Climate-resilient ecosystem-based governance

Deliverable D2.2

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1 PU = Public
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Executive summary

Effective governance is widely recognised as fundamental to sustainable lake protection and restoration, but it remains one of the most challenging aspects, often hindered by siloed, technocratic approaches. A FutureLakes governance framework has been developed to guide lake managers in fostering more integrated, adaptive, and inclusive lake governance. This framework underpins what is needed to transform lake protection and restoration efforts across Europe under the pressures of the 21st century. Lake governance frameworks already exist, but the FutureLakes governance framework developed in this task adds a stronger process- and learning-oriented approach. It provides a structure for self-assessment and planning for lake managers, basin agencies or multi-stakeholder lake committees. It deliberately includes climate adaptation considerations ensuring users consider long-term climate resilience, not just static water quality, ecological or biodiversity targets. The framework provides practical guidance and insights grounded in six diverse European demonstration lakes. It also serves as a key building block for a *FutureLakes Blueprint for lake protection and restoration*. The Governance Framework outlines seven interlinked domains for effective lake governance:

I. Problem identification: Early detection of issues (e.g. water quality decline, habitat loss) triggers action.

II. Coordination, dialogue & governance: The framework highlights the need for a dedicated lake coordination mechanism or leadership to connect agencies and sectors, facilitate communication, and prevent fragmented efforts. It emphasises inclusive multi-stakeholder platforms that bring together government bodies, scientists, land users, NGOs, and communities for regular dialogue and joint decision-making. Building **consensus and trust** among diverse actors, proactively managing conflicts, and fostering **collaborative relationships** are critical for long-term success.

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III. Communication, outreach & stakeholder engagement: Transparent communication, public outreach, and meaningful stakeholder engagement are treated as central pillars of governance. Broad participation – involving local communities, lake user groups, and the public – improves legitimacy, local knowledge uptake, and compliance.
IV. Fundraising: Sustainable financing underpins long-term lake management. The framework reviews strategies to mobilise resources. It stresses aligning lake projects with broader policy goals to unlock funding synergies and the importance of securing ongoing operational funds.
V. Implementation practices include sewage infrastructure upgrades and sediment removal for water quality, nature-based solutions such as constructed wetlands and riverbank buffers, and adaptive interventions like selective fishing (biomanipulation) to rebalance ecosystems.
VI. Knowledge development & monitoring: All cases underscore the value of rigorous monitoring, data sharing, and joint learning. Long-term scientific programmes have provided the evidence base to guide policy and to detect emerging issues.
VII. Policy, regulations & institutional embedding: Finally, the framework highlights the importance of embedding lake governance in higher-level policy and legal frameworks for support and longevity. Integrating lake restoration goals into EU and national directives has driven action in several cases.

Approach and Methodology: The framework was developed through a case study analysis of six FutureLakes demonstration sites: large lake systems in Scotland, Greece, Poland, Finland, Norway, and the Netherlands, that were chosen for their model approaches. The research started with an extensive literature review and designed a survey and semi-structured interviews with local lake coordinators, and experts. Interviews were guided by a *social learning* framework to examine how each lake's governance evolved through processes of innovation adoption, knowledge integration, multi-actor dialogue, joint decision-making, and adaptive planning. Insights from these case studies were compared and synthesized using a combination of expert analysis and AI-assisted transcript analysis in a secure, internal environment, followed by validation and input from local lake experts. This iterative, collaborative approach ensured that the resulting framework is evidence-based, context-sensitive, and rooted in real-world lessons learned across Europe.

Artificial Intelligence statement

This report was developed with the help of Artificial Intelligence (AI), in the transcribing and analysing and cross-comparison of the lake case studies and frameworks. This was done in a closed environment with a special licence which ensures internal-only use of data, and not accessible to other parties. Only data from closed Language models were used, avoiding hallucinations. This information was then verified by reviewing the content involving the relevant lake experts and coordinators.

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1. Introduction

This deliverable is part of the FutureLakes project. This is an EU Horizon project which aims to demonstrate innovative solutions needed to transform lake restoration, integrated into lake management, to significantly improve ecological and chemical status of European lakes, restore biodiversity, enhance the services that lakes provide and make society more resilient to climate change. Demonstrating integration of these solutions in operational lake management in six large European lakes will help develop a Blueprint for lake protection and restoration.

Many scholars agree that governance is fundamental to effective lake management but is at the same time the most challenging aspect and needs increased attention (e.g. Brillo 2023). By understanding and applying good governance principles, lake management can be more effective, equitable, and sustainable, ensuring the well-being of both the lake ecosystem and the communities that depend on it (Brillo 2023). In addition, integrating adaptive management can build resilience to climate changes (Cardona et al 2023; Cools et al 2023). However, such governance is often challenged by siloed and technocratic approaches. For example, lake management is predominantly seen as an environmental concern often focussing on water quality and environmental aspects (e.g. Jarvis et al 2024). Aspects such as risk and resilience are mandated to other actors with a more operational and response-oriented agenda (Vincent 2022; Lyu et al 2020). In addition, knowledge development in relation to lakes is often technical, including hydrological and ecological knowledge, while social science-related governance knowledge is lacking, such as experiential, and local knowledge. This is what Aristotele would have named phronesis (practical wisdom): the ability to make sound, context-sensitive judgments about what is good and how to act rightly in real-life situations (e.g. Ballatore and Muhamdiki 2001).

There are a few existing governance frameworks relevant for lakes, and while some address aspects such as integrated water resources management and adaptive management, we consider there needs to be more emphasis on the social learning and change processes to achieve transformations to meet the current challenges. We, therefore, use a social learning framework to study the cases, which takes note of their evolving process of innovation adoption, knowledge integration, dialogue and decision-making, planning, and governance transformation (Johannessen & Hahn, 2013).

Aims of the deliverable

With this background, task 2.2 aims to develop a **"Climate-resilient ecosystem-based water governance framework"** that can provide new knowledge and insights on lake governance, while at the same time address the climate threats and related challenges: including adaptive management that can enable adequate responses to emerging challenges.

- The framework strives to be *systemic* - informed by several different existing frameworks that combine the necessary elements; both ecologically-focused WFD lake basin management planning with climate risk and resilience considerations (e.g. flood and drought management).
- The framework, and the information provided, also strives to be *practically relevant* and *action oriented*, directly mirroring the specific situation of lake management and governance, with richness of relevant details, to provide guidance to practitioners by collecting and synthesising lessons learnt from six demonstration lakes in Europe.

- The goal of this deliverable is also to enable the *sharing* of lessons learnt, cross-fertilising and inspiring from the case studies and their concrete experiences.

Target audience

The target audience of this framework is lake managers and coordinators, or other persons interested in lake governance – its facilitation, decision-making and other aspects. Other audiences are researchers on lakes that wish to develop governance knowledge, to inform the development of guidelines and blueprints.

2. The analytical framework

The origin of the term *governance* means "steering" of processes that involve decision-making and implementation. This steering takes place through various actors, institutions and networks (Lautze et al. 2011), that can range from individuals, to a family, to corporate business, to government or international institutions, or a market (United Nations Office on Drugs and Crime 2016 p. vi, and UNESCAP n.d., p. 1). This means that governance can be carried out through many different approaches; e.g. laws, norms, power or language etc. (Bevir, 2012). The term governance is, therefore, an elusive, broad and generic concept which often requires contextualisation and more specific details to be meaningful.

Why another governance framework for lakes?

Although existing frameworks for lake governance exists, the Future Lakes governance framework is developed to complement them with aspects that are not emphasised in these frameworks and considered essential for resilience:

- Integrating challenges of **climate change** in lake governance requires more **systemic approaches.** For example, often lake governance has been traditionally governed from an environmental water quality perspective, but increasingly, aspects of floods and droughts and increasing temperatures need to be considered, requiring additional relevant governance integrations. Increasing **development pressures** also require more systemic approaches. For example, lake managers or communities need to be better at justifying their lake's value and demonstrate why a healthy lake has a broader societal value, and not "only" biodiversity. Integrating a broader range of lake - functionalities into governance is needed.
- The framework aims to capture governance as a **"practical wisdom" (phronesis)** alongside the understanding of the more scientific work of monitoring lakes or associated technical interventions in basin management. Scholars of sustainability science have long argued that this kind of knowledge is undervalued and has a central place in transformative governance understanding. **Social learning** puts emphasis on more intangible dynamics and implicit elements, relating to phronesis, such as trust building and conflict management and collaborative learning. Social learning also puts more emphasis on ***process*** related aspects that describe ***how*** we can achieve transformative governance. Process elements are notoriously under-described because the literature often focuses on the governance *outcomes* (e.g. implemented measures or strategies and existing institutions).

Below follows a description of existing lake governance frameworks as well as the key principles for developing these frameworks further.

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2.1 Existing lake governance frameworks

2.1.1 Integrated Lake Basin Management (ILBM)

ILBM, developed in the mid-2000s, provides a high-level "6-pillar" model for lake basin governance: Institutions, Policies (and laws), Participation (public and stakeholder involvement), Information (scientific data and monitoring), Technology (appropriate engineering/technical interventions), and Finance (sustainable funding). It essentially adapts Integrated Water Resources Management to the lake context, recognizing that lakes have unique dynamics (e.g. long retention times, vulnerability to cumulative pollution) (Nakamura & Rast, 2014). ILBM encourages gradual, continuous improvement in each pillar, rather than one-off fixes. A strength of ILBM is its simplicity and completeness – it reminds managers to cover all fundamental aspects. It has been widely used as a planning and diagnostic tool; for example, the World Bank's Lake Basin Management Initiative applied ILBM to 28 lakes worldwide (ILEC, 2005). However, ILBM's original formulation is somewhat static and does not explicitly emphasize adaptive change or managing climate impacts – it was assumed that if all six pillars are tended to, the system will cope. In practice, ILBM-based assessments revealed that, sometimes, formal institutions and policies existed on paper but failed due to lack of stakeholder buy-in or learning (e.g., Lake Chad's ILBM identified strong national agencies but weak local participation; see Brillo, 2023). Thus, ILBM is a crucial foundation, but modern challenges have led to augmenting it with more dynamic governance concepts.

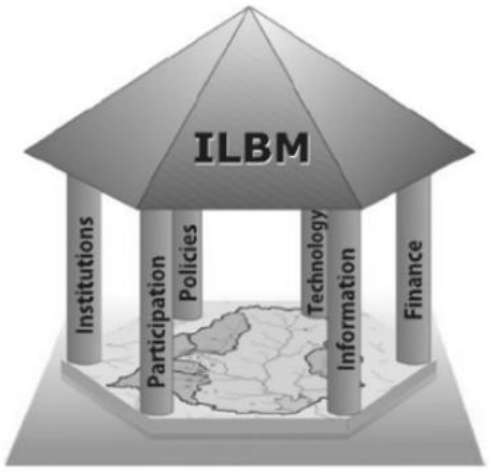

Figure 1 The six pillars of ILBM for sustainable lake basin management. Source: Muhandiki et al. 2014

2.1.2 Adaptive Integrated Lake Basin Management (Adaptive ILBM or AILBM).

AILBM emerged in the 2010s as scholars integrated adaptive governance and resilience thinking into ILBM (Cookey et al., 2016). Cookey and colleagues proposed AILBM as a two-part framework: (1) a diagnostic assessment of the lake's social-ecological context (sectors, stressors, institutions, actors, etc.), and (2) a prescriptive assessment scoring the governance against six ideal criteria: Adaptability,

Collaboration, Resilience, Decentralization, Integration, and Participation (Cookey et al., 2018). These criteria mirror ILBM's pillars but with an explicit focus on process and capacity: e.g., "Adaptability" and "Resilience" require mechanisms to learn and adjust to changing conditions, "Decentralization" implies multi-level power sharing, etc. AILBM thus goes beyond ILBM by asking not just "Do you have institutions/policies?" but "Are they flexible, inclusive, and able to learn?" (Cookey et al., 2016). In application, AILBM has been used to evaluate governance performance; for instance, a case study in Thailand's Songkhla Lake found low scores in collaboration and decentralization, pinpointing why conventional management struggled (Cookey et al., 2016). AILBM aligns closely with the needs of climate adaptation, as it stresses systems that can adjust to floods, droughts, or ecological surprises. It essentially operationalises the concept of adaptive (co-)management for lakes (sensu Folke et al., 2005), complementing ILBM's static checklist with a dynamic scoring of how governance works in practice.

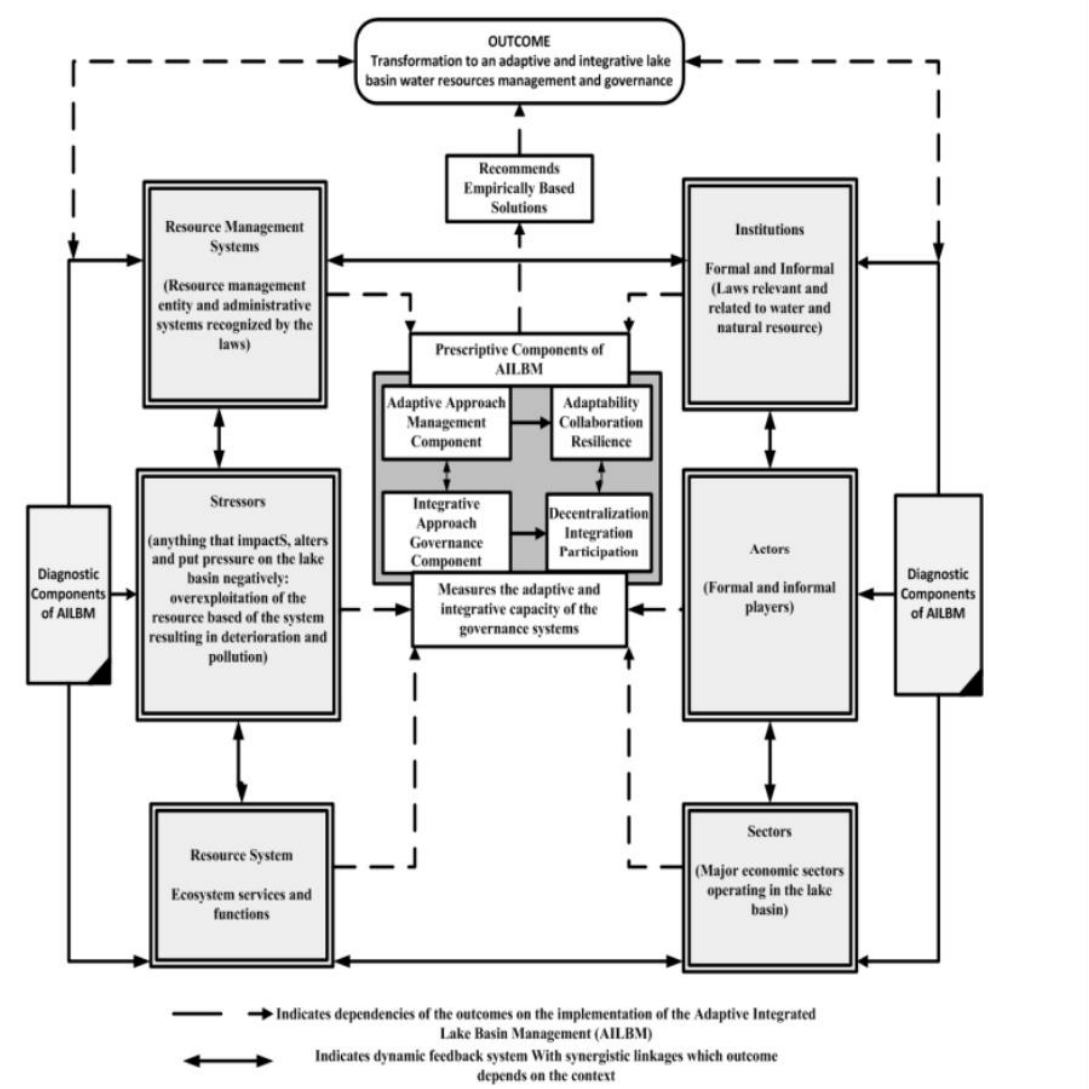

Figure 1. The flowchart of the conceptual framework of the Adaptive Integrated Lake Basin Management (AILBM) for assessment of governance performance of lake basins.

Figure 2 The flowchart of the conceptual framework of the Adaptive Integrated Lake Basin Management (AILBM) for assessment of governance performance of lake basins. Source: Cookey et al 2016.

MoReCo Framework: The MoReCo framework is a very recent contribution (Cianci-Gaskill et al., 2024) that explicitly aims to be a global, climate-ready lake management framework. "MoReCo" stands for Monitoring, Restoring/Protecting, Community Engagement – the three core components of the approach. The framework is depicted as an iterative, interactive cycle with two linked loops (a Monitoring loop and a Restoring/Protecting loop) revolving around a central Community Engagement axis (Cianci-Gaskill et al., 2024). Key features of MoReCo include: (a) Proactive management of multiple stressors – it's designed to handle simultaneous issues (e.g. nutrient pollution *and* invasive species *and* habitat loss) rather than one at a time, reflecting real-world complexity (Cianci-Gaskill et al., 2024). (b) Continuous operation – managers should be engaged even when a lake seems "fine," by monitoring to catch emerging problems early and by taking protective measures for high-quality lakes, not only reacting after degradation occurs. This addresses a noted gap where traditional management focuses on degraded lakes and neglects preserving healthy ones (Cianci-Gaskill et al., 2024). (c) Community Engagement at the core – MoReCo emphasizes identifying stakeholders, incorporating local knowledge, and co-designing and co-implementing solutions at every step (from setting goals to monitoring and adaptation). This reflects modern thinking that broad participation improves legitimacy and outcomes. (d) Explicit benchmarks and feedback – the framework calls for setting quantitative targets (e.g., water quality thresholds, biodiversity indices) and "triggers" (early warning indicators) so that success can be measured objectively and management interventions adjusted based on results (Cianci-Gaskill et al., 2024). Essentially, MoReCo marries an adaptive management loop with a strong participatory approach, tailored specifically to lakes' needs and climate challenges. It builds on earlier frameworks: ILBM is reflected in its holistic scope, and AILBM's influence is seen in its emphasis on iteration and learning; but MoReCo uniquely centres community engagement and maintenance of good conditions. The authors present MoReCo as a tool for lake managers of any kind – government agencies, lake associations, or NGOs – to plan and implement restoration *and* protection in a changing climate (Cianci-Gaskill et al., 2024).

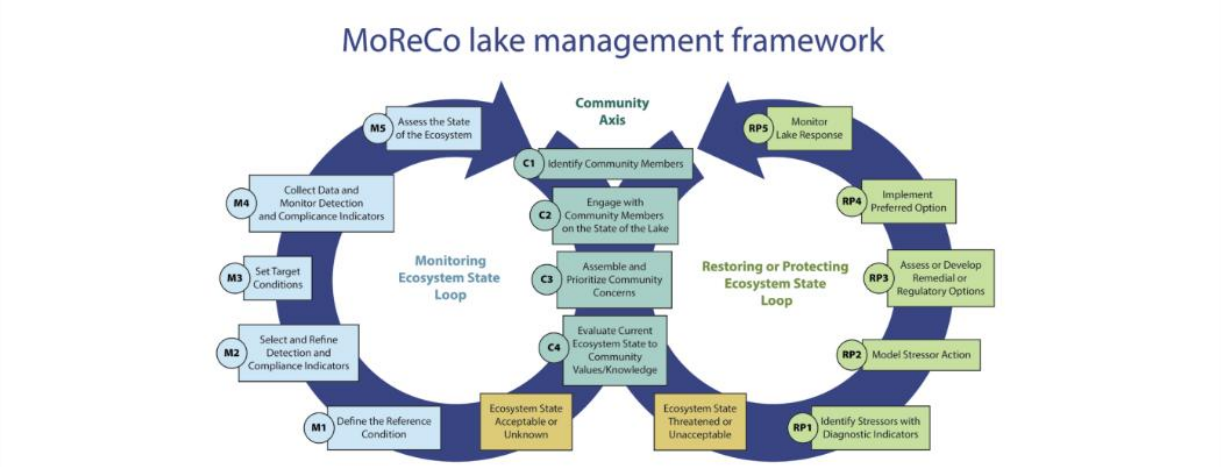

Figure 3 MoReCo (Monitoring, Restoring/Protecting, Community Engagement) lake management framework diagram. Source: Cianci-Gaskill et al 2024.

2.2 EPIC - Framework on floods and droughts

To see if we needed to complement AILBM considerations to climate related stressors, we initially also considered another fully drought and floods-oriented framework: the EPIC Response: The EPIC Response framework (Browder et al., 2021) was developed by the World Bank and Deltares to guide innovative governance for flood and drought risk management. While not lake-specific, EPIC is relevant for lakes in the broader context of water and climate governance. "EPIC" is an acronym for its key components: Enable, Plan, Invest, Control, Respond (Browder et al., 2021). In essence, it is a comprehensive checklist for governments to manage hydro-climatic risks in an integrated way: Enable – establish robust policies, laws, institutions, and information systems (e.g., meteorological services, water agencies) as a foundation; Plan – develop coordinated plans across sectors (water, agriculture, urban, environment) and levels, treating floods and droughts as linked extremes; Invest – secure funding and implement both "grey" infrastructure (dams, levees) and "green" infrastructure (wetlands, watershed restoration) to mitigate risks; Control – use land-use planning, zoning, and water allocation policies to control exposure and vulnerability (for instance, prevent building in floodplains or over-abstraction of lake water); Respond – build capacity for emergency response, early warning, and fast recovery (flood forecasting systems, drought relief programmes, etc.) [1]. EPIC's philosophy is a "whole-of-society" and "joined-up government" approach. It recognizes that traditionally floods and droughts are handled in silos; EPIC calls for breaking silos and engaging all stakeholders, including vulnerable communities, in risk management. EPIC focuses heavily on the **formal governance capacity** (policies, agencies, finance) akin to ILBM's institutional/policy pillars, and it explicitly highlights integration and inclusion. EPIC is about **climate-resilient governance** at a broad scale – its direct application is for national or regional governments to reform governance structures to better handle water extremes. For lake managers, EPIC provides some relevant principles: ensure that lake flood control or drought response is embedded in wider plans, coordinate among disaster agencies and water managers, and invest in both infrastructure and ecosystem-based solutions. But EPIC does not delve into fine-grained community processes or ecosystem-specific monitoring as the lake-centric frameworks do; it's more top-down. One can see EPIC as complementary: EPIC ensures the enabling environment and multi-hazard planning are in place (e.g., a river basin authority empowered to manage lakes and floods together), while the lake frameworks ensure that within that structure, there is adaptive, participatory management of the lake's ecology.

2.3 Framework elements derived from the above frameworks

2.3.1 Stressors

Definition: In the context of lake governance, a stressor is defined as any physical, chemical, or biotic factor that has the capacity to affect another response variable in a linear or non-linear way, be it positive or negative in direction. Examples of stressors are: Societal activities, emerging substances, climate influences (floods, drought, warming), polluting substances.

[1] The EPIC Response Framework | Deltares

The (survey and interview) **responses** should list all stressors to the system and their severity, (including development and climate-related) and if they are long known or emerging (new) and if they are addressed by management and governance.

2.3.2 Resource systems

Definition: Resource systems include the ecosystem services (ESS) and the biodiversity value of the lake basin. ESS are typically categorized into four main types:

1. Provisioning services. Defined as the products obtained from ecosystems, such as food, water, raw materials, genetic resources, etc.
2. Regulating services. Defined as the benefits obtained from the regulation of ecosystem processes, e.g., temperature control, water purification, nutrient cycling, flood and drought resilience.
3. Cultural services. Defined as the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, well-being, reflection, recreation, and aesthetic experiences.
4. Supporting services. Defined as the services required to produce all other ecosystem services.

The **responses** should help assess if all ecosystem services (ESS) are governed or if there are gaps. Documenting the ESS also captures non-biodiversity values for a lake, including climate resilience services etc. Responses also help assess which ESS and biodiversity are affected by the stressors. However, a very specific documentation of the ESS was beyond the scope of this report as it is not crucial for developing a governance framework.

