff in operations and marketing. Additional projects to support the SES case. |
| Unsuccessful in engaging users and stakeholders to foster a full exploitation of services and products | 6 | Revise and check Communication Plan; improve impact of dissemination; check impact assessment and science cases, perform careful user questionnaires and service requirement analysis during the Preparatory Phase Project, implement high quality services. Verify and strengthen communication and dissemination strategy and activities; guarantee the full exploitation of results. |

⁷⁷ The eLTER EnRich project, mentioned in the previous footnote, has several objectives, one of which to prepare for the eLTER ERIC legal entity and the distributed operations of the RI. One particular task is set to support the complex and phased coordination process of further developing the statutes and consecutive frameworks and agreements, with the target to reach the Step-1 ERIC application.

References

- Alam, S.A., et al. (2021). eLTER RI Cost Book. Deliverable D4.1. EU Horizon 2020 eLTER PPP Project, Grant agreement No. 871126.
- Balint, M., et al. (2011) Cryptic biodiversity loss linked to global climate change. *Nat Clim Change*, 1, 313-318.
- Barov, B., et al. (2021). Stakeholder Landscape Analysis. Deliverable D7.1 EU Horizon 2020 eLTER PPP Project, Grant agreement No. 871126.
- Bennett, P. (2023) Climate Change is costing the world \$16 million per hour: study. Website. Accessed 10.6.2024.
<https://www.weforum.org/agenda/2023/10/climate-loss-and-damage-cost-16-million-per-hour/>
- Camargo, J. A., and Alonso, A. (2006) Ecological and toxicological effects of inorganic nitrogen pollution in aquatic ecosystems: A global assessment. *Environ Int*, 32, 831-849.
- Carpenter, S. R., et al. (2009): Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment. *P Natl Acad Sci USA*, 106, 1305-1312.
- Chen, L., et al. (2023) Artificial intelligence-based solutions for climate change: a review. *Environ Chem Lett* 21, 2525–2557. <https://doi.org/10.1007/s10311-023-01617-y>
- Costanza, R., et al. (2014) Changes in the global value of ecosystem services. *Global Environmental Change* 26: 152-158.
[doi:http://dx.doi.org/10.1016/j.gloenvcha.2014.04.002](http://dx.doi.org/10.1016/j.gloenvcha.2014.04.002).
- Donohue, R. J., et al. (2013) Impact of CO₂ fertilisation on maximum foliage cover across the globe's warm, arid environments. *Geophysical Research Letters*, 40, 3031-3035.
- Dynamic Ecological Information Management System - Site and dataset registry, DEIMS (n.d.) Search all active, formally acknowledged European LTER sites. Website. Accessed 24.9.2024. <https://deims.org/search/sites/lter>
- EEA (2015): The European environment - state and outlook 2015: Assessment of global megatrends. European Environment Agency, Copenhagen.
- EEA (2017): Climate change, impacts and vulnerability in Europe 2016. An indicator-based report. Report 1/2017.
- EC (n.d) a. Horizon 2020. Website. Accessed 10.6.2024
<http://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges>
- EC (n.d.) b. Soil Strategy for 2030. Website. Accessed 10.6.2024
https://environment.ec.europa.eu/topics/soil-and-land/soil-strategy_en
- EC (n.d.) c. Farm to Fork Strategy. Website. Accessed 10.6.2023.
https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en
- EC (n.d.) d. New EU Forest Strategy for 2030. Website. Accessed 10.6.2024.
https://environment.ec.europa.eu/strategy/forest-strategy_en