2.3.3 Resource management systems

Definition: Resource management systems are the core of the lake administration. They include the entirety of resources management, administration and technology for pollution/stressor control and funding mechanisms for resource management for the lake. In this section we ask you to describe the main features of the resource management system. For example, is it fit for purpose given new stressors?

Responses should capture if there are baseline assessments, monitoring and warning systems for a systemic approach: both covering ecological status and vulnerability/risk assessment related to climate change impacts.

2.3.4 Actors and stakeholders

Definitions*: Actors* (or change agents) are key players or stakeholders involved in lake governance. An "actor" is defined as an entity possessing agency or power of action, linked with legal, technical, and cultural frameworks in which they operate (Bressers 2009). The actors driving the learning, make important choices about who to engage in different stages of the learning process, and as such, what diversity of input to take onboard, steering the learning and knowledge integration.

Stakeholders are defined as “any group or individual who can affect or is affected by the achievement of an organisation’s purpose” (Freeman, 2010). Stakeholder engagement is a broad concept with diverse processes and various intentions, that can refer to basic communication and consultation with

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stakeholders, but also describes more advanced forms of participation, representation, partnerships with co-decisions, co-production, and knowledge co-creation as the most ambitious form of stakeholder engagement (OECD, 2015).

Stakeholder engagement can be evaluated with reference to its ambition. Benefits of involving stakeholders include generation of results directly relevant to society and decision makers, enhanced communication of data and results to broader audiences, increased stakeholder understanding of and trust in science, active citizenship, and increasing adaptive capacity (Smyth et al., 2021). A fundamental exercise before stakeholder engagement activities is understanding the complexity of actor constellations in the given area. This should be done by a thorough stakeholder mapping approach (done in task 2.1; Szulecka, 2025).

Responses should gain insight on who is driving the initiated actions to adapt to change (and address the stressors), including taking the decisions.

2.3.5 Institutional aspects (sectors)

Major social and economic activities in the lake area may affect the quality and quantity of water and other natural resources in the lake basin area. These activities are often divided into sectors and managed by a diversity of institutions.

Definitions: *Institutions* in lake governance are responsible for creating and enforcing policies, coordinating stakeholder actions, and ensuring sustainable management of lake resources. They include local public institutions, government agencies, and non-governmental organizations that work together to address environmental challenges and promote conservation efforts. Effective lake governance requires strong institutional capacity, clear legal frameworks, and active stakeholder engagement (Faris, 2019). Institutions are key diagnostic component of the AILBM framework.

In the context of lake governance, a *sector* refers to a distinct area of focus or activity that involves various stakeholders, policies, and management practices aimed at the sustainable use and conservation of lake or catchment resources. This can include sectors such as water quality management, fisheries, tourism, and community engagement, each playing a crucial role in the overall governance framework to ensure the ecological health and socio-economic benefits of the lake (Brillo 2023).

Sectors are key diagnostic component of the AILBM framework. In the EPIC response framework, the key focus of the initial assessment involves National Sectoral Frameworks (e.g. water resources management, flood and drought risk and disaster risk reduction). Other sectors are relevant for the response/ measures taken.

Responses should capture if the *relevant* sectors and institutions are involved related to both ecosystems and emerging climate change and the quality of their involvement and collaboration. Stakeholders have already been mapped for the lake ecosystems, but that does not mean they are all adequately represented or engaged in the governance. The sector involvement can be visible via different kind of **planning**, e.g. land use planning and practices such as erosion control and buffer zones, sustainable fisheries management practices, sustainable water use, including allocation, conservation, conjunctive groundwater management (when surface and groundwater are managed jointly). Climate considerations can be visible through **resilience building strategies including** climate-smart agriculture, carbon sequestration. The sector collaboration is critical for systemic governance

which can be evidenced by collaborating/coordinating mechanisms among different governance bodies and sectors. These may be more, or less, fit for purpose and effective in connecting actors and sectors for integration. Roles and responsibilities define how actors are mandated to work together.

2.3.6 Policy and regulatory framework

Definition: A policies and regulatory framework refer to the set of formal rules, laws, guidelines, and strategic directions established by governments or institutions to guide decision-making and behaviour in a specific domain. It provides the legal and institutional structure within which actions are taken, ensuring accountability, consistency, and alignment with broader societal goals. These help in coordinating actions, setting priorities, and allocating resources effectively (ThePolicyGuide, 2024). An example is the governance of the Great Lakes in North America, where policies have been instrumental in managing water quality and invasive species. These policies are based on scientific research and involve collaboration between multiple stakeholders, including government agencies, local communities, and environmental organizations (Allan et al., 2013).

Responses should give insight into if there are adequate regulations that protect lakes and ensure resilience, if policies are integrated and coherent (are the policies related to water management, land use, agriculture, and industry integrated and aligned with lake governance objectives?) and are there compliance and enforcement mechanisms to ensure adherence to regulations?

2.3.7 Equity

Definition: Effective governance ensures that management processes (responsibilities and decision-making) and benefits are equitable and inclusive, addressing the needs of marginalised and vulnerable groups. It ensures that governance processes account for diverse values, needs, and capacities, promoting justice in both environmental outcomes and participation.

Responses should give insights into if lake governance is equitable and inclusive (e.g. related to *water allocation, cultural values and traditional knowledge). Also, it is relevant to know if there is support for* sustainable livelihoods that depend on the lake (e.g. *eco-tourism, sustainable fishing, and agriculture).*

2.3.8 Financing

Lake management and restoration rely on the availability and stability of funding, which should come from diverse sources to ensure resilience. Current business models often include mechanisms for value capture, such as grants and private sector investments, but it is essential to assess whether all ecosystem services (ESS) are adequately valued and funded, and to identify areas where additional resources are needed. Furthermore, innovative financial arrangements could be developed to recognise and capture the value of non-valued ESS, strengthening the overall sustainability of lake governance.

Responses should give an idea whether the lake management and restoration are currently funded and financed. For example, if there is financial stability and are there diverse funding sources.

We considered that it would be interesting to understand the business models including value capture arrangements that are used, for example, grants, private sector investments. In general, is would also be interesting to understand if all ESS are valued/funded, or if more funding is needed from other sectors and actors. We expect lake management to be funded for mainly environmental purposes and not to pay for ecosystem services such as Disaster Risk Reduction and erosion risks. If there is time and

opportunity, it is useful to explore what innovative arrangements could be developed to value and capture other non-valued ESS. However, most of these ambitions are outside the scope of this study.

2.3.9 Knowledge and capacity (gaps)

Definition: Knowledge is the understanding and information acquired through learning and experience, while capacity is the ability or potential to perform tasks, solve problems, and make decisions. Effective lake governance depends on robust systems for data collection, management, and sharing to support informed decision-making. It should promote research and innovation to develop new solutions and improve existing practices, while also fostering education and awareness programmes that engage stakeholders and the public in lake conservation and sustainable use. Governance must recognise the diversity of knowledge and perspectives by involving academic, practical, governmental, and political actors, ensuring that all participants have sufficient capacity and identifying areas where additional knowledge or skills are needed. Finally, cultural values and traditional knowledge should be acknowledged and integrated into governance practices to create inclusive and context-sensitive approaches.

Responses should capture:

- What the systems are for data collection, management and sharing data related to the lake ecosystem and management processes.
- What type of research and innovation is promoted to develop new solutions and improve existing practices for lake management.
- List what education and awareness programmes are available to inform stakeholders and the public about the importance of lake conservation and sustainable use.
- Capture the knowledge diversity, or different perceptions (*e.g. academic, practical, government, political).*
- Assess if everyone involved has sufficient knowledge and capacity, and if not, who needs more knowledge/capacity.

2.4 Practical wisdom – phronesis

The framework aims to capture governance not merely as a set of institutional arrangements or technical procedures, but as a form of practical wisdom—or phronesis—that emerges through situated judgement, contextual understanding, and experiential learning. This notion of governance as phronesis draws on Aristotelian philosophy and has been increasingly recognised in sustainability science as essential for navigating complex, uncertain, and value-laden environmental challenges (Flyvbjerg, 2001; Voß & Bornemann, 2011). It complements the more formalised, scientific modes of knowledge production—such as lake monitoring, modelling, and technical interventions—by foregrounding the tacit, normative, and deliberative dimensions of decision-making.

Scholars have long argued that this kind of knowledge—rooted in practice, ethics, and local context—is often undervalued in dominant governance paradigms that privilege technocratic or evidence-based approaches (Stirling, 2008; Fazey et al., 2006). Yet, in the context of transformative governance, phronetic knowledge is indispensable. It enables actors to navigate trade-offs, mediate between competing values, and adaptively respond to emergent socio-ecological dynamics (Wyborn et al., 2016;

Olsson et al., 2006). By integrating this dimension into the analytical framework, the approach acknowledges that effective lake governance is not only about implementing best practices, or achieving compliance with ecological targets, but also about cultivating the capacity for reflexive, context-sensitive, and ethically grounded action. To capture the phronesis related elements, the theories and frameworks related to social learning was considered appropriate.

2.5 Social learning

Social learning is key to **resilience building** and **transformative governance** because it fosters collective understanding, adaptive capacity and management, and collaborative problem-solving, enabling communities to effectively respond to and recover from various stressors.

Definitions: Social learning is simply defined as: “learning together by doing together”. Originally developed in organisational management, it is often discussed in context of deliberating (i.e. discussing) on the job by a group of actors, (in contrast to learning by training). Schusler et al. (2003) define social learning as the process through which individuals engage with one another, sharing diverse perspectives and experiences to develop a common understanding and basis for joint action over the course of days. Johannessen and Hahn (2013) explore social learning as a mechanism to enhance adaptive capacity in climate and risk management over longer periods, e.g. decade(s). They emphasise social learning as a social process involving to challenge, disrupt or alter the prevailing values, assumptions, behaviours, knowledge systems, modes of operation, or institutional structures (Haxeltine, Avelino, et al., 2016; Rogers et al., 2015). Social learning is as such closely related to **adaptive management** which can be described as a structured, iterative process of robust decision-making in the face of uncertainty, often also described as "learning by doing".

Social learning can be facilitated by different characteristics of the governance system, but also by individuals. Social learning emphasizes the importance of iterative learning processes, categorised into single-loop, double-loop, and triple-loop learning. The framework shown in figure 10 was developed from this thinking and includes social learning process elements such as: triggers and prerequisites for learning, actors deliberating on the job in a social learning process, which is enabled by and challenged by certain factors which can be institutional and/or individual, which generates knowledge and outcomes.

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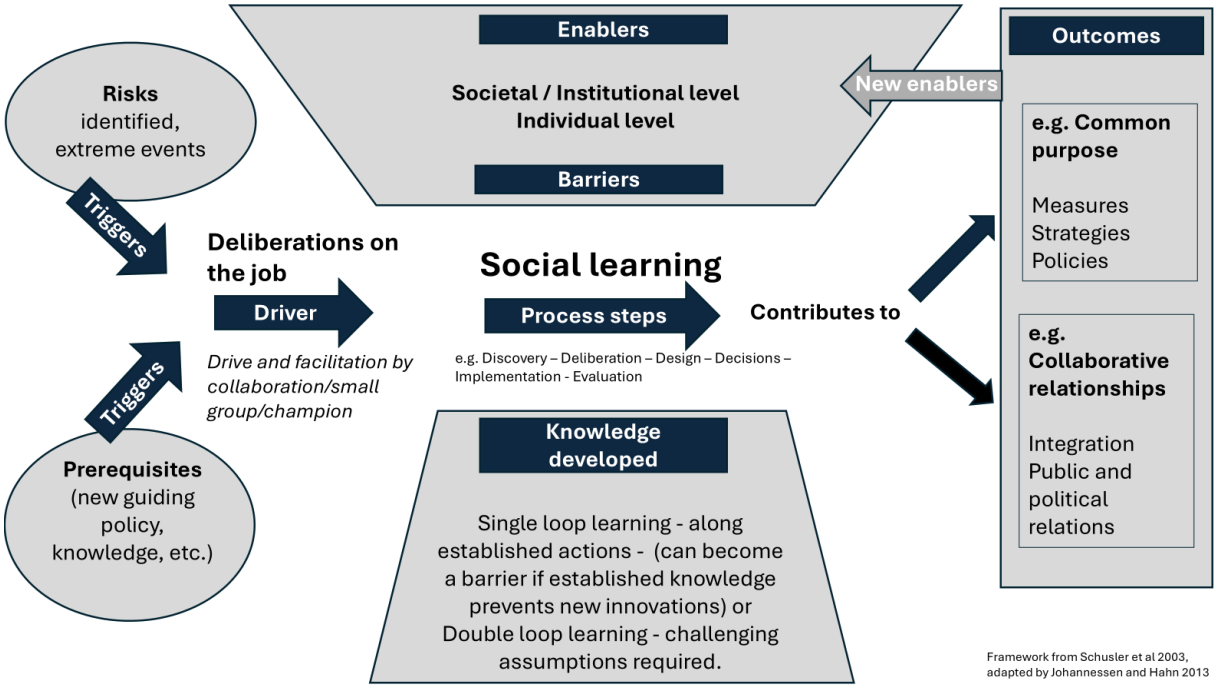

Figure 4 A conceptual model of the main components of the social learning framework used to guide the interviews. Sources: The authors, based on Schusler et al 2003; Johannessen and Hahn 2013.

2.5.1 Enablers: Process attributes that facilitate learning (or provide barriers)

Actors or change agents learning is **facilitated by different process attributes**. For example, people who challenge assumptions, employ unrestrained thinking, open communication, with an inquiring mind, help *individuals* in re-evaluating existing frames of reference, and take onboard new views and perspectives. Furthermore, trust is an important enabler/facilitating factor.

Process attributes at *societal level* are part of the institutional context and can include different policy, regulatory, planning frameworks and guidelines, informational and financial arrangements and capacities that influence learning (Raadgever & Mostert 2005; Jiménez et al 2015). Some of these may even be **prerequisites** for learning, enabling the learning process to start (Johannessen and Hahn 2013). These can also be what some scholars argue to be critical (systemic) **leverage points**, where interventions can lead to significant changes (Meadows 1999; Abson et al. 2017).

External drivers as facilitating factors: Learning and collaboration can also be fostered by external drivers, such as crises and disasters. These 'focusing events' bring a subject to the policy making or action agenda, often by creating awareness of individuals that in turn trigger change in society. Here, pre-existing (risk) perception of the problem, is often necessary for action (Kingdon 2014; Johannessen and Wamsler 2017; Huttunen et al., 2021).

Responses should capture:

- What are the facilitating factors at the individual and social level?

- What kind of institutional context is supporting the monitoring and restoration? E.g., horizontal or vertical (national level initiative to integrate/coordinate? Multi-level governance?) integration/collaboration?
- How flexible and adaptive is the governance to be able to respond to changes in the lake environment?

2.5.2 Barriers to learning (or lock ins)

When the existing institutional arrangements are no longer fit to address the ongoing lake management, needed restoration or additional stressors, they can provide path-dependencies and resistance to change or lock-ins (Johannessen et al. 2019; Siebenhüner et al. 2021; Groen et al. 2022). Introducing new way of doing things, needs to be negotiated with the powers that maintain business as usual (Jongman et al., 2018). This can be perceived as costly in terms of transaction costs to reorganise (Pierson, 2000; Johannessen et al. 2025).

For an *individual*, it is often uncomfortable to change deeply held beliefs and ingrained values (Hornsey & Fielding, 2017). Knowledge resistance, is a result when individuals avoid assimilating available knowledge, believe what they prefer to believe, and dismiss or misunderstand relevant evidence. This defensive routine avoids inquiry (Argyris and Schön 1996).

At a *societal* level, weak **institutional structures** and limited capacity hinder effective management, emphasising the need for good legal frameworks, resource capacity, and stakeholder integration (Faris, 2019).

Responses should capture: What are the individual and social *constraints*? Are there any lock-ins (barriers) due to past trajectories at either the social or institutional level?

2.5.3 Process steps

Definition: Several (social learning) process steps may be involved, including: *Problem identification* identifying a common understanding and shared interests. *Deliberation* and joint fact-finding with thoughtful examination of issues, option evaluation and design of a common approach, (e.g., setting agendas, tabling a discussion, assigning a work group). The learning process ends with *implementation, monitoring and adaptation* enabling a restart of the often-iterative learning process (Daniels and Walker, 2001).

Responses should capture what the (social learning) process steps are when problems are identified and addressed in collaboration. It should identify when the lake governance is engaging with the community (planning phase, or after implementation) and how it is done.

2.5.4 Knowledge created

Social learning leads to generation of knowledge through single, double or triple loop learning, representing different learning "depths". If agents correct errors by modifying existing actions along the same objectives, this constitutes **"single-loop learning,"** requiring less effort. For example, building a

dike, but a bit better. If underlying assumptions about current actions are challenged leading to *changing approaches* to situations this represents "**double loop learning**" including reframing to comprehend or accept something significantly new or different (Illeris, 2009). For example, shifting approach to build nature-based solutions. This deeper learning often necessitates bringing together and bridging different perceptions and knowledge (Feurt 2008; Chaffin et al., 2016; IPCC, 2012). In "**triple-loop learning"** the context in which the activities exist changes, for example a new institution or an arrangement. It can open the possibility of changing deeply held values, norms, beliefs, worldviews, or paradigms. To achieve such **transformational change**, addresses the underlying foundations of our knowledge (Argyris & Schon 1978).

Responses should capture:

- What knowledge is created in governance processes over time?
- How innovative or "transformative" is the knowledge generated? *For example, is the knowledge going beyond established domains, geographies, duration or other frames? Is this knowledge challenging assumptions or 'just doing things a bit better'?*

2.5.5 Outcomes

The outcome of the social learning process can entail a common purpose, translating in technical measures, policies or strategies, or new collaborative relationships such as a new institution, institutional integration or public and political awareness. The outcome can be transformational when the institutional context or social structures is reconfigured, including changes in power, norms and values (Daniels & Walker, 1996; Haxeltine, Avelino, et al., 2016). At individual level, outcomes include personal transformations or transforming relationships (Retolaza 2011; Wilber 1996). These structures thus provide new enablers for the learning and process attributes, reinforcing the new normal (or paradigm).

Responses should capture what are the outcomes of past governance processes and if these outcomes in turn provided further facilitating process elements.

3. Methodology

The methods section outlines how the analytical framework was operationalised—i.e., how data was collected, processed, and analysed using the framework.

3.1 Case study approach

The overarching methodological approach in Task 2.2 is a **multiple empirical case study** (Yin 2009) with the aim to develop a governance framework for resilient lake restoration. A case study approach provides relevant, and practical data that is tailored to the needs of lake management. The case study approach across six European demo basins also aimed at capturing a diversity of aspects relevant for a blueprint which supports the development of a generalisable and transferable framework.

The main criteria for **selecting** the six demo basins (Loch Leven, Lake Karla, Kartuzy Lakes, Lake Vesijärvi, Lake Vansjø, and Lake IJsselmeer), was that they represent role model lakes, as such also being able to provide input to a blueprint. The design of the FutureLakes project has ensured representation across biogeographical contexts. A description of the diversity of lake types and governance settings is found in Chapter 4.

The approach of the analysis was using a **retroductive approach combining deductive and inductive** reasoning (see figure c) (Torfing 2016). **Deductive:** developing an initial framework via literature review of existing governance elements (3.2.1) guiding the survey and interviews (3.2.2-3) – and **inductive approach** guiding the interpretation of findings, allowing governance insights to emerge from and remain grounded in the data (mainly interviews); i.e. grounded theory methodology (Glaser & Strauss, 1967). The inductive approach as such provides the unique insights relevant for practitioners – in that it is not assumed, or top down, but captures what the interviewees say. This ensures a level of specific details to be able to guide implementation.

3.2 Data collection

The data collection used several different sources of data, including literature, survey, interviews, and focus group discussions when testing and reviewing the framework.

3.2.1 Literature review

Initial scoping and literature review was done on water governance and resilience frameworks using SCOPUS, google scholar and copilot AI (Enterprise licence). This used as a keyword the phrase “lake governance framework”. An exhaustive list was not a goal, but to make sure the key elements were considered, and complemented in a purposeful way. The differences between these frameworks are presented in Chapter 6. Social learning is not a governance framework per se but was added as a key analytical lens - see 3.2.2 below). Review of project documentation and online articles provided background information to the lake case studies. For example, for capacity, we harvested data from task 2.1 (Szulecka, 2025), for policy, we harvested data from task 3.1 (Albrecht et al., 2025).

3.2.2 Design of survey and interview protocol

A **survey** with open ended questions based on the framework elements from the literature review was sent to lake coordinators, asking them to fill in relevant information to the initial governance elements identified and that could more easily be answered with this method. See annex 1 (part I) for the survey.

3.2.3 Semi structured interviews

Semi-structured interviews with key stakeholders in each demo basin were carried out to gain information about their specific perspectives, understandings and meanings at lake coordination and management level. Interviews have the benefit of uncovering new issues or concerns that have not been anticipated by the researcher (Pope et al. 2002).

One key informant per lake was interviewed, and two countries were interviewed twice (Finland and The Netherlands). In the Finnish case, two interviewees were present the second time. The sample size

(1-2 persons) was considered to provide sufficient data as these persons were very well informed of the overall management and governance of the lakes.

Seven key informants were **selected** using purposive sampling (Bernard 2002). They were the most relevant key informants who had been involved in lake management of the respective lake case-studies within the FutureLakes project. They had different functions of researchers (3), or directors/ coordinators (4).

Interviews were **guided** by a draft framework of social learning elements that was covered in no particular order (see Annex 1, part II for the interview protocol).

The meetings were **recorded** (Teams) and **transcribed** (AI) in a closed confidential environment. A challenge for a researcher working with interviews is to avoid probing interviewees with leading questions, or comments influencing the interviewees answers. However, sometimes it is necessary to bring the interviewee on topic by providing examples or more context. But this is a challenge when these probes end up in the transcript which is analysed by AI. In the resulting analysis these additions must be manually removed/adjusted if they may risk affecting the result.

Notes were also taken during the interview on a miro board shared with the interviewees - to build a common understanding of the progression and main topics discussed.

3.3 Analysis

The data reflected the key governance dimensions already identified by other frameworks (e.g. coordination, stakeholder participation, knowledge, implementation, institutions) and which guided the design of the survey and interviews, see Annex 1.

The data were analysed in the following way (see figure x):

1. Placing the qualitative data - interview transcripts and survey responses – in a folder on the Deltares cloud, acting as a Large Language Model (LLM).
2. A Copilot research agent was used to define the initial themes and categories.
3. The intermediate result was developed into a self-assessment framework (see table 1 below) and tested on Finland and The Netherlands.
4. The testing revealed the framework needed a more defined shape, providing clear categories (e.g. financing, dialogue, communication) that illustrate a specific domain of activities - resonating more with interviewees, rather than the more abstract self-assessment categories (e.g. adaptive management). The resulting categories were thus developed using a qualitative assessment (by the researcher) taking together components from the initial framework, analysis/ intermediate result and testing insights.
5. The final development of the framework was supported by iterative queries to the LLM, to provide details of the individual elements from the cases, prompting both successes and challenges. Some of these steps will be outlined more in detail below.

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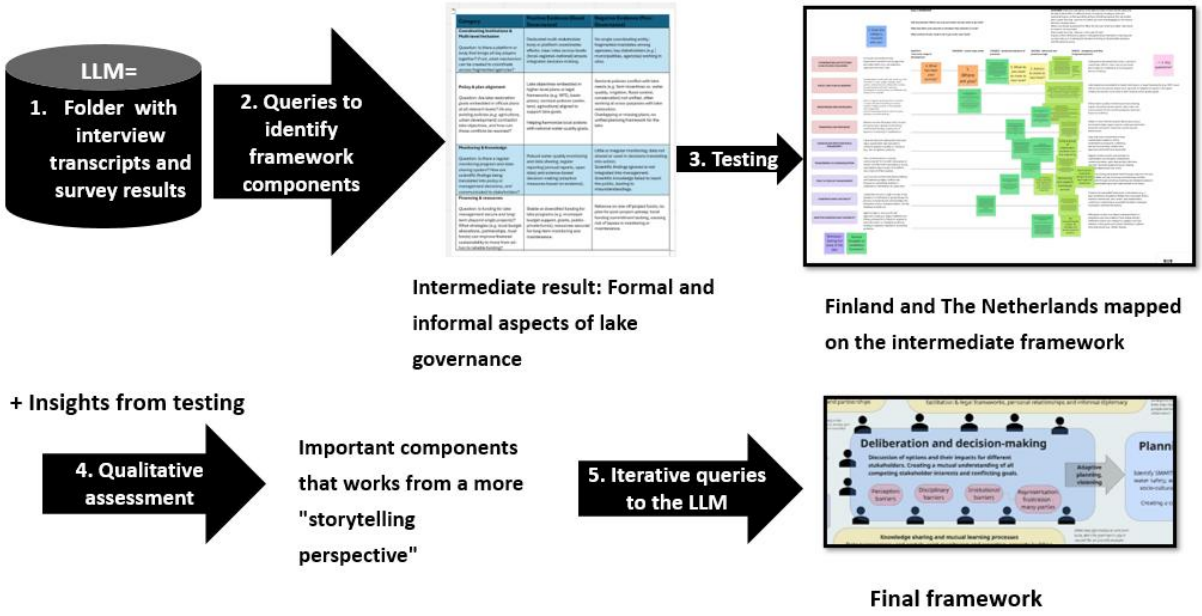

Figure 5 Scheme illustrating the flow of the analysis. Source: Authors.

The result was a thematic coding of interview transcripts.

FORMAL

Category	Positive Evidence (Good Governance)	Negative Evidence (Poor Governance)
Coordinating Institutions & Multi-level Inclusion *Question: Is there a platform or body that brings all key players together? If not, what mechanism can be created to coordinate across fragmented agencies?*	Dedicated multi-stakeholder body or platform coordinates efforts; clear roles across levels (local–regional–national) ensure integrated decision-making.	No single coordinating entity; fragmented mandates among agencies; key stakeholders (e.g., municipalities, agencies) working in silos.
Policy & plan alignment *Question: Are lake restoration goals embedded in official plans at all relevant levels? Do any existing policies (e.g. agriculture, urban development) contradict lake objectives, and how can those conflicts be resolved?*	Lake objectives embedded in higher-level plans or legal frameworks (e.g. WFD, basin plans); sectoral policies (water, land, agriculture) aligned to support lake goals. Helping harmonize local actions with national water-quality goals.	Sectoral policies conflict with lake needs (e.g. farm incentives vs. water quality, irrigation, flood control, conservation) not unified, often working at cross-purposes with lake restoration. Overlapping or missing plans; no unified planning framework for the lake.
Monitoring & Knowledge *Question: Is there a regular monitoring program and data-sharing system? How are scientific findings being translated into policy or management decisions, and communicated to stakeholders?*	Robust water-quality monitoring and data sharing; regular reporting (annual reports, open data) and science-based decision-making (adaptive measures based on evidence).	Little or irregular monitoring; data not shared or used in decisions translating into action; Scientific findings ignored or not integrated into management. Scientific knowledge failed to reach the public, leading to misunderstandings.
Financing & resources *Question: Is funding for lake management secure and long-term (beyond single projects)? What strategies (e.g. local budget allocations, partnerships, trust funds) can improve financial sustainability to move from ad-hoc to reliable funding?*	Stable or diversified funding for lake programs (e.g. municipal budget support, grants, public-private funds); resources secured for long-term monitoring and maintenance.	Reliance on one-off project funds; no plan for post-project upkeep; local funding commitment lacking, causing risk of lapses in monitoring or maintenance.

INFORMAL

Category	Positive Evidence (Good Governance)	Negative Evidence (Poor Governance)
Stakeholder Participation & Engagement *Question: Are all affected groups involved early and meaningfully in lake decisions? How can you bring marginalized voices (e.g. farmers, local residents) into the process so that solutions have local ownership?*	Early and active involvement of local stakeholders (residents, NGOs, landowners) and experts in planning and decision-making; collaborative approach that builds local ownership.	Top-down decision-making with little local input; stakeholders feel excluded or unheard, leading to apathy or resistance (e.g. non-compliance, protests).
Transparency & Communication *Question: Do stakeholders know what's happening (plans, data, results)? What channels (meetings, reports, dashboards) can you use to regularly inform the community and dispel misinformation?*	Regular communication and outreach to stakeholders and the public (newsletters, community events, open data portals); decisions and their rationale explained openly, helping manage expectations and rumor.	Poor communication or secrecy; community left "in the dark" about plans or results; misinformation spreads (e.g. wrong assumptions about causes of problems) due to lack of official updates.
Trust & Conflict Management *Question: Is there a baseline of trust and goodwill among agencies and users? If not, what confidence-building measures (e.g. joint fact-finding, small win projects) could help break down historical grudges and encourage collaboration?*	High trust among participants (built through long-term fairness, joint problem-solving, honoring commitments); conflicts addressed through consensus-building and mediation based on facts; stakeholders give each other benefit of the doubt.	Low trust environment with blame-shifting and historical grudges; conflicts are frequent or unresolved, leading to stalemates or withdrawal of cooperation.
Leadership & continuity *Question: Is there a champion or coordinator driving lake restoration? If the current leader left, is there a succession plan or institutional mechanism to maintain continuity? How can you cultivate new champions for the future?*	Presence of committed "champions" or facilitators (e.g. a lake coordinator, foundation leader) who coordinate efforts, maintain momentum, and mentor new stakeholders; continuity in leadership or successful handover strategies to preserve institutional memory.	Leadership vacuum or high turnover in key positions; no individual or group driving the process consistently; loss of knowledge and motivation when a champion leaves, causing initiatives to fizzle out.
Adaptive Learning & Flexibility *When new information or outcomes arise, does the governance adjust course? Do we critically evaluate what's working or not, and are we willing to discontinue efforts that underperform and experiment with new approaches?*	Willingness to learn and adjust strategies based on experience and new evidence ("learning-by-doing"); ineffective actions are changed or stopped, and new solutions tried; governance shows flexibility to address emerging issues (e.g. climate change).	Rigid mindset or "one-size-fits-all" approach; clinging to legacy methods even if they underperform; failure to respond to new information or changing conditions, leading to repeated mistakes or worsening problems.

Figure 6 The resulting categories emerging from an analysis of the qualitative data.

The categories were used to develop the assessment framework (next figure). For each of these further prompting was done to provide examples of successes and challenges from all lakes.

- The results were initially seen as a base for an assessment framework (see figure 7 and table 1). The categories were put as two extremes along a grade scale also used by AWDO (Asian Water Development Bank Outlook) system of grading maturity ("nascent" to "mature") for its National Water Security Index. Asian Water Development Outlook (AWDO) Series | Asian Development Bank. Here the same LLM was used to probe descriptions of nascent and mature categories, and short intermediary descriptions.
- **Knowledge co-creation** included interactions with interviewees from especially Finland and the Netherlands to create transdisciplinary knowledge development through discussion and associated learning (Regeer and Bunders 2009). Key questions were prepared for the engagement:
    - Where are you (in the scale, for each category)?
    - What do you need to do to go to the next level (ibid)?
    - What has been your journey to get to where you are (ibid)?
    - Do the categories resonate with you?

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Table 1: Questions for self-assessment. These categories are mapped on a gradient from nascent to mature below in figure 7.

Topic and key question	Positive evidence	Negative evidence
Coordinating institutions & multi-level inclusion **Key question:** *Is there a platform or body that brings all key players together? If not, what mechanism can be created to coordinate across fragmented agencies?*	Dedicated multi-stakeholder body or platform coordinates efforts; clear roles across levels (local–regional–national) ensure integrated decision-making.	No single coordinating entity; fragmented mandates among agencies; key stakeholders (e.g. municipalities, agencies) working in silos.
Policy & plan alignment **Key question:** *Are goals for lake restoration embedded in official plans at all relevant levels? Do any existing policies (e.g. agriculture, urban development) contradict lake objectives, and how can those conflicts be resolved?*	Lake objectives embedded in higher-level plans or legal frameworks (e.g. WFD, basin plans); sectoral policies (water, land, agriculture) aligned to support lake goals. Helping harmonize local actions with national water-quality goals.	Sectoral policies conflict with lake needs (e.g. farm incentives vs. water quality, irrigation, flood control, conservation) not unified, often working at cross-purposes with lake restoration. Overlapping or missing plans; no unified planning framework for the lake.
Monitoring and knowledge **Key question:** *Is there a regular monitoring program and data-sharing system? How are scientific findings being translated into policy or management decisions, and communicated to stakeholders?*	Robust water-quality monitoring and data sharing; regular reporting (annual reports, open data) and science-based decision-making (adaptive measures based on evidence).	Little or irregular monitoring; data not shared or used in decisions translating into action; Scientific findings ignored or not integrated into management. Scientific knowledge failed to reach the public, leading to misunderstandings.
Financing and resources **Key question:** *Is funding for lake management secure and long-term (beyond single projects)? What strategies (e.g. local budget allocations, partnerships, trust funds) can improve financial sustainability to move from ad-hoc to reliable funding?*	Stable or diversified funding for lake programs (e.g. municipal budget support, grants, public-private funds); resources secured for long-term monitoring and maintenance.	Reliance on one-off project funds; no plan for post-project upkeep; local funding commitment lacking, causing risk of lapses in monitoring or maintenance.
Stakeholder participation and engagement **Key question:** *Are all affected groups involved early and meaningfully in lake decisions? How can you bring marginalized*	Early and active involvement of local stakeholders (residents, NGOs, landowners) and experts in planning and decision-making; collaborative	Top-down decision-making with little local input; stakeholders feel excluded or unheard, leading to apathy or resistance (e.g. non-compliance, protests).

voices (e.g. farmers, residents) into the process so that solutions have local ownership?	approach that builds local ownership.	
Transparency and communication **Key question:** *Do stakeholders know what's happening (plans, data, results)? What channels (meetings, reports, dashboards) can you use to regularly inform the community and dispel misinformation?*	Regular communication and outreach to stakeholders and the public (newsletters, community events, open data portals); decisions and their rationale explained openly, helping manage expectations and rumours.	Poor communication or secrecy; community left "in the dark" about plans or results; misinformation spreads (e.g. wrong assumptions about causes of problems) due to lack of official updates.
Trust and conflict management **Key question:** *Is there a baseline of trust and goodwill among agencies and users? If not, what confidence-building measures (e.g. joint fact-finding, small win projects) could help break down historical grudges and encourage collaboration?*	High trust among participants (built through long-term fairness, joint problem-solving, honouring commitments); conflicts addressed through consensus-building and mediation based on facts; stakeholders give each other benefit of the doubt.	Low trust environment with blame-shifting and historical grudges; conflicts are frequent or unresolved, leading to stalemates or withdrawal of cooperation.
Leadership and continuity ***Key question:*** *Is there a champion or coordinator driving lake restoration? If the current leader left, is there a succession plan or institutional mechanism to maintain continuity? How can you cultivate new champions for the future?*	Presence of committed "champions" or facilitators (e.g. a lake coordinator, foundation leader) who coordinate efforts, maintain momentum, and mentor new stakeholders; continuity in leadership or successful handover strategies to preserve institutional memory.	Leadership vacuum or high turnover in key positions; no individual or group driving the process consistently; loss of knowledge and motivation when a champion leaves, causing initiatives to fizzle out.
Adaptive learning and flexibility ***Key question:*** *When new information or outcomes arise, does the governance adjust course? Do we critically evaluate what's working or not, and are we willing to discontinue efforts that underperform and experiment with new approaches?*	Willingness to learn and adjust strategies based on experience and new evidence ("learning-by-doing"); ineffective actions are changed or stopped, and new solutions tried; governance shows flexibility to address emerging issues (e.g. climate change).	Rigid mindset or "one-size-fits-all" approach; clinging to legacy methods even if they underperform; failure to respond to new information or changing conditions, leading to repeated mistakes or worsening problems.

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Climate-resilient ecosystem-based governance

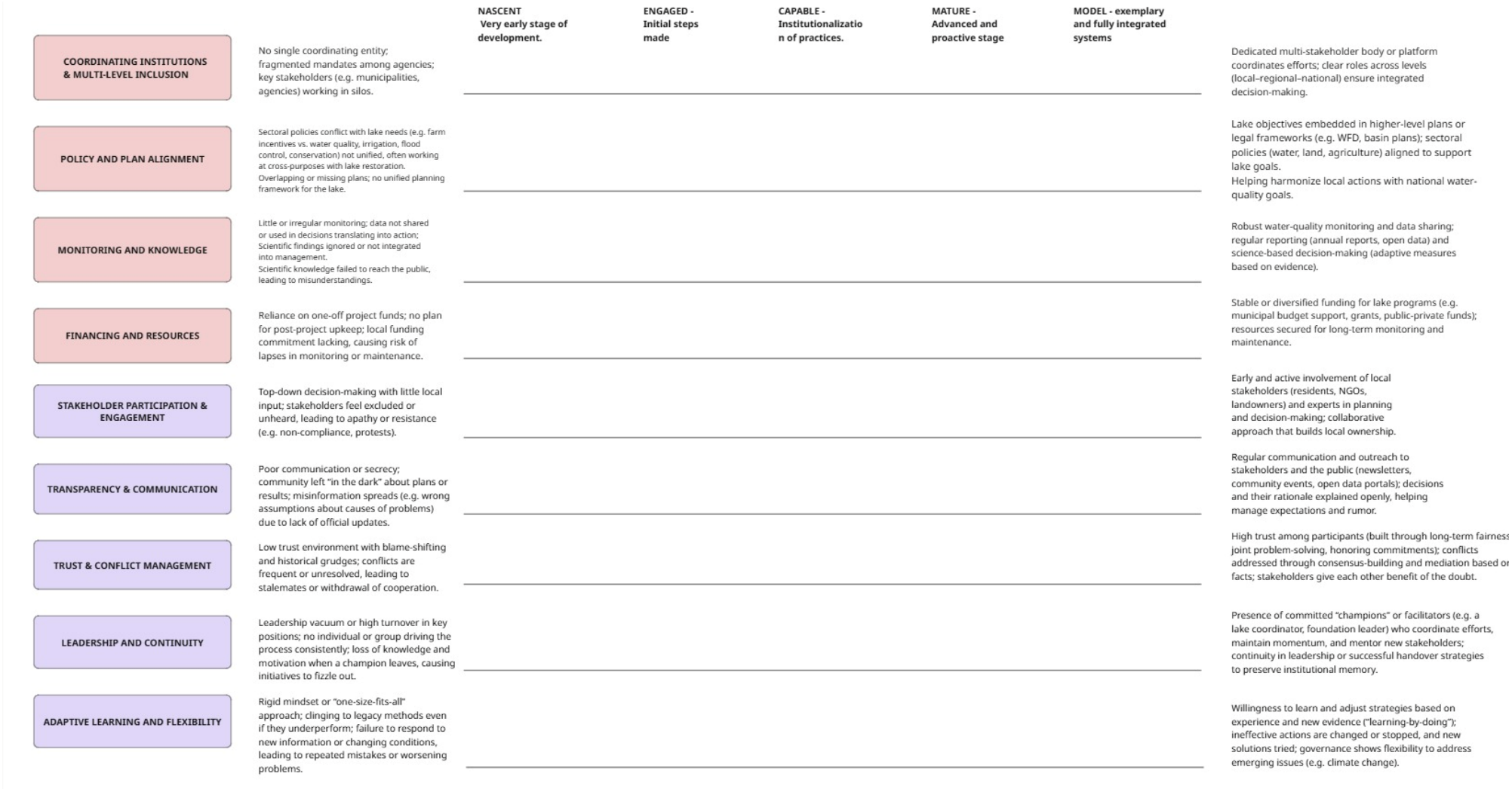

Figure 7 Assessment framework. Source: Authors.

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3.4 Validation

The results were validated in an iterative way with key informants from Finland and The Netherlands which supported the further development of the framework into a more “storytelling” framework with distinct parts and processes.

This result was further validated and discussed with four lake key informants (The Netherlands, Norway, UK, Finland) giving feedback on the near final framework in a final online workshop.

The report was also reviewed by two NIVA experts and lake coordinators.

3.5 Limitations

There were a few methodological limitations, namely:

- **Interviewee sample**: The data provided is depending on the responses of the key informants who are essentially individuals with specific perceptions, disciplinary training and institutional affiliation etc. With one-two interviewees as a sample size, this means that the perspectives may be limited. However, in spite of this, the data was considered highly reliable, and very targeted, as these persons had been working closely with the lake governance and management for many years.
- **Variability in data availability across cases:** The cases were very diverse in terms of institutional setup, with no blueprint, as observed already in the Milestone document. However, this is not a cause of doubting the relevance of the data for being unreliable. Instead, it illustrates that the formal governance setting is not per se determining the success of the lake governance. The data was also diverse in terms of details of the restoration management and activities – and one could in the same way argue that they cannot be compared. However, the analysis showed that in spite of many diverse elements, there are common insights that inform the blueprint on lake governance. The different cases provide their own different knowledge and insights relevant for this lake blueprint on governance, converging on the same elements.
- **Differences in interview depth:** The interviews lasted on average 1-1.5 hours and during that time the interviewees drilled down on different topics on the framework which were unclear to understand the main processes and dynamics going on. The interview was continued until there was “saturation” and the main important information was considered to be obtained. The potential lack of data, could have been validated by additional interviewees, but as mentioned, the persons interviewed were considered to be the persons who knew most about the lake governance of all persons, so adding interviewees was also seen as interesting, but not critical to the main result.
- **Language and translation considerations**: All interviews were done in English, apart from one that was held in Norwegian. In the LLM AI provided a seamless translation to English. For all lake managers with English as a second language, this can provide a barrier in expressing all nuances and influencing the data, however this was not considered significant for the results. The final product (part II) is considered for translation to the local languages of the lakes, after feedback from the final workshop, as this will influence uptake.

- **Time constraints for follow-up validation**: All lake managers/ interviewees are practitioners with a full working schedule alongside participating in the Future Lakes project. This influences their ability to fully engage in the development of the framework, and to validate it. However, the future lakes project will still be able to continuously validate the framework, after this deliverable, including further development and validation.
- **AI was used for transcription and analysis**. While transcription is highly reliable, the challenge can be that probing by the interviewer is also included in the transcript. These aspects can be removed from the transcript, but in this case they were not. Probing by the interviewer was trying to gain more information by neutral probes that does not influence the data (tell me more about /…/ can you clarify /…/ etc).

3.6 Timeline

The process to complete the milestone and the deliverable:

- Feb-March 2025 (M5-M6): Development of draft framework. Develop interview protocol, demo questions on governance situation and interview questions and timeline.
- April 2025 (M7): Share protocol with T2.2. team. Present plan to T2.2 team and discuss.
- May – July (M8-M10) 2025: Organizing 6 semi-structured interviews.
- September 2025 (M12): Milestone achieved (interview summarised and governance elements cross-compared).
- Dec 2025 – Jan 2026 (M15-M16): Interviews with key informants in Finland (5th December 2025) and The Netherlands (8th January 2026) to present the draft framework and test it to support the further development and application further.
- Dec 2025 – Jan 2026 (M15-M16): (M15) Analysis, documentation, writing, improving the governance framework.
- January 2026 (M16): Presenting framework to the remainder of the demo basins in workshop: Online for review. Adjust according to feedback from Demo Basins.
- February 2026 (M17) Internal review (Deltares).
- End February 2026 (M18) Final draft for review report (NIVA reviewers).
- Early March 2026 (M19); processing review comments.
- End of March 2026 (M18): Submitting report.

4. The Future Lakes case studies

The FutureLakes project's six demonstration basins span Europe's diverse lake types, each confronting multiple stressors – from nutrient pollution and climate change to governance and land-use challenges – and each with unique restoration and management approaches.

Table 2: An overview of the Future Lake cases with the coordinates and location notes.

Lake Name	Country	Approximate Coordinates (Latitude, Longitude)	Notes
Loch Leven	Scotland (UK)	56.200° N, 3.370° W	Near Kinross
Lake Karla	Greece	39.500° N, 22.750° E	Thessaly region
Kartuzy Lakes	Poland	54.333° N, 18.200° E	Pomeranian Voivodes
Lake Vesijärvi	Finland	60.983° N, 25.650° E	Near Lahti
Lake Vansjø	Norway	59.400° N, 10.800° E	Østfold region
Lake IJsselmeer	Netherlands	52.750° N, 5.400° E	Central Netherlands

Below, are short introductions for each case study. These highlight special characteristics of the lake's ecology, and key pressures on each lake's ecosystem (ecological, climate-related, socio-economic, and land-use).

2.1 Loch Leven (Scotland)

Lake & setting: Loch Leven is a shallow lowland lake in Kinross-shire (13.3 km² area, mean depth ~3.7 m). It is internationally recognized for its conservation value - it holds multiple national and international biodiversity designations (as a National Nature Reserve, Ramsar site, and formerly (prior to Brexit) as a Special Protection Area (SPA) as part of the EU Natura 2000 network) and supports exceptionally important bird and wetland ecosystems. The loch's catchment (145 km²) is dominated by intensive agriculture (~80% farmland), with the remaining land in forestry and small settlements (Loch Leven, UK).

Key stressors:

- Loch Leven suffered severe eutrophication in the late 20th century – harmful algal blooms surged in the 1970s–1980s, directly linked to excess phosphorus inputs [4]. Primary sources were untreated sewage and industrial effluent from a woollen mill, diffuse runoff from fertilised farmlands, and seasonal internal loading from nutrient-rich lake sediments. The blooms (often toxic cyanobacteria) led to fish kills and loss of amenity by the 1980s.
- Land use pressures (modern farming and some new housing developments) continue to contribute to diffuse nutrient loads.
- In recent years, climate change has emerged as a stressor: warmer summers and lower flushing have contributed to a return of algal blooms after 2015 despite nutrient reductions (Envirotec Magazine 2024).

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2.2 Lake Karla (Greece)

Lake & setting: Lake Karla, in Thessaly (central Greece), is a unique case of a lake literally brought back from the dead. This shallow lake/wetland was historically one of Greece's largest (>180 km²) before it was completely drained in 1962 to create farmland. For decades, the former lakebed suffered from salinized soils and frequent dust storms, and agriculture there was only marginally successful (Zalidis et al. 2005). Starting in the 2000s, a massive EU-supported restoration project partially re-flooded the basin: by 2018 a new Lake Karla (about 38 km² surface) was inaugurated. Today's Lake Karla is much smaller than the original but is again a permanent water body providing habitat for waterbirds (it is designated as a Natura 2000 protected site). Surrounding the lake are agricultural plains (the Karla catchment is ~3,700 km², largely farming), and villages reliant on irrigation water (Bobori et al. 2018).

Key stressors: Lake Karla's key stressors stem from its dramatic hydrological alteration and competing human uses:

- **Hydrological stress & water-level management:** Because Karla was entirely artificial at re-creation, its water levels are regulated by pumps and canals. Balancing water for flood control, irrigation, and ecological needs is a major challenge. In wet years, the lake can overfill (a severe flood in Sept 2023 after Storm Daniel inundated areas), whereas in droughts farmers demand more water for crops, putting stress on lake levels. This tension makes water a "zero-sum" resource – stakeholders have in the past viewed it as irrigation vs. environment.
- **Water quality under multiple stressors:** Decades of drainage eliminated native lake biodiversity; the refilled lake is still recovering. Nutrient and pesticide runoff from agriculture in the catchment now affects Karla's water, making the lake eutrophic to hypetrophic . There have been algal bloom incidents and fish kills reportedly due to low oxygen, indicating ecological instability. This indicates systemic volatility, reduced resilience, and varying magnitude of ecological impacts due to abiotic pressures. Also, because the new lake inundated former farmlands, residual agro-chemicals in soils can leach out. Invasive species (e.g. common carp) may also be a concern for habitat quality.
- **Climate-related extremes:** The Karla basin faces both extreme floods and droughts. The 2023 flood disaster demonstrated that infrastructure and plans were not fully prepared for record rainfall. On the other hand, severe summer droughts strain the lake as farmers pump groundwater and seek to withdraw lake water, which can concentrate pollutants and harm wildlife. Climate change is expected to intensify these swings, making water management even more challenging.