- EC (n.d.) e. Nature Restoration Law. Website. Accessed 10.6.2024.
https://environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-law_en
- EC (n.d.) f. Biodiversity Strategy for 2030. Website. Accessed 10.6.2024.
https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en
- EC (n.d.) g. Causes of climate change. Website. Accessed 10.6.2024.
https://climate.ec.europa.eu/climate-change/causes-climate-change_en
- EC (2021) EU Adaptation Strategy. Website. Accessed 10.6.2023.
https://climate.ec.europa.eu/eu-action/adaptation-climate-change/eu-adaptation-strategy_en
- EC (2023) Soil Health. Website. Accessed 10.6.2024
https://environment.ec.europa.eu/topics/soil-and-land/soil-health_en
- ESFRI (2021) ESFRI roadmap 2021 - strategy report on research infrastructures. Part 2. Landscape analysis.
<https://roadmap2021.esfri.eu/landscape-analysis/>
- eLTER (2017) eLTER ESFRI application: Integrated European Long-Term Ecosystem, critical zone and socio-ecological system Research Infrastructure.
- eLTER (n.d.) a. LTER Facilities. Website. Accessed on 10.6.2024 <https://elter-ri.eu/lter-facilities>
- eLTER (n.d.) b. Developing our service portfolio. Website. Accessed 10.6.2024.
<https://elter-ri.eu/service-portfolio>
- eLTER (n.d.) c. Background information. Webpage. Accessed 10.6.2024.
<https://elter-ri.eu/transnational-remote-access-ta-ra#background-information>
- Fan, Z. et al. (2023) Deep Learning and Artificial Intelligence in Sustainability: A Review of SDGs, Renewable Energy, and Environmental Health. Sustainability; 15(18):13493. <https://doi.org/10.3390/su151813493>
- Fujimori S., et al. (2023) Climate change mitigation costs reduction caused by socioeconomic-technological transitions. Npj Climate Action 2. Art. 9.
<https://doi.org/10.1038/s44168-023-00041-w>
- Gaur, N., et al. (2024) Green Chemistry Approaches to Environmental Sustainability, Chapter 2 – Environmental Pollution, 23-41.
<https://doi.org/10.1016/B978-0-443-18959-3.00010-0>
- Gupta, S. K., et al. (2000) Methaemoglobinaemia in areas with high nitrate concentration in drinking water. Natl Med J India, 13, 58-61.
- Haubold, H, et al. (2021) eLTER Host Selection Process. Deliverable D5.4 EU Horizon 2020 eLTER PPP Project, Grant agreement No. 871126.
- Helmholtz Centre for Environmental Research (n.d.) Website. Accessed 3.9.2024 Our Vision. <https://www.ufz.de/index.php?en=34258>
- Hlasny T., et al. (2011): Expected impacts of climate change on forests. Czech Republic as a case study. Journal of Forest Science 57, 422–431.
- Hughes, B. B., et al. (2017): Long term Studies Contribute Disproportionately to Ecology and Policy. BioScience, 67 (3), 271-281
- ICSU (2010) Scientific Grand Challenges identified to address global sustainability. Accessed on 10.6.2024.

<https://council.science/current/press/scientific-grand-challenges-identified-to-address-global-sustainability/>

IISD (2023) Managing Chemicals and Pollution: The economic costs of failure, and what can be done about it? Website. Accessed 10.6.2024

IPCC (2013) Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Jaureguiberry, P., et al., (2022) The direct drivers of recent global anthropogenic biodiversity loss, *Science Advances* 8(45) DOI: 10.1126/sciadv.abm9982

Kolar J. et al. (2019) Key performance indicators of Research Infrastructures. Website. Accessed on 10.6.2024. <https://www.accelerate2020.eu/key-performance-indicators-of-research-infrastructures-2-executive-summary/>

Kurth, T., et al. (2021). The Biodiversity Crisis Is a Business Crisis.

Lindner M, et al. (2014) Climate change and European forests: what do we know, what are the uncertainties, and what are the implications for forest management? *Journal of Environmental Management* 146, 69–83.

Mirtl, M., et al. (2023) eLTER Standard Observations methods and first cost implications.

Mooney, H., et al. (2009) Biodiversity, Climate change, and Ecosystem Services. *Current Opinion in Environmental Sustainability*, Vol 1, Issue 1, October 2009, 46-54.

National Geographic (n.d.) Pollution. Website. Accessed 10.6.2024. <https://education.nationalgeographic.org/resource/pollution/>

National Research Council (2001) Grand Challenges in Environmental Sciences. Washington, DC: The National Academies Press. <https://doi.org/10.17226/9975>

Nikolaidis N., et al. (2021) eLTER RI Strategic Plan. Deliverable D1.1 EU Horizon 2020 eLTER PPP Project, Grant agreement No. 871126.

Pretzsch H., et al. (2014) Forest stand growth dynamics in Central Europe have accelerated since 1870. *Nature Communications* 5, 4967

Pörtner, H.O., et al. (2021) IPBES-I IPCC co-sponsored workshop report on biodiversity and climate change; IPBES and IPCC. DOI:10.5281/zenodo.4782538

Qlik (n.d.) Horizon Dashboard for lump sum evaluations (personnel costs). Website. Accessed 5.6.2024. https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/10526974-8664-4f61-8b86-8ecd3a3c8aec/sheet/8c5fa073-b500-4bf0-b5a3-ed4e6c8a8386/state/analysis

Richardson, K. et al. (2023) Earth beyond six of nine planetary boundaries, *Sci. Adv.* 9, issue 37. DOI: 10.1126/sciadv.adh2458

Rigling, A., et al. (2013) Driving factors of a vegetation shift from Scots pine to pubescent oak in dry Alpine forests. *Global Change Biology* 19(1):229-40. DOI:10.1111/gcb.12038

Ritchie, H. (2020) Sector by sector: where do global greenhouse gas emissions come from? Our World in Data. Accessed 10.6. <https://ourworldindata.org/ghg-emissions-by-sector>

Rockström, J., et al. (2023). Safe and just Earth system boundaries. *Nature*, 619(7968), 102-111.