Source: Lake Karla, Greece

2.3 Kartuzy Lakes (Poland)

Lake & Setting: The "Kartuzy Lakes" are a quartet of small, interconnected lakes (combined area ~1.1 km²) in the town of Kartuzy, northern Poland. These lakes – Karczemne, Klasztorne Małe, Klasztorne Duże, and Mielenko – were known for their beauty but by the late 20th century had become severely degraded urban water bodies. They form a chain through Kartuzy, receiving water from a small stream and draining downstream, effectively a lake-river system. The town of Kartuzy (population ~15,000) grew around these lakes, which were once used for fishing and recreation.

Figure 8 Kartuzy Lake. Photo: Renata Augustyniak-Tunowska, June 2024

Key Stressors: For decades, the Kartuzy Lakes suffered from classic **urban pollution** problems:

- **Domestic sewage** – Throughout much of the 20th century, raw or inadequately treated wastewater from the town was discharged into the lakes. Similarly, industrial effluents (e.g. from a local dairy and other small industries) flowed in. This led to extreme nutrient enrichment.
- **Eutrophication and internal loading** – By the 1990s, two of the lakes (Karczemne and Klasztorne Małe) had become *hyper-eutrophic*: they experienced dense blooms of algae and toxic cyanobacteria, very low water clarity, and periodic fish kills. Thick layers of polluted sediment accumulated on the lake bottoms, acting as an internal nutrient source (releasing phosphorus and nitrogen back into the water each summer). This "legacy pollution" meant that even if new inputs were reduced, the lakes could remain degraded for years.
- **Aesthetic and socio-economic impacts** – The foul odours and unsightly algal scums from the lakes lowered local property values and deterred recreation. The once-popular lakeshore became a local blight, raising public concern. In this sense, the town's socio-economic stake in the lakes (as community assets) was a driver to address environmental stress.

Source: Kartuzy Lakes, Poland

2.4 Lake Vesijärvi (Finland)

Lake & setting: Lake Vesijärvi, adjacent to the city of Lahti in southern Finland, is a large shallow lake system (surface area ~107 km²) composed of five basins. It is a seepage lake (water outflow mainly via seepage and a small river) situated in a forested and agricultural catchment. Land use in the basin is ~51% forest, 18% agriculture, with the rest being urban areas (Lahti and smaller towns). Portions of Vesijärvi's wetlands are protected (Natura 2000 sites for bird habitat). Historically, by the 1970s

Vesijärvi was one of Finland's most polluted lakes due to rapid industrialization and urban growth in Lahti after WWII (Ventelä et al. 2007).

Key stressors:

- **Nutrient pollution (eutrophication):** From the 1920s to 1970s, Lahti's sewage (and industrial wastewater from e.g. a pulp mill) flowed largely untreated into Vesijärvi. By the 1960s, this caused severe eutrophication – chronic cyanobacterial blooms, fish kills, and near collapse of the lake's ecology [76]. The external phosphorus loading was extremely high. Even after sewage diversion (completed in 1976), the lake continued to suffer from **internal loading**: decades of accumulated nutrients in sediments fuelling algal blooms each summer. This internal P recycling became a long-term stressor that proved hard to break, requiring continuous management (see below).
- **Agricultural & land use pressures:** The Vesijärvi catchment includes farmland (about one-fifth of land use) and settlements that contribute diffuse nutrient runoff (fertilizers, manure, stormwater) into the lake. Forestry practices and peatland drainage in the catchment also affect water quality (e.g. episodic spikes of suspended solids or nutrients). While point-source pollution was curtailed by the late 1970s, diffuse loading from the watershed remains a stress, and some shoreline areas still have nutrient inputs from cottages or fields. A noted issue has been misalignment between local water protection and broader land-use policies – for instance, national agricultural subsidies can incentivize high production even in the catchment, counteracting local efforts to reduce nutrient runoff.
- **Climate change:** Warming temperatures and changing precipitation are a growing stressor. In the 2000s–2010s, despite nutrient reductions, Vesijärvi saw occasional resurgence of algae in hot summers. Warmer water promotes cyanobacteria dominance and can increase internal loading (as stratification strengthens and oxygen in bottom waters depletes). Additionally, climate change brings more intense rain events (causing runoff surges) but also summer droughts (lowering inflows). The lake's managers have identified climate as an emerging pressure that could "counteract restoration gains" if not addressed.
- **Ecological constraints:** Invasive species (like the small-bodied fish *Prussian carp* that appeared in Vesijärvi) and changes in the food web have occasionally stressed the lake's ecology. Also, Vesijärvi is relatively shallow and sectioned by underwater ridges, making some basins more prone to stagnation. Two basins remain only in moderate ecological status (not yet "Good" per EU Water Framework Directive criteria) due to these legacy and natural constraints.

Sources: Lake Vesijärvi, Finland, Vesijärvi Foundation, 2021.

2.5 Lake Vansjø–Morsa (Norway)

Lake & setting: Lake Vansjø is a large lowland lake in Østfold county, southeast Norway, with an area of about 37 km². It consists of multiple basins, notably a deeper eastern basin and a broad shallow western basin (often called Vanemfjorden), which drains via the Mosseelva river to the Oslofjord. The lake's catchment (the Morsa watershed) is 690 km² of predominantly gentle terrain. Land cover is ~78% forests and ~15% agriculture (mostly grain farming). Vansjø is regionally important: the eastern

basin serves as a drinking water source for ~60,000 people, and the lake is heavily used for recreation (swimming, boating, fishing). It also supports a valuable pike-perch fishery (Bechmann & Skarbøvik 2010).

Key stressors: Since the mid-20th century, **nutrient enrichment** has been the primary concern:

- **Agricultural runoff**: Farmlands in the catchment have contributed significant phosphorus (P) and nitrogen (N) loads to the lake via soil erosion and fertilizer runoff. By the 1970s–80s, this led to frequent summer cyanobacterial blooms, especially in the shallower western parts. Algal toxins sometimes forced beach closures and raised costs for water treatment.
- **Sewage inputs**: Until the 1990s, many rural communities and scattered dwellings had suboptimal sewage treatment, meaning additional P input (though smaller than agriculture's share) flowed to the lake. Failing septic systems and municipal wastewater bypasses were identified as stresses.
- **Multiple uses and expectations**: Because Vansjø has mixed uses (drinking water, recreation, ecological habitat), trade-offs arise as stressors too. For instance, maintaining high water levels for water supply vs. occasionally lowering them for shoreline management can be at odds; likewise, anglers and water companies have different tolerances for algal proliferation.
- **Climate variability**: While not as acute yet, there is an observed climate influence – warmer conditions can lengthen stratification in the deep basin and promote more intense algal growth. Also, heavy rainfall events cause pulses of nutrient-laden runoff (challenging preventive measures).

Source: Lake Vansjø, Norway

2.6 Lake IJssel complex (The Netherlands)

Lake & setting: The **IJsselmeer** region in the Netherlands is a sprawling freshwater lake system created by the Netherlands' historic land reclamation projects. In 1932, the Afsluitdijk dam was completed, sealing off the Zuiderzee (a former brackish inlet of the North Sea) and forming the IJsselmeer – which at ~1,100 km² is today the largest lake in Western Europe. Further engineering in 1975 split off the southern portion as **Lake Markermeer** (700 km²). Together, these adjacent smaller lakes form the **IJsselmeergebied**. Average depths are only 3–6 m; water levels are artificially regulated. The lake receives inflow from the IJssel (Rhine) River and others and is drained to the sea by sluices and pumps. Surrounding its shores are multiple provinces (Noord-Holland, Flevoland, Friesland, Overijssel) and extensive polders (reclaimed lands, now prime agricultural areas). The IJsselmeer's roles are multifaceted: it is the Netherlands' largest freshwater reservoir for drinking and irrigation, a key component of flood control (buffering storm surges and storing river water), a Natura 2000 habitat (important for waterfowl and fish nursery areas), and a centre for recreation and fisheries.

Key Stressors: Managing the IJsselmeer complex means managing trade-offs among uses, and dealing with the legacy of its creation:

- **Hydro-morphological changes:** The transformation from a dynamic estuary into a stable freshwater lake caused loss of natural habitats (tidal marshes, mudflats) and disrupted connectivity for migratory fish. The lake has uniform, regulated water levels (kept high in

summer for water supply and lower in winter for flood safety). This regime, while serving human needs, is a stressor for ecology – e.g., the lack of natural fluctuation and hard shorelines (dikes) mean limited spawning/nursery habitat for fish and birds. Also, the sediment dynamics changed: fine silts that used to flush in and out with tides became trapped, contributing to turbid water, especially in Markermeer. The lakebed, a remnant of the seafloor, is predominantly silty; without tidal action, wind-driven waves constantly resuspend sediment, impairing water clarity and aquatic plant growth.

- **Nutrient enrichment:** Although not as acute as in small lakes, nutrient runoff (particularly phosphorus from the surrounding highly developed farmlands) has impacted IJsselmeer/Markermeer. Eutrophication peaked in mid-20th century (algal blooms, etc.) but was mitigated by national policies (e.g. improved sewage treatment) post-1970s. However, Markermeer struggled with an odd combination of high turbidity and low algal productivity (the "Markermeer Paradox"). Essentially, light was so limiting due to suspended sediment that despite moderate nutrients, the food web was impoverished. This was identified as a major ecological stress: the waterbody was not attaining good status for flora/fauna.
- **Climate change:** The region faces new climate pressures: more erratic rainfall and droughts affect the lake's role in water supply. In recent summers, drought has drawn down IJsselmeer levels to meet agricultural and municipal water demand, while future projections suggest sea level rise may constrain how much water can be discharged (challenging flood management). Heatwaves could increase algal growth and stress cold-water fish, although current nutrient levels are moderate. Extreme storms can also suddenly shift sediment or damage shallow habitats.

Sources: Lake Ijssel, The Netherlands *IJsselmeer in Netherlands - 1,100 km2 - Ijssel Lake Facts, Map*

5. Results: governance setup – successes and challenges

5.1 Lake Vesijärvi (Finland) – Strong coordination, but external pressures

5.1.1 Governance structure

Lake Vesijärvi is managed through a distinctive governance model centred on the **Vesijärvi Foundation** (est. 2007), a public–private partnership led by the City of Lahti together with neighbouring municipalities (Hollola, Asikkala). The foundation brings local governments, scientists (SYKE and

universities), businesses (water utility, energy company), and community representatives together on a single board:

- City of Lahti
- Municipality of Hollola
- Municipality of Asikkala
- Etelä-Suomen Sanomat
- Kemppi Ltd
- Industrial Society of Lahti

This broad inclusion ensures that decisions are science-informed and reflect the interests of those who use the lake for drinking water, cooling, and recreation. The foundation works within Finland's Water Framework Directive planning system and collaborates with regional authorities to align local lake actions with regional river basin management plans.

5.1.2 Key governance elements

Integrated monitoring and science

- The foundation sponsors **intensive monitoring**, including automatic stations and biannual sampling across all basins (≥6×/year).
- Data are **publicly available** through an open platform and summarised in annual "State of the Lake" reports.
- Semi-annual **Vesijärvi researcher meetings** facilitate direct exchange between scientists and managers, enabling continuous adaptive management.

Stakeholder culture

Informally, Vesijärvi's governance is marked by an open, collaborative atmosphere. Stakeholders openly discuss challenges, and citizens are actively engaged through events such as Vesijärvi Week. Transparent communication fosters public trust and long-term commitment.

Financing and Participation

The foundation raises funds from municipalities, businesses, EU projects, and citizen initiatives, including the popular "Lake Godparent" donation scheme. This diversified funding base has been key to sustaining restoration efforts for decades.

5.1.3 Restoration history and management measures

Early Restoration (1970s–1990s)

After wastewater discharges were diverted in 1976, the lake began recovering. A major milestone came with the 1987 "Save Lake Vesijärvi" project, which introduced large-scale biomanipulation. From 1989 onward, annual mass removals of planktivorous fish (roach, smelt) reduced algal blooms by allowing zooplankton grazers to rebound. By the mid-1990s, water quality in the main basin had improved from hypereutrophic to mesotrophic.

Catchment-level measures

Over time, extensive watershed interventions have been implemented:

- Buffer strips along agricultural fields
- Sedimentation ponds and artificial wetlands
- Two-stage ditches and small retention dams

These reduce nutrient and sediment inflows and complement improved agricultural practices.

Adaptive management

Monitoring is tightly linked with management decisions. For example, long-term aeration trials in two basins were discontinued in 2020 after research showed limited effects on internal phosphorus loading. This willingness to abandon ineffective measures exemplifies Vesijärvi's adaptive approach.

5.1.4 Current Status

Decades of restoration have enabled Vesijärvi's largest basin to reach "Good Ecological Status" under EU criteria. Water clarity has improved, and fish populations (e.g., perch, pike) have recovered. However, several enclosed bays remain at moderate status, due to persistent internal loading and ongoing catchment pressures. The lake is "locked into" a need for continuous management, including:

- Ongoing fish removal to limit algal blooms
- Maintenance of wetlands and sedimentation structures

Climate risks are increasingly considered, and researchers are exploring measures such as enhanced wetlands and adaptive fish stock management.

5.1.5 Challenges and lock-ins

1. Misalignment of land-use and water policies

Agricultural and forestry policies often conflict with water quality goals. National incentives for intensive production can undermine local nutrient reduction efforts. Because these policies operate at higher administrative levels, the foundation cannot fully resolve these mismatches — creating a formal governance lock-in.

2. Internal nutrient load

Legacy phosphorus in sediments continues to impair some basins. Despite reduced external inputs, internal loading maintains eutrophic conditions unless costly or ecologically constrained interventions (e.g., dredging, chemical treatments) are undertaken. As such, Vesijärvi remains dependent on ongoing biomanipulation and catchment measures, with no quick technical fix available.

3. Emerging climate pressures

Warming temperatures and more intense runoff events threaten to offset restoration gains by favoring algae even at lower nutrient levels. Although the governance system is beginning to integrate climate

adaptation, some climate-driven impacts remain beyond local control and could create a future climate-related lock-in.

5.1.6 Summary

Lake Vesijärvi's governance is robust, characterized by strong local coordination, scientific integration, and active public engagement. Yet its success is tempered by broader structural constraints — misaligned land-use policies, persistent internal loading, and growing climate pressures. These external factors limit how far local governance alone can drive recovery, underscoring the need for multi-level policy alignment.

5.2 Kartuzy Lakes (Poland) – Community-driven action vs. institutional capacity gaps

5.2.1 Governance structure

The Kartuzy lakes—four small urban lakes in northern Poland—were historically governed in an ad-hoc manner. For decades, raw sewage, urban runoff and industrial discharges degraded the system without coordinated response beyond cosmetic fixes. The turning point came from **citizen pressure**: in the 2000s, residents alarmed by toxic blooms and foul smells pushed the municipal government to act.

Lacking internal lake expertise, the municipality engaged limnologists from the University of Warmia–Mazury, who carried out a full ecosystem diagnosis (2012–2013) and produced a science-based restoration plan. This plan enabled the municipality to integrate the lakes into the **Regional Water Management Plan for the Vistula basin**, a prerequisite for large-scale funding. The project subsequently secured ~€14 million through the EU Infrastructure & Environment Programme (2014–2020), with municipal co-financing. Governance thus coalesced around an **expert–municipal partnership**: scientists supplied technical leadership and continuous oversight, while the municipality provided political support, administrative capacity and funding mobilisation.

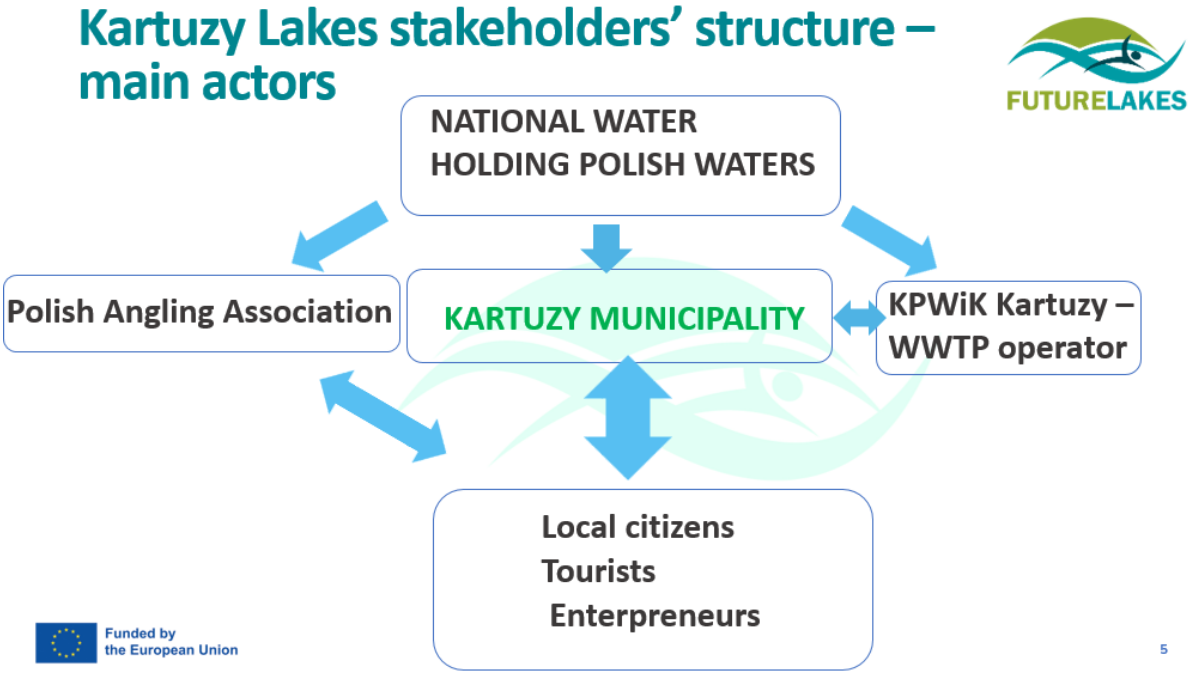

Figure 9 Kartuzy lake stakeholder structure -main actors. Source: Presentation on Lake Kartuzy governance structure in Gdansk March 2026 by Renata Augustyniak-Tunowska.

5.2.2 Key governance elements

Once funded, the project implemented several coordinated measures:

- **Sewage system upgrade:** eliminating external nutrient sources by modernizing sewer lines and diverting all wastewater for proper treatment—a necessary precondition for any in-lake action.
- **Dredging:** removal of ~240,000 m³ of nutrient-rich sediments from Lake Karczemne. The dredged material was pumped to the wastewater treatment plant, dewatered, and turned into an agricultural soil product—an innovative circular-use solution requiring close coordination with the utility.
- **Phosphorus inactivation:** where dredging was not feasible, the team applied calibrated iron and aluminium compounds to bind phosphorus in bottom sediments (2018–2023).
- **Biomanipulation:** large-scale removal of rough fish to enhance zooplankton grazing and improve water clarity.
- **Constructed wetlands:** to treat inflowing water and reduce nutrient loads.

The collaboration was characterised by **openness and trust**. Municipal officials were receptive to scientific advice and eager to understand restoration options. Scientists remained involved throughout construction and monitoring, supervising contractors and advising on methodological adjustments.
A pivotal moment was the **2011 public information event**, where the university team explained different restoration methods and their conditions. This helped decision-makers differentiate robust solutions from ineffective "quick fixes," creating a science-based consensus.

5.2.3 Special characteristics & management

The Kartuzy lakes illustrate a **community-driven restoration model** where residents catalysed change, and scientific experts provided credible, long-term guidance.
Key management actions included:

- eliminating sewage inflows as the foundational step for recovery;
- large-scale dredging combined with an innovative sediment-to-fertiliser process;
- sequential phosphorus inactivation treatments in the remaining lakes;
- biomanipulation and wetland construction as complementary measures;
- persistent public outreach, which helped maintain political will and community support.

By 2023, all major works were completed. Early outcomes show clearer water, reduced algal blooms, and returning macrophytes. Lakeside amenities and recreation have visibly improved, benefiting residents and local businesses.
Long-term sustainability depends on continued **annual maintenance** (biomanipulation, wetland upkeep, sewer system monitoring) and **post-project scientific monitoring**, which the municipality has committed to retaining.

5.2.4 Challenges and lock-ins

Governance and knowledge gaps

Earlier attempts in the 1980s–1990s failed due to insufficient limnological knowledge and use of inappropriate technologies sold as “silver bullets.” Installing a deep-water aerator in a 3 m lake, which then sank into the sediment, became a symbol of **cognitive lock-in**—a belief in gadgets over systemic solutions. The new governance model broke this cycle by insisting on **diagnosis before intervention** and prioritising the removal of sewage inputs.

Historical neglect

Decades of untreated sewage left heavy legacy sediment loads. Overcoming this history required large, costly interventions, making the project dependent on EU funding cycles.

Procurement lock-ins

Public procurement rules, which favour the lowest bid, created major setbacks. The first dredging contractor underperformed, deviated from plans and caused delays. The municipality, supported by scientific oversight, made the rare decision to **terminate the contract mid-project**, preventing long-term ecological and financial damage. This episode reflects a broader **formal lock-in**: systems that reward low-cost bids over quality in complex environmental projects.

Financial sustainability

The restoration relied on a one-time EU investment. Sustaining gains now depends on municipal budgets. While the city continues to fund monitoring through the university team, there remains a risk of a **boom–bust cycle**, where intensive project funding is not followed by stable long-term financing. Institutionalising lake management as a routine municipal responsibility is essential to avoid regression.

Funded by
the European Union

5.2.5 Governance & outcomes

The Kartuzy case demonstrates that **citizens + science + local political will** can break long-standing governance inertia. The expert–municipal partnership ensured adaptive management: scientists monitored dredging progress, contractors were held accountable, and restoration methods were adjusted when needed. With EU and national funds enabling the heavy works, the municipality led implementation and continues oversight into the post-project phase.
Environmental results are already visible, and the socio-economic environment around the lakes has improved. The main governance challenge ahead is ensuring stable long-term financing and institutional continuity so that improvements are maintained rather than lost to neglect.

5.3 Lake Karla (Greece)

5.3.1 Governance structure

Lake Karla has a uniquely complex governance history shaped by its dramatic transformations. Once a large natural lake–wetland in Thessaly, it was fully drained in the 1960s to create farmland and then partially re-flooded in the late 2000s as part of a major restoration and flood control effort. This created an institutional landscape split across sectors and ministries. Karla is a Natura 2000 protected site, giving the Ministry of Environment and its agencies responsibility for ecological management. At the same time, the lake's refilling and the associated hydraulic infrastructure were led by the Ministry of Agriculture and the Region of Thessaly, which remain responsible for irrigation and flood control operations.

As of the mid-2020s, governance is divided among three core actors:

- NECCA (Natural Environment & Climate Change Agency) — operates a local Management Unit for Lake Karla, responsible for ecological monitoring and Natura 2000 obligations. This unit was strengthened in 2022 through the merger of smaller bodies, giving it more stable staffing and funding.
- Regional Government of Thessaly — oversees water resource infrastructure (pumping stations, canals, dikes), irrigation management, and regional land use planning.
- Organization for Water Resources Management of Thessaly (est. 2024) — a new supra regional coordination body established after the catastrophic 2023 flood. It aims to align flood protection, water supply, irrigation, and environmental objectives across agencies and ministries.

This multi-level arrangement reflects decades of fragmented roles, inconsistent mandates, and siloed decision making.

5.3.2 Key governance elements

Karla's restoration involved major public works and significant investment in hydraulic infrastructure: pumping systems, retention structures, engineered canals, and irrigation networks designed to stabilise water levels for both flood prevention and agricultural supply. Formal planning frameworks exist — such as river basin plans, Natura 2000 management requirements, and flood-risk management plans — but historically they were poorly integrated across sectors.

Informally, governance has struggled with policy discontinuity and low institutional trust. “Every time the regional government changed, policies changed.” This produced implementation, uncertainty for farmers, and a sense that plans were repeatedly “reinvented.”

More recently, governance actors have recognised the need for broader engagement. NECCA’s Management Unit is developing a Master Plan for sustainable lake use (fisheries, ecotourism) in consultation with communities. NGOs and cooperatives are being more actively involved to shift away from historic top down decision making and foster local stewardship.

5.3.3 Special characteristics & management

Lake Karla is one of Europe’s most ambitious wetland restoration projects. Its unique history — ancient lake, drained agricultural plain, then an engineered lake requiring continuous management — gives it both ecological and cultural significance. Since refilling, biodiversity has begun to recover: pelicans and other waterbirds have returned in notable numbers. The restored lake now provides multiple benefits: habitat for wildlife, opportunities for tourism and fisheries, improved local microclimate, groundwater recharge, and crucially, flood mitigation for the broader Thessaly plain. However, unlike natural lakes, Karla’s water levels depend on active hydraulic management. Pumps, gates, and reservoirs must be continuously operated to balance flood protection, irrigation demand, and ecological needs. Thus, governance and operations are deeply intertwined with engineering systems. Institutional reforms after the 2023 flood accelerated efforts to integrate these functions. The new 2024 water organisation and the strengthened NECCA unit signal a shift toward coordinated, long term management — if collaboration can be sustained.

5.3.4 Challenges and lock-ins

Governance fragmentation

For decades, no single authority had holistic oversight of Lake Karla. Biodiversity was managed by NECCA, water infrastructure by the Region and the Ministry of Agriculture, and local municipalities pursued their own initiatives. With no local water management body, day-to-day decisions — such as when to pump water — were taken ad hoc, sometimes leading to conflict between farmers and environmental authorities. Fragmentation became a structural lock in where “everyone did their part,” but no one managed the system as a whole.

Institutional gaps

Although the restoration created a massive hydraulic system, the expected local water agency to operate it never materialised. This gap resulted in unclear authority, informal workarounds, and situations where farmers pumped independently when water was needed. During the September 2023 flood, lack of coordination contributed to downstream impacts — a failure that finally triggered the 2024 governance reform.

Political discontinuity and short-termism

Frequent changes in regional leadership meant fluctuating priorities: irrigation expansion under one administration, flood prevention under another, tourism under a third. This produced “pilot project

syndrome" — many initiatives launched, few sustained. Without continuity, farmers saw policies change before they were implemented, weakening enforcement and trust. Institutional memory was minimal, and long-term strategy suffered.

Conflicts between water uses

Karla must simultaneously deliver flood protection, irrigation supply, and ecological services. In normal years these aims can align, but during droughts or extreme floods they directly compete. Stakeholders have historically treated water as a zero sum resource, leading to a blame culture: farmers accusing conservation rules, environmentalists blaming overextraction, authorities blaming climate extremes. This social lock in persists partly because there is still no agreed operational water level plan (e.g., rule curves balancing all uses). The new 2024 organisation is intended to create such a framework, but implementation will require trust-building and shared responsibility.

5.3.5 Summary

Lake Karla's governance has been shaped by fragmentation, institutional gaps, political turnover, and competing water uses — classic governance lock-ins that hinder integrated management. The 2023 flood created a turning point, leading to new institutional arrangements and momentum toward coherence. Long-term success will depend on whether formal reforms are matched by sustained collaboration, community engagement, and a stable operational strategy.

5.4 Loch Leven (Scotland) – Long-term success threatened by coordination gaps

5.4.1 Governance structure

Loch Leven, a shallow nutrient rich lake in Scotland, is widely recognised as a scientific success story in restoration thanks to major reductions in phosphorus loading since the 1980s. However, its governance remains highly informal**.** There is no dedicated lake authority or foundation. Instead, management relies on a loose network of agencies, landowners, and local stakeholders who intermittently collaborate under the Loch Leven Catchment Management Group (LLCMG)**.**

Key actors include:

- **UK Centre for Ecology & Hydrology (UKCEH):** Long-term research body monitoring the lake since 1968, providing data and scientific advice.
- **Scottish Environment Protection Agency (SEPA):** Regulator responsible for enforcing water quality standards; Loch Leven is designated a "Priority Catchment," prompting farm inspections and pollution control efforts.
- **NatureScot:** Oversees conservation interests as Loch Leven is both an NNR and formerly an SPA under the Birds Directive; manages habitats and species conservation and informally coordinated the LLCMG approximately from the early-1990s to 2019.
- **Perth & Kinross Council:** Local authority responsible for planning and development.

- **Landowners and community stakeholders:** Private estate (fishery and visitor centre), farmers, an angling club, and residents.
- **Scottish Water:** Responsible for water supply and wastewater treatment in the catchment.
- **Historic Environment Scotland:** Manages cultural heritage sites, including Loch Leven Castle.
- **RSPB:** Operates a visitor centre and contributes to nature management.

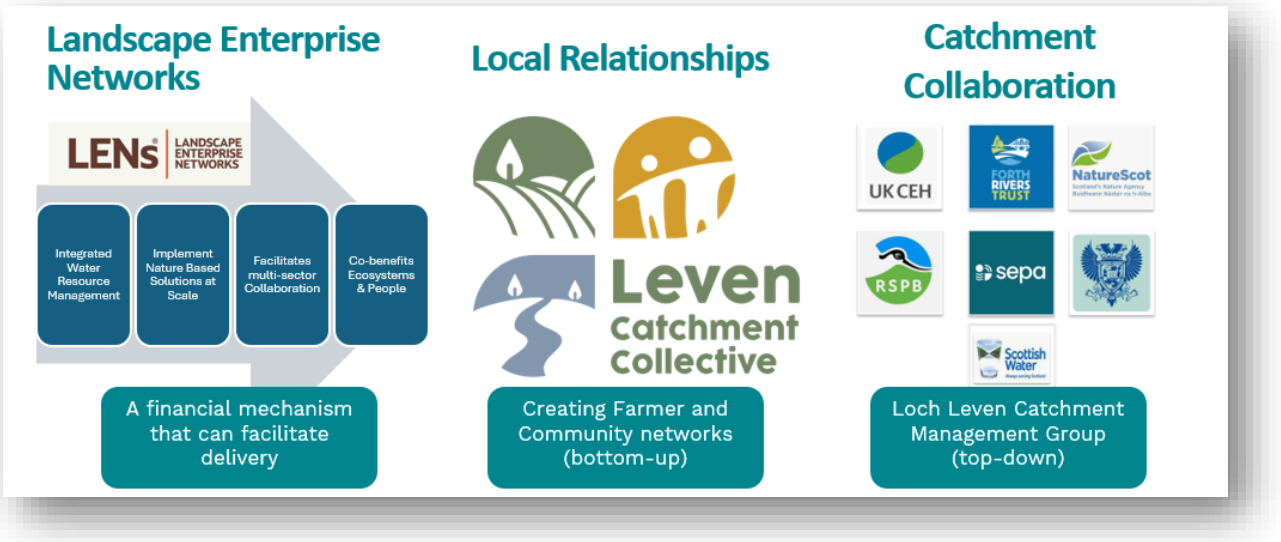

Figure 10 Loch Leven's governance structures. Source: Presentation on Loch Levens governance structure in Gdansk March 2026 by Amelia Heath.

After several years of inactive coordinated management, in 2025 there was a positive change, and the Loch Leven LENs initiative was initiated - a collaborative model for landscape restoration in Scotland's Leven catchment. It combines three key components:

1. **Financial mechanism**: LENs links businesses and public bodies (the "demand side") with farmers and landowners (the "supply side") to co-fund environmental measures such as wetland creation, soil improvement, and biodiversity enhancement. The Forth Rivers Trust coordinates the initiative locally, supported by 3Keel and funding from NatureScot and the National Lottery. See figure below.
2. **Local relationships (bottom-up)**: The Leven Catchment Collective and Farmer Network foster peer learning and community engagement. These networks empower local stakeholders to co-design and implement sustainable land management practices, ensuring that interventions are grounded in local knowledge and priorities.
3. **Catchment collaboration (top-down)**: The Loch Leven Catchment Management Group (LLCMG), recently revived, brings together regulators (SEPA, NatureScot), scientists, local authorities, landowners, and NGOs to coordinate strategy and align policy with on-the-ground action. This governance layer ensures oversight and integration across sectors.

Together, these elements form a holistic governance and finance model for resilient, community-driven landscape restoration (Forth Rivers Trust 2025).

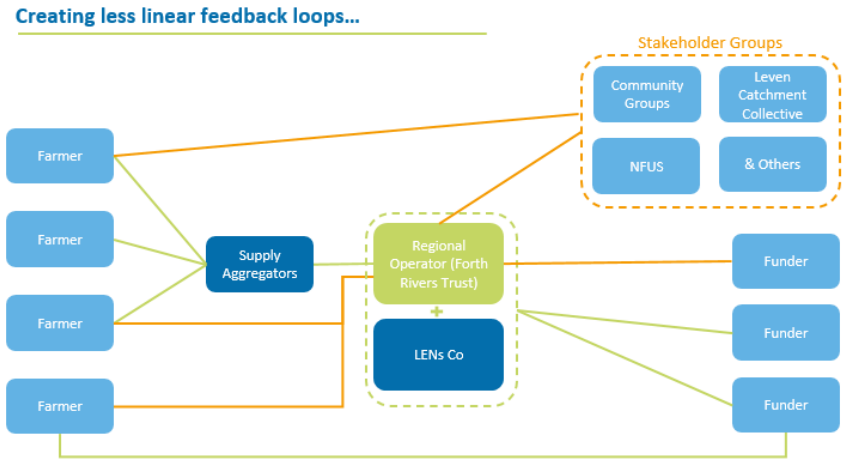

Figure 11 Financial mechanism connecting farmer's network with financing. Source: Presentation on Loch Levens governance structure in Gdansk March 2026 by Amelia Heath.

5.4.2 Key governance elements

Loch Leven benefits from robust regulatory and scientific structures: SEPA's Priority Catchment designation provides a mandate for targeted enforcement; decades of UKCEH monitoring offer unparalleled long term data for diagnosing issues and evaluating responses. Major wastewater and industrial upgrades in previous decades were driven by regulatory pressure and demonstrated strong policy–science alignment.

Despite excellent scientific capacity, informal mechanisms have in the past been weak. Knowledge has not flowed effectively to stakeholders. Many residents blamed sewage works for recent algal blooms, unaware that phosphorus inputs from sewage had been halved in the 1990s. This reveals a longstanding communication gap and the absence of a continuous outreach function. The revived catchment meetings in 2025 began to fill this gap by presenting accessible, long term data and restoring shared understanding.

5.4.3 Special characteristics & management

Loch Leven is one of the **most intensively monitored lakes in the world**, with a near continuous scientific record since 1968. This evidence base guided a major restoration effort from the mid1980s to 2000s: tertiary treatment upgrades, diversion/improvement of industrial discharges, and agricultural nutrient reduction measures (e.g., buffer strips). These interventions cut phosphorus inputs by ~50%, and by 2007 water quality had met recovery targets. Ecological improvements followed, including clearer water and reduced harmful algal blooms.

However, since around 2016 the lake has experienced renewed summer algal blooms, attributed to warmer temperatures**,** lower flushing**,** and legacy phosphorus released from sediments. Governance responses are now turning toward climate adaptation**,** exploring options such as constructed wetlands or flow management interventions.

The LLCMG historically provided a multistakeholder forum (agencies, scientists, landowners, fisheries, RSPB, council, community), meeting twice per year without formal authority. It dissolved in 2019 due

to lack of funding and mandate. Its revival in 2025 aims to reestablish joint action, communication, and adaptive planning for climate driven challenges. Below is a timeline of the developments.

- **1990s: Loch Leven Catchment Management Group Established**

The *LLCMG* was formed as a voluntary multi-party forum in the **early 1990s**, uniting SEPA, NatureScot (then SNH), UKCEH scientists, local authorities, landowners, and community stakeholders to coordinate lake restoration and water quality efforts.

- **2019: Catchment Group falls inactive**

After decades of informal operation (and lacking formal mandate or funding), the **LLCMG ceased meeting by 2019**, leaving no active catchment-wide management group for Loch Leven.

- **Nov 2023: LENs Programme Funding Secured**

3 Nov 2023 – Forth Rivers Trust and partners announce a **£250k+ funding award** (FIRNS & National Lottery) to develop the **Leven Landscape Enterprise Network**. This initiated the LENs *financial mechanism* in the catchment.

- **June 2025: Official launch of Leven LENs**

19 June 2025 – The **Leven LENs initiative** formally launches at the **Royal Highland Show**. The first **LENs trade agreements** are unveiled, with Diageo, SSEN, and Perth & Kinross Council investing jointly in environmental measures on 10–15 local farms.

- **2025: Leven Catchment Collective created**

2025 – The **Leven Catchment Collective** (facilitated by Forth Rivers Trust) is set up to boost community and farmer involvement in restoration. It includes the *Community Springboard* (community projects hub) and a Farmer Network.

- **Nov 2025: Farmer Network inaugural meeting**

Mid-November 2025 – The **Leven Catchment Farmer Network** holds its first meeting at Loch Leven's Brewery, bringing local farmers together to share knowledge and shape future training and collaboration.

- **2025: Catchment Management Group Revived**

2025 – A local initiative led by researchers (e.g., UKCEH) **restarts the LLCMG**, restoring a top-down catchment coordination group for Loch Leven after a six-year gap.

5.4.4 Challenges and lock-ins

Lack of a coordinating body

The central lock in was for a long time the absence of a sustained coordinating institution. A formal coordinating mechanism existed briefly in the 1990s, when a dedicated catchment manager led development of a Catchment Management Plan. After that project ended, **coordination collapsed**, and actors largely stopped meeting. By the 2010s, stakeholders lacked a common regular forum. In 2025, a researcher voluntarily reconvened the catchment group with project funds to reestablish dialogue among agencies, farmers, NGOs, and residents.

Responsibilities have in the past been fragmented across regulators, conservation bodies, landowners, utility operators, and local authorities. Without a coordinating officer or funded platform, cross mandate issues—particularly diffuse pollution—fell between institutional gaps. Each actor worked within its remit, but no one oversaw the system as a whole, leading to slow responses to emerging problems.

Loss of visibility and contested narratives

A longer wastewater outfall made sewage overflows less visible, reinforcing perceptions among residents that wastewater remained the dominant pollution source. Meanwhile, institutional memory eroded as staff roles changed. Without continuous outreach, public understanding lagged behind scientific knowledge, creating a social lock in where misinformation fuelled blame rather than cooperation.

Resource and mandate limitations

SEPA and NatureScot have limited scope and capacity: SEPA can inspect farms but cannot implement broader catchment measures; NatureScot can manage habitats but not water quality. Measures like wetlands, upstream natural flood management, or expanded buffer strips sit in a governance grey zone, lacking clear ownership or funding. As a result, proactive catchment wide actions stalled.

Climate change pressures

Climate warming now drives renewed blooms even at stable external nutrient loads. Severe drought in 2023 caused record clear water due to minimal runoff—highlighting the strong influence of diffuse sources once rains return, as well as the growing importance of water quantity dynamics (flows, flushing, drought cycles). Many stakeholders initially resisted climate explanations, seeking traditional culprits (e.g., new housing). This risked locking governance into outdated problem frames. Adaptive management requires integrated planning across pollution control, land management, and climate resilience, which has been hindered by fragmented governance.

5.4.5 Summary

Loch Leven demonstrates how early restoration success can lead to governance complacency. Strong regulatory enforcement and scientific monitoring resolved acute pollution problems in past decades, but the absence of a coordinating institution led to fragmented, reactive governance. Climate warming, legacy nutrients, and shifting land use pressures now require integrated, adaptive collaboration—something the revived catchment initiatives are beginning to rebuild. The case highlights that technical success must be matched by durable social, institutional, and coordination capacities to sustain long term lake resilience. The recent revival of both financial and organisational efforts is a sign of resilience and promising future sustained action.

5.5 Vansjø–Morsa (Norway) – Strong collaboration, minor lock-ins in scaling and sustaining effort

5.5.1 Governance structure

The Vansjø–Morsa catchment in southeast Norway is widely regarded as a leading example of integrated water governance. Since 1999 it has been coordinated by the Morsa Water Area Board, one

of Norway's first multi-municipality water partnerships. The Board brings together nine municipalities, the County Governor (state representative) and relevant sector agencies (agriculture, environment, health, wastewater).

The structure includes (see figure below):

- The Water Board - a political committee composed of mayors
- multiple technical working groups (agriculture, wastewater, ecological monitoring, etc.)
- a long serving dedicated coordinator who ensures continuity, maintains relationships, and convenes actors
- Executive committee

The governance is formally embedded in Norway's **Water Framework Directive** implementation as an official "Water Area," connecting local practice to national planning. Over two decades this system developed a strong shared culture, regular coordination routines, and jointly agreed action plans.

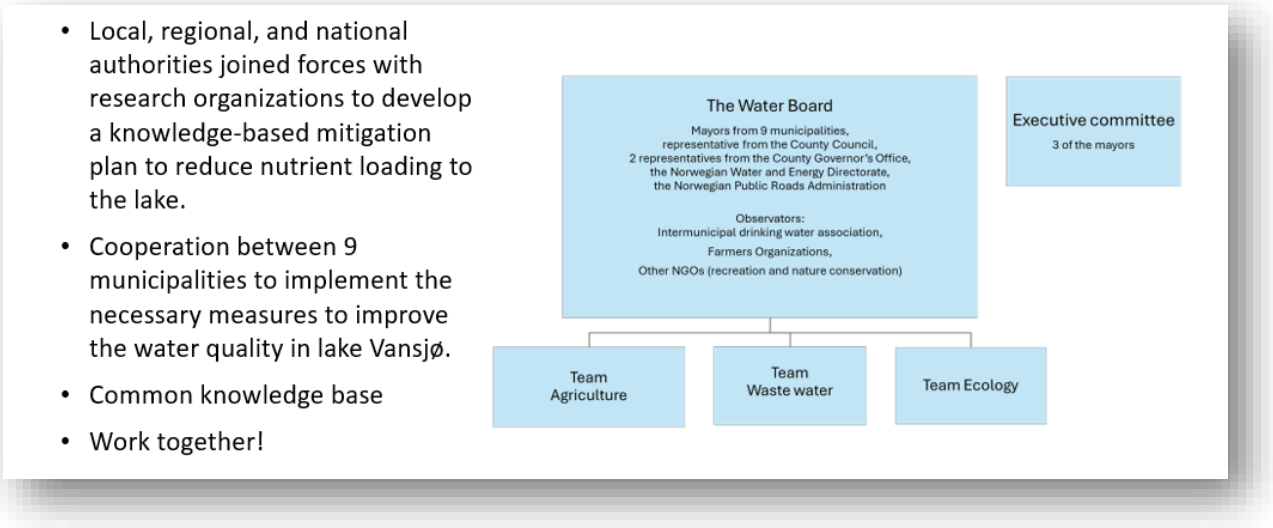

Figure 12 The Morsa organisation. Source: Source: Presentation on Morsa organising structure in Gdansk March 2026 by Carina Rossebø Isdahl.

5.5.2 Key governance elements

The Vansjø–Morsa Board benefits from:

- **Stable funding** from municipalities and the county, ensuring continuous coordination
- **Institutionalised working groups** that meet regularly and report to the Board
- **Monitoring systems** that inform adaptive management (tracking phosphorus, nitrogen, algal blooms)
- **Formal alignment with national WFD planning**, providing legitimacy and a long term strategic framework

Informal strengths are central to Vansjø's success:

- A strong ethos of **voluntary cooperation** and consensus decision making
- Exceptional **trust and social capital**, built through 20+ years of collaboration
- The **coordinator's onboarding role**, giving every new politician or staff member a one-on-one introduction to the history, culture, and expectations of the collaboration
- A culture of **knowledge sharing**, including study tours, farmer dialogues, and multi-day workshops
- Proactive adaptation: when data showed ongoing nitrogen impacts, the Board expanded its focus beyond phosphorus, signalling organisational learning and flexibility

Stakeholder engagement is especially strong: farmers meet with "champion farmers," politicians receive tailored communication tools to defend investments, and public outreach helps maintain community support.

5.5.3 Special characteristics & management

The Vansjø–Morsa collaboration is considered a national pioneer in integrated lake governance. Its long term coordinator and early establishment (before WFD implementation) allowed the partnership to mature into a stable, trusted forum able to implement a comprehensive suite of measures:

Agriculture

- widespread adoption of best management practices
- improved fertilizer application, reduced tillage, cover crops
- vegetated buffers and wetland restoration
- ~20,000 free trees distributed for riparian planting
  → measurable reductions in soil loss and phosphorus runoff.

Wastewater

- significant municipal investment in sewer network extensions and treatment upgrades
- replacement and upgrading of private septic systems
  → major declines in point source phosphorus loads by mid2000s.

Monitoring & adaptive management

- continuous monitoring of water quality and algal dynamics
- Evidence based expansion from phosphorus to nitrogen reduction to protect both Vansjø and the downstream Oslofjord.

Stakeholder engagement

- public meetings, newsletters, farm visits, and peer led farmer presentations
- strong onboarding routines for new municipal politicians
  → very low conflict and a "common understanding" of shared goals.

Outcomes

- large reduction in phosphorus concentrations

- severe toxic blooms from the 1990s have not returned
- the western basin has shifted from hypereutrophic toward mesotrophic
- the eastern basin meets drinking water criteria, reducing treatment costs
- visible successes help maintain long term political buy in

5.5.4 Challenges and lock-ins

Although Vansjø–Morsa is a success case, several subtle lock ins and long term risks remain:

Political complacency

Improved conditions can weaken perceived urgency. As veteran politicians retire, newcomers may lack memory of the 1990s crisis. The Board mitigates this through onboarding and continually setting new goals (climate adaptation, microplastics, nitrogen).

Voluntarism lock in

Most voluntary measures have already been adopted; further progress requires more demanding actions (e.g. large wetlands, taking farmland out of production). Voluntary approaches plateau, yet stricter regulations risk undermining trust. The Board seeks new "win win" framings (e.g. climate adaptation funding) to advance without damaging relationships.

Dependency on key individuals

Strong continuity has depended on the long term coordinator and several core members. Although routines and documentation exist, loss of these individuals could weaken coordination. The system remains a voluntary association, not a legally binding institution; its strength is relational rather than statutory.

5.5.2 Summary

Vansjø–Morsa demonstrates how long-term collaboration, clear structures, sustained leadership, and high social capital can overcome many typical governance barriers. Its challenges are now those of maturity: avoiding complacency, scaling beyond voluntary measures, and ensuring continuity beyond key individuals. Unlike lakes where fragmentation is the primary lock in, Vansjø's coordinating mechanisms are precisely what unlocked progress—and must be safeguarded to meet new climate and nutrient challenges ahead.

5.6 IJsselmeergebied (Netherlands) – Stakeholder platform vs. complexity of scale

5.6.1 Governance structure

The IJsselmeer region in the Netherlands—comprising Lake IJssel, Markermeer and surrounding waters—is a multi-functional freshwater system that provides flood protection, drinking water

storage, Natura 2000 habitat, fisheries, recreation and regional economic value. Governance is strongly multi-layered:

- Rijkswaterstaat (national water authority) manages lake water levels, major hydraulic infrastructure (sluices, dikes) and ensures compliance with national water policy.
- Provinces (Flevoland, Friesland, North Holland) regulate spatial planning and coordinate regional development around the lake.
- Water Boards (Waterschappen) manage regional water quantity and quality in the polder landscapes adjoining the lake.
- Municipalities and stakeholder groups (fisheries organisations, environmental NGOs, recreation interests) influence local initiatives.