Sutton, M. A., et al. (2011). The European nitrogen assessment: sources, effects and policy perspectives. Cambridge university press.

van Teeffelen A., et al. (2014) How climate proof is the European Union's biodiversity policy? *Regional Environmental Change* 15, DOI:10.1007/s10113-014-0647-3

United Nations Development Programme, UNDP (2024). What is climate change mitigation and why it is urgent? Web article. Accessed 5.9.2024. <https://climatepromise.undp.org/news-and-stories/what-climate-change-mitigation-and-why-it-urgent#:~:text=Climate%20change%20mitigation%20involves%20actions,restoring%20forests%20and%20critical%20ecosystems>.

United Nations General Assembly (2015) Transforming our world: the 2030 Agenda for Sustainable Development. UN Resolution. <https://sdgs.un.org/2030agenda>

Wang, Y. P., et al. (2010) A global model of carbon, nitrogen and phosphorus cycles for the terrestrial biosphere. *Biogeosciences*, 7, 2261-2282.

Wani, A. et al. (2024) Environmental resilience through artificial intelligence: innovations in monitoring and management. *Environ Sci Pollut Res* 31, 18379–18395. <https://doi.org/10.1007/s11356-024-32404-z>

Winkler, K., et al. (2021) Global land use changes are four times greater than previously estimated. *Nat Commun* 12, 2501. <https://doi.org/10.1038/s41467-021-22702-2>

de Wit, H. A., et al. (2008) Winter climate affects long term trends in stream water nitrate in acid-sensitive catchments in southern Norway. *Hydrol Earth Syst Sc*, 12, 393-403.

World Bank (2021) Protecting Nature Could Avert Global Economic Losses of \$ 2.7. Trillion Per Year. Website. Accessed 10.6.2024. <https://www.worldbank.org/en/news/press-release/2021/07/01/protecting-nature-could-avert-global-economic-losses-of-usd2-7-trillion-per-year>

Zacharias, S. et al. (2021). Discussion paper on eLTER Standard Observations (eLTER SOs). Deliverable D3.1 EU Horizon 2020 eLTER PLUS Project, Grant agreement No. 871128

Zhu, Z., et al. (2016): Greening of the Earth and its drivers. *Nature Climate Change* 6, 791–796

Annex A. eLTER's Key Performance Indicators

| KPI # | KPI | Evidenced by |
|-------|--|--|
| KPI 1 | Increase in the number of operational sites fulfilling all requirements of labelling at each level (eLTSE Platform, eLTER Category 1, 2 or 3 Sites) | Head Office and Topic Centres databases |
| KPI 2 | Number and description of (software) tools and services offered | Databases from RI and Topic Centres. The number calculation includes dynamic ecosystem modelling tools, integrated data products |
| KPI 3 | Number of access to eLTER RI data via eLTER Cyberinfrastructure (from a total of ca 1000 users as calculated in the user study of the eLTER H2020 project) | Service Portal databases, number of downloads of open data, and data requests by research profiles |
| KPI 4 | Number of visitors at RI, by type: scientific users, university classes, school classes. Quantitative description of the use of RI facilities and services. | Number of visitors collected from Databases from RI, platforms and sites. Number of requests for the use of RI facilities by all types of users. |
| | Number of scientific events hosted, and number of participants | Several types of events to be included : academic/technical conferences, seminars, workshops, webinars, open days, both at RI and sites & platforms level. Number of participants depending on nationality, user type, and gender. |
| KPI 5 | Number of users of Transnational Access, Virtual Access and Remote Access | Includes number of Transnational Access/ Virtual Access/ Remote Access |
| | Number and increase of policy advisory initiatives at local, regional, national and European level | International Science press, bibliometric analysis, European Commission databases Narrative to be included by sites, platforms and/or national nodes in annual reports |
| KPI 6 | Number of meetings attended online instead of physically, number of green transports used to attend eLTER RI related meetings by eLTER RI personnel during operation phase | Information collected at the beginning of the physical meetings for the number of travels by green transports, or number of travels that had carbon compensation options. Narrative produced by meeting organizers that centralize information about choices of service providers and of location for the in-person meetings |
| KPI 7 | Satisfaction of service users per type | Narrative based on information obtained through a questionnaire that the Service Portal proposes to service users |
| KPI 8 | Number of publications/co-publications with industrial partners | International Science press, bibliometric analysis, European Commission databases |
| KPI 9 | Number of patents, methodologies and start-ups created by eLTER users and partners using products or expertise gained from eLTER RI | Number of patents from eLTER partners. Concerns patent applications, patent granted. Number of new methodologies, prototypes or developed designs based on scientific publications. |
| | Mixed quantitative description of HR strategies as planned during the preparation phase | Databases from Head Office. |