To coordinate across this institutional landscape, the Platform IJsselmeergebied was established. It is a programmatic, multistakeholder governance platform bringing together national ministries, provinces, water boards, municipalities, NGOs and user groups. The Platform does not have regulatory authority, but functions as an integrating forum—a place where parties align agendas, negotiate trade offs, and set a common strategic vision. It works as a deliberative coordinating body similar in purpose to Vansjø–Morsa's board but operating at a much larger scale with even greater diversity of actors.

5.6.2 Key governance elements

The Platform is embedded in Dutch water governance traditions and national policy frameworks (e.g., National Water Programme). It is supported by:

- Tiered working structures: an "Integration Team (Iteam)" for cross sector coherence, thematic groups (ecology, water safety, spatial quality), and a review team (Afweging & Advies) that evaluates any new proposal—such as land use plans or infrastructure projects—against five shared goals for the IJsselmeer:
  flood safety, freshwater availability, ecological quality, spatial quality and sustainable economy.
- Joint fact-finding and planning: scientific disagreements (e.g., sediment vs nutrient drivers in Markermeer) are resolved through jointly commissioned studies, preventing institutional stalemates.

These structures ensure that projects and policies are considered holistically, reflecting the Netherlands' integrated, consensus based water management model.

Strong informal process facilitation is central to the Platform's effectiveness. A programme director acts as a neutral coordinator responsible for keeping actors aligned, ensuring that "the right questions are on the agenda", and guiding deliberation when mandates overlap.

Dialogue-oriented practice is intentional: meetings begin with small group conversations to build trust and allow frank discussion, followed by formal agenda-setting. The governance culture emphasises relationship building, inclusiveness and mutual understanding—key to navigating conflicting interests in a system with no single decision-making authority.

Funded by the European Union

5.6.3 Special characteristics & management

The IJsselmeer region exemplifies the Dutch "polder model": consensus based, collaborative water management institutionalised across government layers.
Under the Platform, several major management initiatives and innovations have taken place:

Marker Wadden
A flagship ecological restoration project in Markermeer (completed in 2018). Artificial islands and wetlands—constructed from dredged sediment—reduce turbidity, enhance habitat diversity, and have already boosted fish and bird populations. Marker Wadden illustrates how engineered nature-based solutions can address ecological degradation at scale.

Flexible water level management (pilot)
Experiments explore more dynamic water levels (seasonally varied peaks and drawdowns) to support wetland development while maintaining flood safety. Although delicate and politically sensitive, these adaptive trials reflect the Platform's integrative, negotiated approach.

Nutrient and pollution control
Diffuse nutrient reduction remains a priority for achieving EU Water Framework Directive goals. Measures include agricultural runoff controls in surrounding polders, buffer zones, nutrient-efficient farming and invasive species management.

Integration of new uses
The Platform mediates emerging proposals such as freshwater storage islands for drought resilience, floating solar infrastructure combined with habitat creation, and other multifunctional innovations. All new uses undergo integrated assessment against the Platform's shared goals.

5.6.4 Governance and outcomes

The Platform's coordination has prevented fragmented policymaking and has resolved scientific disputes that previously stalled ecological action (e.g., the Markermeer turbidity debate resolved through joint research enabling Marker Wadden). While water supply and flood safety objectives are met, ecological "good status" remains incomplete—especially in Markermeer—though restoration efforts show encouraging biodiversity gains. Current national programmes (e.g., PAGW – Programma Aanpak Grote Wateren) aim to accelerate nature-based and climate-resilience measures.

5.6.5 Challenges and lock-ins

Competing stakeholder interests
Farmers, fishers, conservationists, planners, water managers, recreation interests and renewable energy proponents all have stakes in the lake. Divergent preferences (e.g., water levels, land use, ecological interventions) create inherent tension. Without coordination, siloed advocacy could produce contradictory or lowest common denominator outcomes.

Scale and institutional complexity

Funded by the European Union

The number of authorities and sectors involved can slow decision-making. The Platform mitigates this but cannot eliminate structural complexity. Because it has no binding authority, any strong resistance from a key actor can stall progress, leading to a lock in of cautious incrementalism.

Conflicts and trade-offs

Some objectives are zero sum—flood safety vs ecological variability, water storage vs habitat needs, fisheries vs bird conservation. Fixed water level regimes, ingrained by decades of flood safety practice, create institutional inertia against ecological experimentation. Agricultural nutrient reduction depends partly on broader national policies; the Platform alone cannot enforce measures, creating a land–water governance mismatch.

Fragmented implementation capacity

Even when agreements are reached, implementation can lag due to multi-tiered administrative processes and complex funding arrangements. Bureaucratic delays create an operational lock-in where ecological improvements proceed more slowly than planned.

5 Summary

The IJsselmeer region is a large, multifunctional lake system governed by a dense web of institutions. The Platform IJsselmeergebied is a major governance innovation designed to overcome historic fragmentation and enable integrated, consensus-based decision-making. It has succeeded in aligning actors, resolving disputes, and launching high-impact projects like Marker Wadden. Yet the very scale and diversity that necessitate the Platform also make progress slow and often cautious. Long-term resilience will require sustained facilitation, political commitment, and continued investment in joint fact-finding and nature-based adaptation measures.

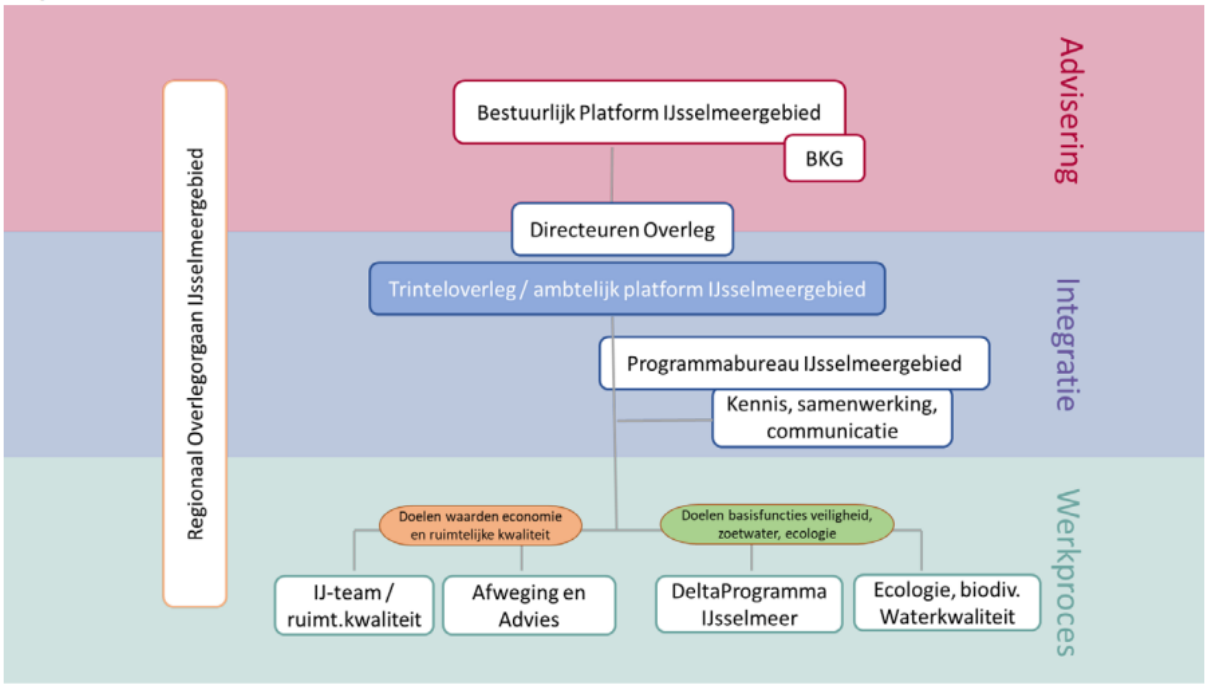

Figure 13 Structure of the collaboration in Platform Ijsselmeergebied.

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5.7 Initial conclusions: No blueprint of formal coordination structure

An analysis of the different lake governance revealed that there is no blueprint of the formal governance structure. Instead, every lake represented its own typology. This typology is based on factors such as coordination structure, stakeholder engagement, knowledge integration, funding mechanisms, and adaptability. This typology reveals a spectrum of governance models, from **highly integrated foundation-led systems** to **fragmented science-led approaches**. Each model reflects different strengths and constraints, shaped by institutional context, stakeholder dynamics, and historical trajectories. Understanding these types can help tailor governance frameworks to local conditions while identifying opportunities for cross-case learning and innovation.

1. Foundation-Led Collaborative Governance (Finland)

Example: Vesijärvi Foundation
Defining Features:

- Dedicated coordinating body with legal status
- Multi-stakeholder board (municipalities, businesses, scientists)
- Long-term strategic planning and monitoring
- Diversified funding (municipal, EU, donations)
- Strong public engagement and education (e.g. Vesijärvi Week, school programmes)

Strengths: Institutional stability, broad stakeholder inclusion, scientific integration, and sustained impact.
Typology Label: *Integrated Foundation Model*

2. Municipality-Initiated Restoration with Scientific Partnership (Poland)

Example: Kartuzy Lakes
Defining Features:

- Restoration initiated by citizen pressure and led by municipality
- Partnership with university for diagnostics and planning
- EU-funded implementation with sediment reuse innovation
- Adaptive response to contractor issues
- Strong local ownership, but limited national coordination

Strengths: Responsive to local needs, science-based, innovative sediment management
Typology Label: *Municipal-Scientific Partnership Model*

3. Regional Collaborative Governance with Thematic Working Groups (Norway)

Example: Morsa Catchment
Defining Features:

Climate-resilient ecosystem-based governance

- Long-standing regional coordination across municipalities
- Thematic groups (agriculture, wastewater, ecology)
- Regular meetings and joint project development
- Strong integration of local and scientific knowledge
- Flexible and adaptive to new issues (e.g. climate change)

Strengths: Deep-rooted collaboration, shared ownership, policy influence
Typology Label: *Regional Network Model*

4. Centralized Governance with Emerging Local Integration (Greece)

Example: Lake Karla
Defining Features:

- Restoration coordinated by local management unit under national agency (NECCA)
- Strong scientific monitoring and microclimate impact
- Fragmented responsibilities across sectors
- Emerging umbrella organization for water governance
- Limited stakeholder engagement, but growing interest in ecotourism and local economy

Strengths: Scientific innovation, potential for integrated governance
Typology Label: *Centralized-Local Hybrid Model*

5. Decentralized Governance with Regional Water Boards (Netherlands)

Example: Dutch lake systems (e.g. IJsselmeer)
Defining Features:

- Regional water boards with legal authority and financial autonomy
- Strong stakeholder engagement and co-creation processes
- Integration of spatial planning, water safety, and ecology
- Institutionalized multi-level governance
- Emphasis on trust-building and long-term visioning

Strengths: Legal clarity, financial independence, cross-sectoral integration
Typology Label: *Decentralized Water Board Model*

6. Science-Led Monitoring with Fragmented Governance (UK)

Example: Loch Leven
Defining Features:

- Long-term scientific monitoring (since 1968)
- Lack of coordinating body post-early restoration
- Fragmented institutional responsibilities
- Strong data availability but weak implementation
- Recent efforts to reconvene catchment group

Strengths: Rich data, scientific credibility
Challenges: Funding cuts, lack of coordination, limited stakeholder engagement
Typology Label: *Science-Led Fragmented Model*

6. The framework: Climate-resilient ecosystem-based governance

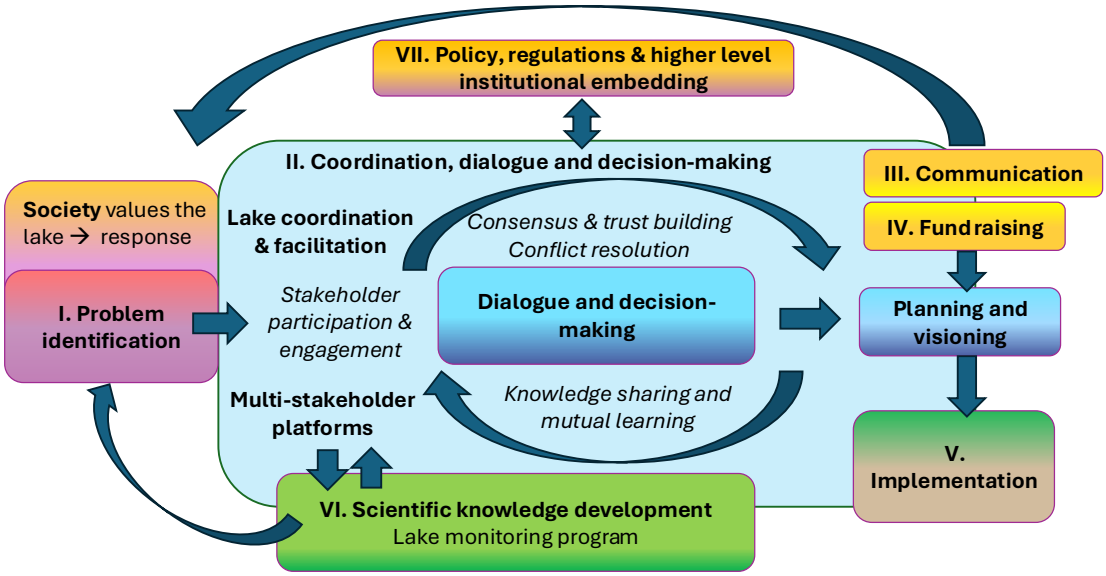

Figure 16 The climate-resilient ecosystem-based governance framework. Source: The authors.

6.1 Introduction to the governance framework

The six cases illustrate a spectrum of governance approaches to stakeholder deliberation: from highly institutionalized (Vesijärvi's foundation, IJsselmeer's platform, Vansjø's committee) to relatively informal or nascent (Loch Leven's fledgling group, Karla's evolving setup). Despite differences, some common themes emerge:

Dedicated forums matter: Lakes with a formal coordinating body (Vesijärvi, Vansjø, IJsselmeer) clearly benefited from having a regular venue for discussion and conflict resolution. In contrast, Loch Leven and Karla, which lacked this for years, experienced drift and persistent stakeholder discord until an integrative forum was (re)introduced. Kartuzy, as a smaller-scale case, managed via the municipal framework but still needed deliberate engagement events.

Facilitation and champions: Every successful deliberation process had at least one champion or coordinator driving it – be it a neutral coordinator (Vansjø, Ijssel), a foundation leader (Vesijärvi), a committed civil servant (Karla) or practitioner (NatureScot regional manager at Loch Leven), or an activist scientist (Kartuzy. These individuals and their teams maintained communication channels, bridged gaps between stakeholder groups, and kept the focus on shared goals, thereby preventing conflicts from derailing progress.

Consensus culture vs. conflict culture: There is a stark contrast in stakeholder culture:

- In **Vansjø and Vesijärvi**, a consensus culture took root – stakeholders trust each other and approach problems collaboratively, thanks in part to long-term relationship-building and transparency. Deliberations there are characterized by mutual respect and willingness to compromise.
- **In Loch Leven** and (historically) **Karla**– agencies and user groups acted defensively, and communication was poorer. Changing this culture has required efforts in communication and convening to slowly rebuild trust. **Kartuzy** was somewhere in between: initially frustration and apathy, transformed into unity once an actionable plan was co-developed.
- The **IJsselmeer** case sits in the middle; with so many stakeholders, disagreements are frequent, but the Dutch tradition of compromise (polder model) provides an underlying ethic that solutions must accommodate all sides, tempering conflict into more constructive negotiation.

Knowledge as a unifier: All cases highlight that shared knowledge is the foundation for shared understanding. Whether through formal reports, data portals, or informal storytelling, getting everyone to see the same picture of the lake's condition and challenges is a pre-condition to agreeing on actions. Lakes that invested in joint learning (**Vesijärvi, Vansjø**) show far more cohesive decision-making. Loch Leven and Karla are now actively trying to implement this lesson by divulging data and demystifying issues for locals.

Adaptability and continuous dialogue: Finally, to manage trade-offs among competing interests (ecology vs. agriculture, local vs. national priorities, etc.), the governance processes need to be iterative and adaptive. In practice, this means ongoing dialogue, not one-off meetings. **Vesijärvi's** stakeholders meet and adjust plans yearly (or more often), **Vansjø's** board revisits targets regularly, and **IJsselmeer's** Platform is a standing body that will continue to steer policy as conditions change. This permanency and flexibility allow conflicts to be addressed not as one-time events but as part of a living process where learning and negotiation are continuous. In contrast, when engagement was sporadic (Loch Leven's gap years, Karla's on-off projects), misunderstandings and conflicts had time to fester.

In summary, deliberation and decision-making in lake governance benefit from formalized inclusive structures, skilful facilitation, a culture of trust, evidence-based dialogue, and persistent engagement. Each FutureLakes demo basin contributes a piece to this puzzle, demonstrating that while the exact format may differ (committee, foundation, platform, or town hall), the underlying principles of collaborative governance remain consistent for achieving resilient outcomes. By comparing these experiences, the FutureLakes project can distil best practices for balancing diverse stakeholder interests through effective deliberative processes. The following framework has been developed with these elements as its core.

The FutureLakes governance framework presented below is balancing formal structures and informal processes. Formally, it stresses clear institutions, policies, and funding: e.g., dedicated lake coordinators or councils, alignment of lake plans with higher-level policies, robust monitoring programmes, and sustainable financing. Informally, it highlights stakeholder engagement, trust, leadership, transparency, and learning as critical for success. The framework's novelty lies in treating these "soft" factors on par with formal arrangements. It explicitly addresses climate resilience by encouraging adaptive learning and integration of related issues like flood control and drought management into lake governance. This unified framework is intended for practitioners to get

inspiration for how their work can be improved and diagnose governance gaps and design more holistic, climate-resilient lake management strategies.

This governance framework puts an emphasis of governance as a process of adaptive management – based on several elements related to "practical wisdom" that will be described further below: problem identification, knowledge development, consensus, trust building, conflict management and learning, for decision making on climate resilient development planning and measures.

6.2 Problem identification (I)

The framework starts with problem identification that often triggers action. Problem identification is a foundational element of effective lake governance, serving as the entry point for coordinated management responses. It encompasses the processes through which ecological, social, or institutional issues are first recognized and framed as requiring intervention. Problems may be identified through scientific monitoring and data analysis, public complaints, media attention, or policy evaluations. The credibility and visibility of the problem often determine the urgency and scale of response. Importantly, the actors involved in identifying problems—such as researchers, local communities, NGOs, or government agencies—influence how issues are prioritized and addressed- i.e. awareness in society of lake values is fundamental to the response after a problem has been identified. A robust governance framework acknowledges the diversity of knowledge sources and ensures mechanisms are in place to detect, validate, and communicate emerging challenges in a timely and inclusive manner. Below are examples from the different lakes.

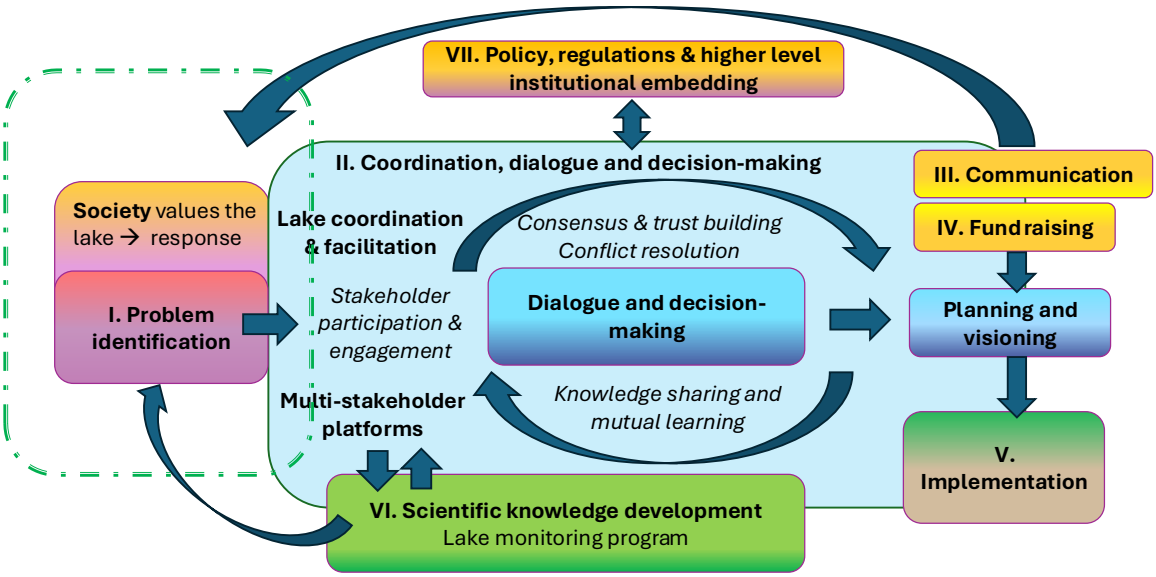

Figure 17 I. Problem identification - The climate-resilient ecosystem-based governance framework. Source: The authors.

Loch Leven (Scotland)

Climate-resilient ecosystem-based governance

Problem identified by: Long-term scientific monitoring and visible algal bloom crises. Extensive data from UKCEH showed severe eutrophication in the 1970s–80s, corroborated by fish kills and public concern. Local anglers and media also raised alarms as the lake turned green.

Main drivers addressing the problem: Environmental agencies & scientists. The Scottish EPA and other regulators took the lead in the 1980s-90s by upgrading sewage works and curbing farm runoff (investing £4.5M in treatment). A dedicated Catchment Manager was appointed in the early 90s to coo**rdinate actions.** Researchers from UKCEH were pivotal in guiding policy with data (e.g. proving that nutrients, not just sewage, were the cause). In short: government agencies implemented pollution controls, heavily informed by CEH scientists' evidence.

Lake Karla (Greece)

Problem identified by: Top-down planning after decades of issues. The complete drainage of Karla (1962) led to dust storms, lost wetlands, and farm failures – problems well-known to Greek authorities by the 1980s. Karla's status as a Natura 2000 site and recurring floods/droughts in Thessaly kept the issue on the national radar. (E.g. a major 2023 flood was a continental news event.)

Main drivers addressing the problem: National government and EU-backed initiative. The Ministry of Environment spearheaded Karla's restoration in the 2000s, securing EU funds to re-flood the lake. The Ministry of Agriculture supported it for irrigation benefits. Local/regional bodies executed projects but lacked power – Athen's ministries drove decisions, also influenced by delays in WFD programmes of measures. Recently, after climate disasters, the central government formed a Water Management Organization of Thessaly (2024) to coordinate all sectors. In sum: central ministries (with EU pressure and funding) initiated action, while local agencies now carry it forward under new national coordination.

Kartuzy Lakes (Poland)

Problem identified by: Citizen complaints in the town of Kartuzy. Residents saw (and smelled) that their four urban lakes had turned into "sewage ponds" – toxic cyanobacteria blooms, foul odours, unusable for swimming. Public outcry in the 2000s pushed the issue onto the municipal agenda.

Main drivers addressing the problem: Local government and academic partnership. The Kartuzy Municipality responded to citizen pressure by seeking expert help. They engaged limnologists from the University of Warmia & Mazury, who conducted a thorough lake diagnosis in 2012–2013. The Mayor and town council then championed an EU-funded restoration project (securing ~€14M via Poland's Infrastructure & Environment Fund). Throughout implementation, the municipality led on ground actions (sewer upgrades, dredging), guided closely by the scientists' recommendations. In short: local officials (backed by residents) and scientists drove the cleanup, with funding and policy support from higher levels (regional water plans and EU grants).

Lake Vesijärvi (Finland)

Problem identified by: Public environmental crisis recognised in Lahti. By the 1970s Vesijärvi's fish were dying en masse and algal scums covered the lake – a situation impossible to ignore. City officials, local fishermen, and researchers all "hit the alarm" when the lake was declared biologically dead

around 1976 (widely reported in Finnish media). Extensive water-quality monitoring by scientists documented the pollution.

Main drivers addressing the problem: City-led restoration with scientific guidance. The City of Lahti took early action (building a sewage treatment plant in 1976 to stop raw effluent). In 1987 the city, with researchers, launched the "Save Lake Vesijärvi" project – pioneering biomanipulation and catchment measures. Key drivers were local government officials and limnologists (from SYKE and universities) who formed a working group. In 2007, the community established the Vesijärvi Foundation – a public–private body uniting city authorities, scientists, firms, and residents to fund and steer ongoing management. Thus, the city (and later the Vesijärvi Foundation) has been the main champion, continually advised by scientific experts and supported by an engaged public (volunteer monitors, donors).

Lake Vansjø (Norway)

Problem identified by: Drinking water and recreation scare. In the 1990s Vansjø suffered frequent toxic algal blooms, which by 1999 threatened the lake's role as a drinking-water source. This triggered alarm at the regional water utility and in local newspapers. Anglers and boaters also pressed local leaders as access to safe water and swimming diminished. Essentially, a water crisis (cyanotoxins) made the problem undeniable.

Main drivers addressing the problem: Coalition of municipalities ("Morsa" water board). The response was spearheaded in 1999 by local governments: all 9 municipalities in the catchment and Østfold County formed the Vansjø/Morsa catchment board. A dedicated watershed coordinator was hired to drive actions across jurisdictions. Political leaders (mayors) in the board pushed through agricultural pollution controls (with farmers' groups) and sewer system upgrades. They were strongly supported by county environmental officials and scientists from NIVA (who provided data and plans). In summary: local authorities organised a formal watershed partnership to tackle Vansjø's issues collaboratively, with steady leadership by a coordinator and input from environmental experts – a bottom-up, inter-municipal drive that proved very effective.

Lake IJsselmeer (Netherlands)

Problem identified by: Official assessments & stakeholder pressure. The lake's ecological degradation (especially in Markermeer) was flagged by EU Water Framework Directive reports in the 2000s – e.g. fish and bird populations failing targets. At the same time, Dutch NGOs like Natuurmonumenten and academic experts publicised the "mud problem" and habitat loss. Commercial fishermen's catches were declining, adding economic pressure. And climate adaptation studies noted IJsselmeer's water-level management challenges. These combined signals pushed the government to act.

Main drivers addressing the problem: National agencies and multi-stakeholder platform. The Ministry of Infrastructure & Water Management (via Rijkswaterstaat) initiated an integrated programme for IJsselmeer. In the 2010s they established the Platform IJsselmeergebied – bringing together national ministries, provincial governments, water boards, NGOs, and user groups to jointly define goals. On the ecological front, Natuurmonumenten (NGO) partnered with government to drive projects like the Marker Wadden islands (a large habitat restoration). Thus, central government agencies were key drivers (ensuring flood safety and water supply), while NGOs and provincial authorities pushed for

nature restoration – all coordinated through a formal multi-stakeholder governance structure. In effect, policy change came from the top but was shaped by intense consultation with regional and civil-society actors through the Platform.

6.3 Coordination, dialogue and governance (II)

Dialogue and decision-making are often coordinated by dedicated lake coordinators or other key facilitators and enabled by different multi-stakeholder platforms for dialogue. These will be described more in depth below for the different lakes.

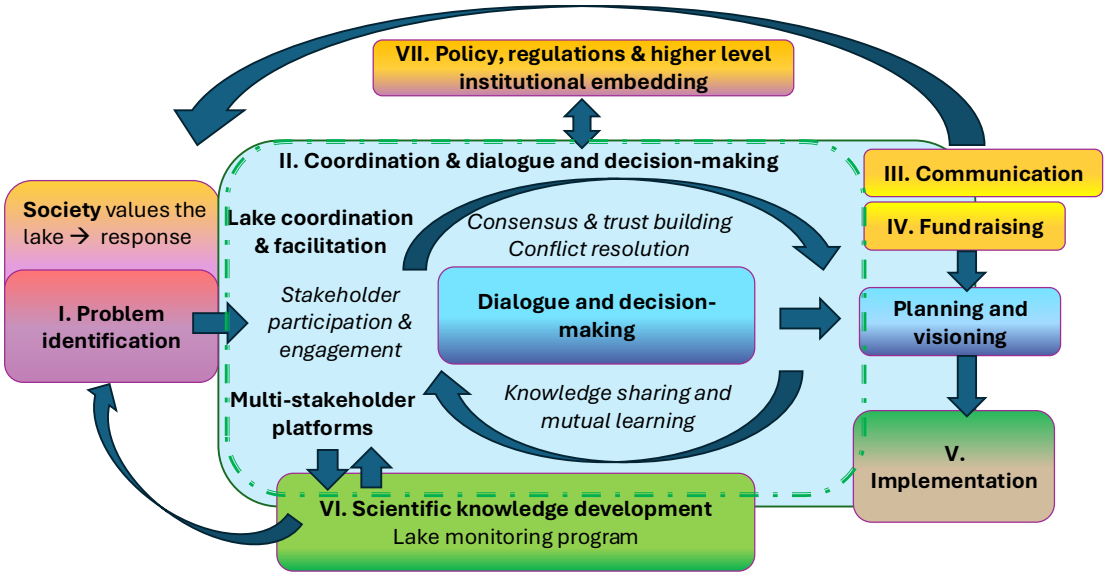

Figure 18 II. Coordination & dialogue and decision making - The climate-resilient ecosystem-based governance framework. Source: The authors

6.3.1 Lake coordination and facilitation leadership

Strong **facilitators or coordinating leaders** are crucial for guiding stakeholder deliberations and maintaining momentum. Whether through dedicated coordinators, scientists, local officials, or foundation leaders, or shared leadership models, these facilitators play a crucial role in aligning diverse stakeholders, maintaining momentum, and fostering trust across governance levels. They use their credibility, networks, and convening power to sustain collaboration and dialogue.

- **Loch Leven:** In absence of formal leadership, scientists have stepped in and emerged as an **informal facilitator**, using scientific credibility to call meetings and share data. In the 1990s a temporary **catchment manager** position coordinated efforts, but after funding lapsed Loch Leven lacked any formal coordinator for years. The current revival of the group is being held

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together by researchers and local agency staff voluntarily, underscoring the need for a dedicated facilitator to sustain dialogue.

- **Lake Karla:** Leadership has been largely top-down from Athens. However, the head of the local management unit serves as a crucial **bridge** between central authorities and the community. He advocates for an umbrella organization and has been personally engaging farmers and NGOs informally to build trust. With the new Water Organization, a formal director will likely take on facilitation, but until then local staff play the de facto convening role.
- **Kartuzy Lakes:** The **Mayor of Kartuzy** and city environmental officers provided political leadership, while university experts acted as **knowledge facilitators**. The scientists organized information sessions (explaining lake conditions and restoration options), effectively mediating between the technical solution and public understanding. This tandem – local political will plus expert facilitation – drove consensus on the path forward.
- **Lake Vesijärvi:** The **CEO of the Vesijärvi Foundation** and the Foundation's board fulfil coordination roles. They schedule and facilitate stakeholder meetings, ensure follow-ups on agreed actions, and engage external partners. The City of Lahti's representatives also provide leadership by aligning municipal resources with Foundation plans. This shared leadership model – a dedicated foundation director supported by committed public officials – keeps the multi-actor effort on track.
- **Lake Vansjø:** A full-time **Watershed Coordinator** has been key to Morsa's success. She convenes board meetings, prepares agendas with input from all municipalities, and crucially, provides **one-on-one onboarding** to new members (e.g., newly elected mayors) to instil the cooperative spirit and maintain institutional memory. This neutral coordinator ensures continuity despite political turnover and actively nurtures trust among stakeholders. Local agricultural advisors and agency officials also act as facilitators within working groups, but the coordinator is the linchpin for integration.

- **Lake IJsselmeer:** The **Programme Director** of the IJsselmeer Platform functions as a neutral **facilitator and integrator**. Backed by an "Integration Team," that is not only oriented to technical but also social and governance understanding - this director mediates between different sectoral interests, steering meetings toward common ground and ensuring each party's concerns are heard. Additionally, **working group chairs** (often senior agency staff or regional officials) play convening roles on specific issues (e.g., ecology or shipping), then bring negotiated proposals to the full Platform. Strong leadership from Rijkswaterstaat also helps by providing data and proposals that serve as a starting point for discussion, around which the facilitator can guide dialogue. The facilitator also acts to connect content and decision-making, actively putting things on decision-makers table, and making people aware what their roles are if they sit in two different platforms, making the decision system more effective.

6.3.2 Multi-Stakeholder platforms for dialogue

Multi-stakeholder platforms provide essential spaces for dialogue, coordination, and joint decision-making among diverse actors, ranging from government agencies and scientists to community members and NGOs. Whether formalised through foundations, watershed committees, or informal forums, these platforms help overcome fragmented governance by fostering shared understanding, trust-building, and integrated planning and align management actions across sectors and scales.

- **Loch Leven (Scotland):** *Historically absent.* No permanent forum existed for decades, leading to fragmented efforts. In 2025, scientists re-convened a **Catchment Management Group** as an informal platform to finally get agencies, landowners, and community reps "in the same room" sharing information. This forum is advisory (no legal mandate) and is just beginning to foster joint planning after years of siloed decision-making.
- **Lake Karla (Greece):** *Newly established.* Until recently, governance was split among ministries with **no unified platform**. After the 2023 floods, the government created a **regional Water Management Organization** (Thessaly) to bring together the Environment and Agriculture ministries, regional authorities, and (planned) local stakeholder representatives under one umbrella. Additionally, a local **Management Unit** (within NECCA) now engages community members. These structures are intended to replace past top-down silos with a coordinated dialogue forum, though they are still in early stages of operation.
- **Kartuzy Lakes (Poland):** *City-led engagement.* With governance essentially at the municipal level (Kartuzy town), a separate multi-organization platform was not needed. Instead, the **municipal government** itself served as the forum, working closely with residents and scientists. Public **consultation meetings** (e.g. an open workshop to discuss restoration options) functioned as ad hoc dialogue platforms. Thus, deliberation was community-centric rather than through a formal committee, reflecting the smaller scale and unified local authority.
- **Lake Vesijärvi (Finland):** *Public–Private Foundation.* The **Vesijärvi Foundation** (est. 2007) acts as a permanent multi-stakeholder platform. Its board unites city officials, neighboring municipalities, researchers, NGOs, fishers, and businesses in regular meetings. This formalized forum coordinates all lake restoration decisions and ensures that various interests (e.g. water quality, recreation, fisheries) are deliberated collectively. It is a **consensus-oriented platform** that institutionalizes stakeholder dialogue on an ongoing basis.
- **Lake Vansjø (Norway):** *Watershed Committee.* Since 1999, the **Vansjø–Morsa Water Board** (Water Area Committee) has provided an integrated forum linking 9 municipalities, county authorities, environmental agencies, and stakeholder groups. The Board meets regularly to discuss and decide catchment measures, operating through sub-committees for technical topics. It was one of Norway's first watershed committees, enabling *joint* deliberation across political boundaries. The platform's longevity has built a culture of open dialogue and collective ownership of lake issues.
- **Lake IJsselmeer (Netherlands):** *National-Regional Platform.* A formal **Platform IJsselmeergebied** was established to reconcile the lake's many uses. It convenes national ministries (Infrastructure/Water, Agriculture/Nature), Rijkswaterstaat, provincial governments, water boards, NGOs, and user group representatives in one forum. The Platform operates via working groups and an integration team, functioning as a **deliberative arena** where policies for flood safety, water supply, ecology, and recreation are debated and aligned. This Dutch "polder model" approach ensures all parties hear each other's positions before decisions are made, preventing unilateral actions.

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6.3.3 Consensus & trust building

All lakes employ practices to build consensus, though approaches differ in formality and intensity. Common practices include inclusive dialogue, joint fact-finding, and incremental trust-building measures:

Inclusive dialogue & regular meetings: Each case shows commitment to open discussion

- **Vansjø:** The Morsa Board emphasizes that all decisions should be unanimous or broadly supported; they rarely resort to voting. They hold frequent meetings and workshops where everyone (politicians, farmers, NGOs) speaks openly, fostering a norm of "solve it together" rather than adversarial debate.
- **IJsselmeer:** The Platform runs on the "polder model", meaning long deliberative sessions and iterative drafts of plans until no stakeholder has major objections. This can be time-consuming, but it ensures buy-in. If conflicts arise, the Platform might form a small task force to work out a compromise offline and then present it back for consensus. During meetings the coordinator ensures smaller groups (8) during meetings to facilitate good conversations and making time to really talk on what is on people's minds, avoiding to just work through the agenda and every three minutes take a decision. Field visits are also aimed for people to understand and get to know each other (build relationships, trust) - extended engagement facilitates social learning. A collaborative mindset is enabling: Do people believe that they need each other or do they work to solve things independently?
- **Kartuzy:** The city convened public meetings and council sessions to agree on the restoration plan. By involving residents early (especially those living around the lakes) and transparently discussing pros/cons of each method, the community reached consensus to support the disruptive but necessary actions (like dredging).
- **Loch Leven:** The revived Catchment Management Group operates on a principle of open dialogue and shared learning. Meetings bring together regulators, scientists, landowners, and community representatives, with a strong emphasis on exchanging data and perspectives rather than assigning blame. While still evolving, the group fosters a "solve it together" culture, aiming to rebuild trust and coordination after years of fragmented governance.
- **Vesijärvi**: The Vesijärvi Foundation leads a broad, inclusive platform where stakeholders—from government and research to businesses and citizens—collaborate on lake management. Regular meetings, volunteer events, and public forums ensure transparency and shared ownership. Consensus is built through open communication and a shared commitment to the lake's health, with social learning and trust underpinning the process.
- **Lake Karla:** Dialogue has historically been informal and reliant on personal relationships, but recent efforts aim to institutionalise collaboration. While public participation is still limited, initiatives like citizen-science events and multi-stakeholder meetings are laying the groundwork for more structured consensus-building and inclusive governance.

Joint Fact-finding & science integration: Using scientific evidence to unite perspectives:

Climate-resilient ecosystem-based governance

- **IJsselmeer:** A notable practice is commissioning joint research when stakeholders disagree on facts. For instance, when ecologists and fisheries interests disputed the cause of Markermeer's poor ecology, the Platform initiated a collaborative study which all parties trusted. The findings from this shared fact-finding then formed the basis of a mutually agreeable action plan (e.g. sediment-focused remedies).
- **Loch Leven:** Scientists have taken on the role of presenting long-term monitoring data to all stakeholders together. In recent stakeholder meetings, sharing 50+ years of data on nutrient inputs and algal trends helped dispel myths (e.g., overestimating sewage impact) and created a common understanding of the real drivers. This evidence-based dialogue is beginning to shift the conversation from finger-pointing to problem-solving.
- **Vesijärvi:** Continuous scientific monitoring results are discussed in Foundation meetings, ensuring all stakeholders ground their decisions in the same evidence. When a measure isn't working (e.g., aeration outcomes), the data convince everyone to adapt strategy, providing strong arguments.

Incremental trust-building measures: Small wins and fairness build consensus:

- **Vansjø:** The Board built trust with farmers by initially emphasizing voluntary measures and incentives (like free buffer strip planting and advisory services) rather than immediately imposing fines. As water quality improved, stakeholders saw the approach working, which made them more willing to accept tougher steps later. This gradual ramp-up created a virtuous cycle: early successes -> increased trust -> deeper cooperation.
- **Karla:** In the new governance setup, managers are trying to frame solutions as win-win. For example, instead of just telling farmers "use less water," they highlight how improving the lake also enhances local groundwater and climate, which benefits agriculture. By reframing the narrative to mutual benefits and acknowledging cultural ties (many local families were fishers generations ago, not only farmers), they aim to soften resistance and create a shared vision of the lake as a common good.
- **Kartuzy:** Consensus was bolstered by the very tangible shared goal – everyone wanted a cleaner, odour-free town lake. The city kept the process inclusive (public feedback was incorporated into project planning) and fair (e.g., ensuring that those affected by dredging inconveniences were heard and mitigations planned). This fairness in process meant there was little public opposition once the project kicked off.

Neutral facilitation & rules of engagement: Many governance setups use neutral parties or agreed protocols to maintain a constructive atmosphere:

- **Morsa (Vansjø):** The coordinator's neutral position and the practice of onboarding new members in the group's collaborative norms prevent conflicts caused by personality or party-politics. Meetings are often structured to focus on problems ("how do we reduce phosphorus here?") rather than blame ("who caused the phosphorus?"), which channels discussions toward solutions.

- **IJsselmeer:** The Platform's charter essentially requires integrated evaluation of proposals – any plan must be checked against all five pillar goals (safety, water supply, nature, etc.). This protocol forces proponents to address others' concerns in advance, making it easier to reach consensus in the plenary meeting because plans have been pre-adjusted to balance interests.

6.3.4 Conflict resolution

Even with consensus aims, conflicts arise (e.g., over resource allocation, or interpretations of data). The cases reveal strategies to manage and resolve these disputes:

Structured negotiation & compromise:

- *IJsselmeer:* Uses formal negotiation rounds. If, say, provincial planners and conservationists clash over water levels, the Platform might mandate a **mediation session** or task a technical subgroup to propose alternative scenarios (perhaps a moderate water level change plus compensatory habitat creation). By presenting a compromise package, parties can agree without feeling they "lost."
- *Vansjø:* Relies on a **consensus norm** – contentious proposals are tabled until further dialogue yields a compromise all can accept. For instance, when tighter manure regulations were needed, rather than pushing through a divisive rule, the Board negotiated a phased implementation coupled with farm support programmes, satisfying both environmental and agricultural interests over time. This avoid-majority-rule approach means decisions might take longer but have lasting buy-in, so conflicts are resolved through patience and adjustment.

Blame culture to shared accountability:

- *Loch Leven:* An ongoing challenge is overcoming the entrenched "blame game" among agencies (environment vs. planning vs. landowners). The new approach is to use **transparent information-sharing** to underscore interdependence – for example, showing that both sewage upgrades *and* farm practices must work in tandem, so no single entity can solve the issue alone. In recent meetings facilitated by researchers, stakeholders tentatively acknowledged that pointing fingers isn't productive. While not fully resolved, this shift toward *shared accountability* is the chosen strategy to quell conflicts.
- *Karla:* Previously, each sector blamed the other for failures (flood managers vs. ecologists vs. farmers). With the new unified authority, the strategy is to **create one decision-making structure** so that disputes are resolved internally rather than via public blame. Also, by bringing local representatives into the discussion (previously excluded), misunderstandings can be addressed in meetings instead of escalating. Early signs show a reduction in open conflict as the **"one lake, one team"** idea takes hold (helped by the shock of the 2023 flood focusing minds on a common enemy – extreme weather – rather than each other). Usually, political will and political conflicts create rivalling sides.

External facilitation & legal frameworks:

- *When deadlock looms*, some cases lean on external intervention:

- *IJsselmeer:* If stakeholders simply cannot agree, ultimately the national government (Ministry) can step in with a decision, or the law (e.g., EU Water Framework Directive targets) sets a non-negotiable requirement. Knowing this "backstop" exists encourages parties to find a compromise *themselves* so a top-down decision isn't imposed.
- *Karla:* The lake's Natura 2000 status means certain environmental standards must be met. This external legal pressure can be invoked in deliberations – i.e., reminding irrigation interests that, regardless of view, the lake **must** maintain habitat for birds, so solutions must accommodate that baseline. While not a conflict resolution per se, it provides a boundary that shapes negotiations (and can settle debates by reference to law/science when needed).

Personal relationships and informal diplomacy:

- Across all cases, **informal chats** and personal rapport often smooth over conflicts that formal meetings couldn't. In Vansjø, for example, if a municipality was hesitant about funding a measure, the coordinator or a fellow mayor might call them privately to talk it through. In Vesijärvi's Foundation, the CEO regularly meets stakeholders one-on-one over coffee to hear concerns outside the boardroom. Such behind-the-scenes diplomacy builds empathy and often leads to compromises that are later ratified publicly.

6.3.5 Knowledge sharing & mutual learning

A recurring theme is the use of **knowledge sharing** to level the playing field among stakeholders, dispel misinformation, and enable evidence-based joint decisions. Each lake's governance incorporated learning mechanisms:

Data transparency & portals:

- *Loch Leven:* Established a **local data portal** where water quality data and interpretive summaries are posted for all to access. This was in response to stakeholders saying they "had nowhere to find things out" about the lake. Coupled with articles in a local newsletter summarizing scientific findings in plain language, this has started to improve general understanding and reduce rumours.
- *Lake Karla:* The management unit has also set up a **public-facing data portal and newsletter** to regularly inform locals about lake conditions and project updates. This push is breaking the older pattern where information stayed in ministry reports and never reached farmers or residents. By proactively sharing monitoring results, they hope stakeholders will recognize issues (e.g. groundwater drop) and the rationale for actions (e.g. pumping restrictions) as common knowledge, not top-down edicts.

Joint monitoring & reporting

- *Vansjø:* Stakeholders participate in or observe the **water monitoring programme**. Results (e.g. phosphorus trends, algal levels) are presented in easy-to-read formats at board meetings and public forums. The Board issues an **annual summary report** to all interested parties, so

everyone works off the same facts. This collective learning – seeing the lake respond to actions – reinforces commitment (when data show improvement) and urgency (if data show setbacks).

- *Vesijärvi:* Has one of the most robust learning setups: the Foundation organizes an **annual "Vesijärvi Week"** with seminars, where scientists, officials, and citizens discuss the latest research and status of the lake. They also publish frequent updates on social media and local press about what is happening in the lake. This continual education means stakeholders (from fishermen to politicians) are relatively well-informed and can engage in decision discussions with a common baseline of understanding. This was seen as crucial to the lake's governance success.

Capacity-building workshops

- *Vansjø & Vesijärvi:* Both have hosted **training sessions** for stakeholders: e.g., agricultural best-practice workshops for farmers (in Vansjø) to share knowledge on reducing runoff, or invasive species identification training for volunteers (in Vesijärvi). These activities not only transfer practical knowledge but also build a sense of joint stewardship – stakeholders become more like partners after learning together.
- *IJsselmeer:* While a more top-level governance arena, the Platform has organized **knowledge exchange field trips** – such as visits to the new Marker Wadden islands for all stakeholders to see ecological restoration first-hand. This kind of shared learning experience can align perspectives (seeing a successful pilot convinces sceptics and educates everyone on how an intervention works, outside of meeting rooms). Connecting to practice like this can also help clarify for decision-makers if they really understand what all the policies (e.g. Natura 2000, guidelines) mean in practice. This is part of an important task to make sure decision-makers are committed to the area and that they understand what they have to do or if they understand where there are management issues. Field visits to help understand complexity, webinars and websites also help (as people also don't always read reports).

Social learning and culture change:

In several lakes, the process of working together over years has led to a culture of learning:

- *Morsa (Vansjø):* Initially, municipalities were guarded about "their" part of the watershed. Over time, through continuous information sharing and cooperative problem-solving, they developed a **collective identity as Morsa**. Now they openly share lessons with each other and even with other watersheds, indicating a mature social learning outcome (the group learns and adapts as a whole).
- *Karla:* Here, the shift is just beginning – from a culture of mistrust (where knowledge was hoarded or ignored) to one where people like farmers are invited to planning meetings and **hear explanations from experts**. Early feedback suggests that when locals understand *why* a decision is made (backed by data or examples from elsewhere), they are more willing to go along with it, whereas in the past edicts came with little explanation, breeding resistance.
- *Loch Leven:* Social learning had stagnated (stakeholders "weren't learning… just doing the same things"). The recent re-engagement is trying to kick-start learning by direct encounters – e.g., workshops where residents, agency staff, and scientists talk through graphs and maps together. The hope is to create a new culture where local knowledge (e.g., farmer

observations) and scientific knowledge inform each other, leading to more nuanced understanding and less conflict over “what the problem really is.”