| | | |
|--------|--|---|
| | Number of organisations/countries with a formal engagement of the RI | Number of organisations/countries (e.g. members, associated members or observers, bound by legal agreement or MoU) based in an ESFRI member country. Information collected by the RI. |
| KPI 10 | Number of co-located sites : a site that is a part of multiple RIs | RI database. Includes percentage per site categories (eLTSE Platforms, eLTER Category 1, 2, 3 Sites) |
| KPI 11 | Number of working agreements and support letters from Collaborating Infrastructures | RI and Topic Centres databases |
| KPI 12 | Number of eLTER experts integrated in international committees and scientific groups/bodies (e.g. PECS, IPCC) | National delegates and CO-PPP inquiry |
| | Increase in the number of partners signing legal entity contract (from 17; or number of members in Council) | RI and Topic Centres databases |
| KPI 13 | Number of conceptual and transdisciplinary papers based on the research performed using facilities/resources of the RI in related journals | Queries/databases from eLTSE Platforms and Topic Centres, International Science press, bibliometric analysis. Task can be automatised using citation to datasets/site IDs, using consistent keywords |
| KPI 14 | Number of publications based on the research performed using facilities/resources of the RI | Bibliometric analysis from WoS and Scopus, International Science press. Number of proceedings papers, book chapters, books, technical reports and datasets directly gathered from users of the RI. Task can be automatised using citation to datasets/site IDs, using consistent keywords |
| KPI 15 | Number of users of the services, and partition of international users | Databases from RI and Topic Centres. Sorted by: type (scientific, student, public, stakeholders and SME), nationality |
| KPI 16 | Quantitative description of habitats diversity across eLTER Sites and eLTSE Platforms. | Number of habitats and increase in representativity of habitats across eLTER Sites and eLTSE Platforms. |
| KPI 17 | Number of MSc and PhD students from local universities using the RI services during their studies (funded by the RI or as a user) | Databases from RI, by compiling the number of unique individuals accessing the RI as a facility or its data. Users do not need to be funded by the RI to be included as user. Can also be collected via Sites & Platforms annual reports |
| KPI 18 | Number and description of training programs provided by the RI | Databases from RI |

| | | |
|--------|---|---|
| KPI 19 | Number and satisfaction of participants in RI training activities | Narrative based on information obtained through questionnaires to participants |
| KPI 20 | Increase in the number of operational sites fulfilling all requirements of labelling at each level (eLTSEER Platform, eLTER Category 1, 2 or 3 Sites) | Head Office and Topic Centres databases |
| KPI 21 | Number and description of (software) tools and services offered | Databases from RI and Topic Centres. The number calculation includes dynamic ecosystem modelling tools, integrated data products |
| KPI 22 | Number of access to eLTER RI data via eLTER Cyberinfrastructure (from a total of ca 1000 users as calculated in the user study of the eLTER H2020 project) | Service Portal databases, number of downloads of open data, and data requests by research profiles |
| KPI 23 | Number of visitors at RI, by type: scientific users, university classes, school classes. Quantitative description of the use of RI facilities and services. | Number of visitors collected from Databases from RI, platforms and sites. Number of requests for the use of RI facilities by all types of users. |
| KPI 24 | Number of scientific events hosted, and number of participants | Several types of events to be included : academic/technical conferences, seminars, workshops, webinars, opendays, both at RI and sites & platforms level. Number of participants depending on nationality, user type, and gender. |

Together with our clients
and the collective
knowledge of our 22,000
architects, engineers and
other specialists, we co-
create solutions that
address urbanisation,
capture the power of
digitalisation, and make our
societies more sustainable.

Sweco – Transforming
society together