6.3.6 Planning and visioning

Restoring degraded lakes requires not just technical measures but also strategic planning and a shared vision that align ecological ambitions with social and economic values. Across the six FutureLakes demonstration lakes, stakeholders have emphasised the importance of clearly articulating what is at stake, setting goal-oriented plans with SMART objectives (i.e. specific, measurable, achievable, relevant, and time-bound), securing broad support for a common direction, and integrating biodiversity and water quality goals with other regional priorities (such as flood safety, water supply, and economic needs). Example of questions to ask during planning (to make it clear what the values are, like what is at stake if we don't protect this):

- What do we want nature to be in this area? What steps to take to achieve that?
- Are people supporting the current plans and directions?
- What do we value above, or alongside, the biophysical values (e.g. cultural values)?
- How can you make sure that you have biodiversity, that you have good water quality in this area, also considering the other important issues? (Not just regarding Nature 2000 as a restriction).
- Which choices do we have to make in this area for water availability and for our safety? And what does it mean on the scale of the country? Where are we dependent on other programmes?

A vision is a future image of how we look at nature (the ecosystem), its biodiversity and the ecosystem services that a lake and its catchment supports, creating a common understanding and a common language.

The following examples from each lake illustrate how “planning and visioning” underpins effective restoration:

Lake Vesijärvi (Finland): A long-term Lake Management Plan is at the heart of Vesijärvi’s recovery, with explicit goals to return this once-polluted lake to good ecological status and prevent the catastrophe of the 1970s from ever recurring. The community-led Vesijärvi Foundation coordinates actions and funding, translating broad goals into concrete steps (“who does what, where, how, when, by which money”) to achieve the shared vision of a healthy, resilient lake. Clearly defined values – including water quality for fisheries and recreation, biodiversity conservation, and local identity – are continually communicated to keep stakeholders motivated and to justify each measure, alongside visible in-lake actions and multi-channel outreach that maintains public support.

Loch Leven (Scotland): At Loch Leven, an early catchment management plan successfully restored water quality by the 2000s, but the subsequent lapse in coordinated planning led to fragmented efforts and loss of momentum. Stakeholders have recognised the need to revitalise a shared vision and improve planning processes: recent community engagement meetings highlighted knowledge gaps and the importance of jointly defining what the lake’s future should look like, from water quality targets to climate resilience. Re-establishing a stakeholder group and updating the plan with clear goals (e.g. controlling nutrient inputs and adapting to warming) are enabling agencies, landowners,

and residents to once again align their efforts and rebuild trust in a common direction for the lake's long-term stewardship, whilst maintaining important activities in the catchment (agricultural production).

Lake Karla (Greece): The restoration of Lake Karla is guided by a holistic vision that balances ecological restoration with human needs like flood protection and irrigation supply. Planning has been goal-oriented and multi-sectoral: the government set clear targets (e.g. re-flood ~38 km² of wetland, use the reservoir to irrigate 8,000 hectares of farmland and mitigate floods) and coordinated multiple ministries and local authorities to achieve them. To integrate Natura 2000 biodiversity obligations with regional development, a new Water Resources Management Organisation for Thessaly now works to align environmental goals with agricultural and safety programmes, engaging farmers, municipalities and NGOs so that protecting the lake's biodiversity is viewed as a benefit rather than a constraint on regional growth.

Lake IJsselmeer (Netherlands): The IJsselmeer region operates under an ambitious, integrative long-term plan that treats flood safety, freshwater supply, nature restoration, and economic uses as equal pillars of a shared vision. A formal multi-stakeholder Platform IJsselmeergebied (with national ministries, provincial and local governments, water boards, NGOs, user groups, and researchers) co-develops and oversees this vision, ensuring all projects are evaluated against the lake's collective goals (from dike upgrades to habitat creation). Detailed objectives (quantitative targets for water levels, nutrient reductions, habitat areas, etc.) and open communication in the Platform's meetings have built trust and buy-in, enabling goal-oriented planning where sectoral interests are aligned and trade-offs are managed through joint decision-making.

Kartuzy Lakes (Poland): In Kartuzy, a clear and compelling vision – to restore four small urban lakes for swimming, recreation and civic pride – galvanised local action. Planning was concrete and SMART: the municipality, advised by university scientists, developed a phased restoration plan (first stop raw sewage inflows, then remove nutrient-rich sediments) with specific targets such as meeting bathing-water standards and eliminating toxic algal blooms. Strong public demand and support from local authorities were instrumental, and by embedding the project in the official regional water management plan (a key dependency for funding) the town secured significant EU and national funds – ensuring that the community's vision of clean, healthy lakes is backed by policy commitments and resources.

Lake Vansjø (Norway): In Lake Vansjø – a vital drinking water source that suffered severe algal blooms in the early 2000s – planning and visioning were driven by a "Morsa" catchment coalition formed to tackle eutrophication. Stakeholders from multiple municipalities, water agencies and the farming community co-created a plan with quantified goals (e.g. halving phosphorus runoff) and a shared vision of a lake that could safely supply water and support recreation again. Guided by Norway's Water Framework Directive programme, this cross-sector partnership implemented coordinated measures (upgrading sewage treatment, agricultural best practices, wetland restoration), and by around 2010 the lake's water quality had markedly improved – demonstrating the power of clear targets, integrated planning, and collective buy-in to achieve a resilient, healthy lake.

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6.4 Communication, outreach & stakeholder engagement (III)

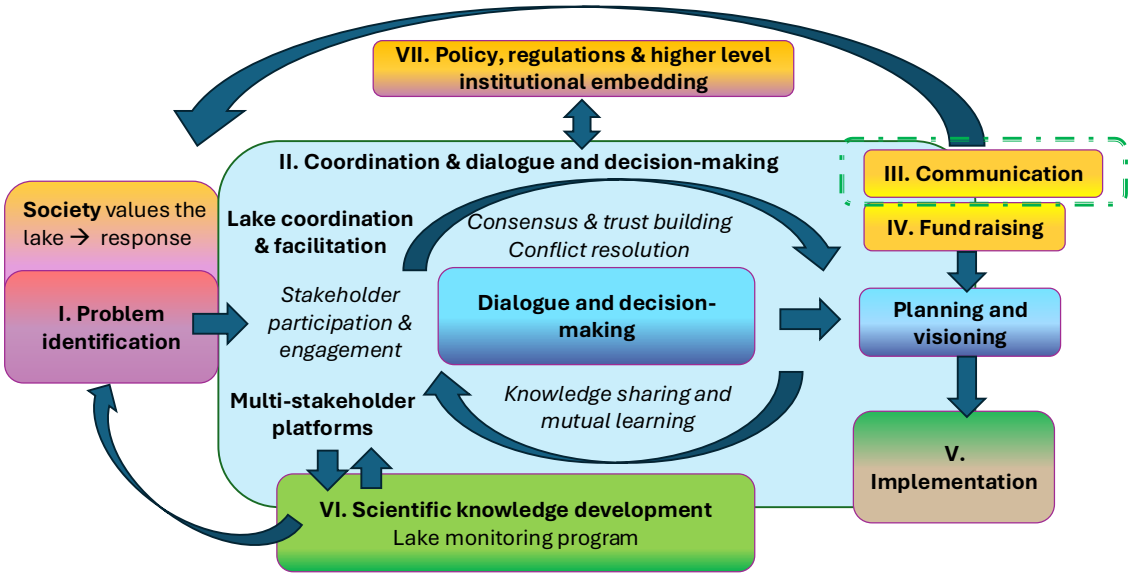

Figure 19 III Communication - The climate-resilient ecosystem-based governance framework. Source: The authors.

Each FutureLakes site has used a variety of outreach tools to build support, share knowledge, and involve stakeholders. Below we summarize key practices per lake – and note where insufficient outreach caused challenges:

Loch Leven (Scotland)

- **Knowledge-sharing:** Recently launched a Loch Leven data portal and contributions to a widely-read local newsletter ("Kinross Community Magazine") to publish monitoring data and explain algal bloom causes. These easy-to-read articles (with graphs) help correct myths and have broad reach in the community.
- **Stakeholder forums:** Revived a multi-party Catchment Management Group and held a series of stakeholder meetings for residents, farmers, anglers, and officials. They offered free food & coffee as an incentive, drawing ~50–60 people total (mostly older residents). These meetings surface local concerns (e.g. development policy) and allow scientists to share 50+ years of research insights directly.
- **School & youth outreach:** Initial attempts include liaising with local schools (to integrate lake topics into classes) and youth clubs, though rigid curricula limit field trips. The team noted few under-40 attendees at public meetings, highlighting a need to better engage younger people (e.g. via social media or in-school presentations).
- **Fragmented messaging:** For years there was no central hub for information, leading to differences in opinions about what caused the lake's problems. Residents (among them some lake experts) blamed it on sewage works. The absence of a common understanding

meant stakeholders were positioning themselves impeding joint action. The recent creation of a local info portal and newsletter articles is directly tackling this gap.

- **Low community turnout:** Efforts to hold open meetings revealed how hard it is to mobilize residents: despite free catering and multiple slots, only ~0.4% of catchment residents showed up. Key groups – notably younger people – remain underrepresented. This lack of broad participation slows community buy-in. For example, without youth engagement, future stewardship of the loch is uncertain. The team is now considering alternative outreach modes (like partnering with youth orgs and using social media) to resonate with a wider audience.
- **Historical mistrust:** In the absence of an ongoing forum in past decades, agencies often worked in silos and "blamed each other" for the loch's issues. Locals, in turn, blamed government and felt nothing was being done. Rebuilding trust after "40 years of no joined-up thinking" takes time – early meetings showed lingering scepticism. Consistent communication and a visible coordinating presence are needed to overcome this legacy.

Lake Karla (Greece)

- **Local stakeholder inclusion:** Historically managed top-down, Karla lacked forums for local voices. Since 2022, the new Management Unit (NECCA) has been actively engaging locals – e.g. organizing a multi-stakeholder workshop on citizen science that drew ~35 participants from village councils, farmers' co-ops, schools, NGOs, and municipal officials. Participants shared observations and ideas, marking one of the first broad community dialogues about Lake Karla's future. The unit now regularly invites local representatives to sit in regional water committees (previously purely governmental), ensuring local feedback (e.g. farmers' needs, cultural values) is heard in decision-making.
- **Cultural reconnection:** Managers leverage Karla's rich cultural history to build public support. They supported establishing a Lake Karla Museum (local initiative) that showcases the lake's heritage – traditional fishing practices and vessels (a UNESCO heritage), folklore, photos from before drainage. By highlighting "what was lost" and now regained, they tap into community pride and nostalgia. This has spurred interest from former fishing families eager to see the lake thrive again. A proposed master plan for ecotourism and fisheries is being co-created with local residents and fishermen – essentially weaving cultural revival into lake management.
- **Outreach on benefits**: Communication now stresses win-win aspects. The unit's staff meet informally with farmers to explain how a healthy lake can improve local groundwater and microclimate (more rain, aquifer recharge).
- **Previously poor communication:** For decades after Karla's 1962 drainage, locals were left in the dark about plans. The massive EU-funded refilling (2000s) was engineered with minimal community input – villagers suddenly saw land re-flooded with little explanation beyond official edicts. This bred mistrust: farmers and officials ended up at odds, viewing each other as adversaries. Until recently, there was no on-site authority to answer questions or adjust operations, so frustrations (e.g. over pump schedules or water allocations) festered.
- **Fragmented messages:** With responsibilities split among ministries, often each agency "spoke" separately – sometimes giving conflicting information. For example, "agri" officials

would encourage irrigation expansion even as ecologists warned of low lake levels. This incoherence meant policies were not trusted or followed. The new Thessaly Water Management Organization is trying to fix this by unifying messaging, but it's very recent. In the interim, the Management Unit has acted as de facto communicator, yet it has no mandate over irrigation rules – limiting its authority in farmers' eyes.

- **Local disengagement:** Years of being excluded from decisions led many locals to tune out official guidance. Farmers, never consulted, came to see the lake and "Athens bureaucrats" as threats to their livelihood. The consequence: uncoordinated water use (e.g. farmers pumping freely with no local water user association). The lack of a local water management body (still pending as of 2025) means there's no trusted local intermediary to translate policies into practice. This gap was stark during the Sept 2023 flood: communication breakdown contributed to chaos (villagers reported getting evacuation info late, and conflicting accounts of why infrastructure failed). The crisis has since become a rallying point to improve outreach – officials recognized that without community buy-in and clear information, even the best plans on paper can falter. HVA International experts were consulted for failures accounting and next steps in management (HVA 2023).

Kartuzy urban lakes (Poland)

- **Community-driven planning:** The turnaround of Kartuzy's four town lakes began with grassroots pressure and the city responding through open dialogue. In 2011, as public anger over foul water peaked, the municipality and university experts held a well-publicized open meeting ("Lake Forum"). Dozens of residents, local business owners, and activists attended to learn about the lake's problems and discuss solutions. Scientists presented possible methods (dredging, aeration, biomanipulation, etc.) with pros/cons, and crucially, listened to residents' concerns (smell, health, property values). This transparent process built consensus around an aggressive restoration plan – when the city later applied for EU funds to dredge the lakes, local support was unified, having been part of the plan's formation.
- **Public progress updates:** Throughout the 2017–2022 restoration, officials kept citizens informed via regular media briefings and signage. Local newspapers ran before-and-after photo spreads of dredging works and reported on water quality improvements in plain language (e.g. "Town Lakes Safe for Swimming Again!"). The city installed information boards around popular lakefront paths describing what work was underway ("Dredging in progress – removing 240,000 m^3 of sludge to restore water clarity") and why it was necessary. By making the process visible, the municipality maintained public patience through years of disruption. Now, as the lakes have cleared, the mayor's office celebrates milestones with the community (ribbon-cuttings for new piers, a "Water Festival" day), reinforcing local pride in the collective achievement.
- **Education & volunteering:** The project spurred local civic groups to get involved in lake care. A school-led "Lake Keepers" programme was created, where students helped monitor basic parameters (transparency, litter collection) and presented findings at town hall meetings. The city also coordinated annual clean-up days, rallying volunteers to remove trash from shores. Seeing neighbours engaged, further cemented a sense of shared stewardship.

- **Past neglect and secrecy:** In the communist era and 1990s, pollution built up without public knowledge – sewage was piped in and nothing was done. The first attempts to address it (e.g. installing an aeration system in the 90s) were implemented with no community input and scant explanation. When those quick fixes failed, residents grew cynical about official competence. The early lack of an outreach strategy meant many townspeople simply gave up on the lakes. It took a crisis (toxic algal blooms making headlines) to re-engage the public and prompt the inclusive approach described above.
- **Initial pushback:** Even once restoration began, there were hiccups in communication. For example, during dredging some locals complained about odour and truck traffic, not realizing it was a sign of long-term improvement. The city addressed this by stepping up messaging – holding an impromptu community Q&A and publishing a fact-sheet ("Yes, the dredging smell is unpleasant, but it means decades of waste are finally being removed – by next summer our lakes will be cleaner and odour-free"). Once informed of the purpose and timeline, complaints largely turned to support. It demonstrated that whenever outreach faltered or was reactive rather than proactive, misunderstandings could arise – but also that clear, empathetic communication could quickly restore trust.
- **Post-project vigilance:** A current challenge is sustaining engagement now that the crisis is solved. There's slight complacency creeping in (some assume "problem fixed forever"). The Kartuzy revitalization team recognizes this and is working to keep outreach ongoing – for instance, they plan to publish annual "State of the Lakes" bulletins and continue school monitoring programmes. Without continuous outreach, there's a risk the hard-won community stewardship could fade, leading to behaviours (like dumping yard waste in the water or ignoring storm-drain stencilling) that could re-pollute the lakes. In short, Kartuzy's experience showed that consistent public communication must be maintained even after visible success, or apathy can return.

Lake Vesijärvi (Finland)

- **Multi-channel public communication**: Lake Vesijärvi is often cited as a model for community outreach. The nonprofit Vesijärvi Foundation leads with an intensive communications strategy. It hosts an annual "Vesijärvi Week" festival featuring public talks on the lake's health, educational exhibits, and guided lake tours. The foundation issues easy-to-read State of the Lake reports each year (with infographics on water clarity, fish catches, etc.) and maintains an open-access data portal where anyone can view water quality data updated in real time. Importantly, they push updates through local media and social media – e.g. posting before/after photos of algae conditions and success stories like the return of underwater plants, to keep the lake's status in the public eye.
- **Stakeholder meetings and transparency:** The Foundation convenes roughly 100 stakeholder meetings a year – ranging from formal board sessions with scientists and officials, to townhall meetings for residents, to small-group meetings with waterfront property owners and anglers. These frequent face-to-face interactions have built a high level of trust. For instance, if a new measure (say, introducing carp traps) is proposed, the foundation first discusses it in a public info session and even solicits volunteers. All meeting minutes and presentations are shared on the foundation's website, so even those not

present can stay informed. The guiding philosophy is "no surprises" – the community feels directly involved in lake management decisions.

- **Citizen participation & stewardship:** Vesijärvi's outreach doesn't just inform – it actively recruits the public as partners. The "Lake Godparents" programme allows any citizen or local business to sponsor the lake with a yearly donation (and in turn receive newsletters and invites to special donor events). Hundreds of locals have become "godparents," giving them a personal stake in the lake's welfare. The Foundation also coordinates volunteer opportunities like mass fish removal days, where local recreational fishers join hired crews to net invasive roach and bream (followed by a community fish BBQ). By tangibly involving people – whether through monitoring, habitat clean-ups, or fundraising – Lake Vesijärvi's managers have cultivated a proud sense of collective ownership in the community.
- **Strong engagement as a success factor:** Vesijärvi's story shows the power of consistent outreach: water quality improved and the community rallied because communication and engagement were strong. That said, the Foundation is keenly aware of pitfalls if outreach were to lapse. For example, they note that many lake restoration projects fail when residents don't see immediate results. To avoid "engagement fatigue," they make results visible (scientific and aesthetic). One tactic is pairing less-visible catchment measures with more obvious aesthetic actions – e.g. building wetlands upstream and periodically mowing excessive reeds along shore for a nicer view. Without that dual approach, the public might lose interest in supporting measures whose benefits are real but harder to perceive. In Vesijärvi's case, outreach is so deeply ingrained that there have been few serious struggles. Possibly the biggest challenge is sustaining funding, which the Foundation addresses by broadening its donor base (hence the godparent programme and benefit events). They recognize that if financial support waned, outreach would suffer (and vice versa), creating a risky spiral. Thus, they treat community relations and fundraising as two sides of the same coin – an innovative governance culture that has so far prevented the kinds of public disengagement seen elsewhere.
- **Comparison to others:** In other Finnish lakes where communication is weaker. Those lakes often see more conflict – e.g. landowners resisting restrictions because they were never brought into the process. Vesijärvi avoided that: from the 1980s onward, even unpopular steps (like banning fishing during biomanipulation periods) were accepted because stakeholders had been part of the discussion and saw the long-term data. In short, Vesijärvi's lack of outreach "failures" underscores how crucial extensive, early, and continuous engagement is to lake restoration success.

Lake Vansjø (Norway)

- **Transparent, frequent communication:** The Vansjø–Hobøl watershed (Morsa) partnership has prioritized keeping all stakeholders informed. The inter-municipal Morsa Water Board publishes a plain-language newsletter ("Morsa Nytt") that updates on water quality trends, actions taken, and upcoming plans, which is distributed to local residents and available online. They hold well-attended annual public meetings presenting monitoring results – e.g. showing phosphorus levels dropping and fewer algal blooms. These forums allow farmers, cabin owners, anglers, and NGO representatives to ask questions and voice concerns directly to the board and scientific advisors. By openly sharing both successes and

remaining challenges, the Board earned a reputation for honesty, which reinforced public trust.

- **On-farm engagement and peer learning:** A key outreach focus has been the farming community (since agriculture is a major nutrient source). Rather than top-down edicts, Morsa relied on personal outreach to farmers: agricultural extension agents visited individual farms to discuss erosion control and offer help (like free advisory plans for fertilizer reduction). They also organized demonstration field days where "champion" farmers who adopted measures (buffer strips, no-till, cover crops) showed neighbours side-by-side plots illustrating reduced runoff. This peer-to-peer element – farmers communicating with farmers – was crucial in overcoming scepticism. Over time, an informal network of local farmers became ambassadors for Vansjø, even speaking at meetings about how protecting water also benefitted their soil and yields. This collaborative style turned what could have been antagonistic (farmers v. environment) into a shared endeavour.
- **Inclusive governance and responsiveness:** The Morsa Board itself is an exercise in engagement – it includes municipal politicians, County authorities, environment agency reps, and stakeholder observers (e.g. a farmers' union rep often attends). Decisions (such as tightening manure spreading rules) are discussed in a consensus-seeking manner. If a stakeholder group raises a red flag, the Board addresses it – for example, when cabin owners worried about impacts of new rules on their property use, the Board held a dedicated meeting in that community to listen and adjust implementation details. This culture of responsiveness has kept opposition minimal. People feel "heard" in Morsa; as a result, compliance with measures (from farmers abiding by winter slurry bans to local councils investing in sewer upgrades) has been exceptionally high.
- **Overcoming initial tensions:** Early on (late 1990s), before the Morsa collaboration solidified, communications were shakier. Some farmers felt unfairly blamed for the lake's algae problems, while townsfolk pointed at farmers – a classic divide. The Board's outreach efforts (described left) were specifically aimed at defusing this tension. By bringing farmers into planning and highlighting shared wins (e.g. less fertilizer wasted = cost savings, cleaner lake = better drinking water for all), they changed the narrative. Without such outreach, Vansjø might have suffered the fate of many watersheds: protracted lawsuits or stalemate. In fact, local officials recall that when strict farm regulations were first mooted, there was talk of protest – but open dialogue and pilot projects turned would-be opponents into partners. The lesson was that proactive engagement and tangible support (e.g. grants for sediment ponds) pre-empted conflict that arises when policies are just imposed cold.
- **Maintaining momentum:** One current challenge is keeping the community engaged now that water quality has improved (the urgency has faded). The Board noticed attendance at public meetings dipped slightly after toxic blooms stopped recurring. To counter complacency, they broadened the conversation to emerging issues like climate change impacts on Vansjø and even hosted talks on microplastics. By continuously "refreshing" the topics and showing that stewardship is ongoing, they remind stakeholders that vigilance is needed to preserve the gains. Board members explicitly communicate that "we're not done" – emphasizing, for instance, that while phosphorus is down, nitrogen and climate-driven runoff surges still require action. Without this frank messaging, complacency could erode the broad support. So far, the community seems to understand the need for long-term care, a testament to the trust built through years of open communication.

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- **If outreach were weaker:** Morsa members acknowledge that their success is somewhat fragile – it hinges on the continued goodwill and voluntary cooperation of many players. They've seen other areas in Norway with similar issues get stuck because stakeholders felt excluded. For Vansjø, a hypothetical breakdown in communication (say, if the watershed coordinator role were eliminated or public updates stopped) could quickly lead to misinformation and suspicion returning. Thus, they treat outreach as non-negotiable. In summary, Vansjø's few early hiccups were overcome by doubling down on engagement, and the avoidance of major outreach failures explains much of its restoration success.

Lake IJsselmeer (Netherlands)

- **Structured multi-stakeholder dialogue:** The Dutch "polder model" of consensus-building is epitomized in the IJsselmeergebied Platform. This formal body brings together national agencies (water, nature, agriculture), provincial and municipal authorities, water boards, NGOs (e.g. nature organizations, fishing associations), and recreation groups. It meets regularly to deliberate on lake management proposals. Crucially, discussions are highly transparent – agendas and minutes are published, and independent facilitators ensure each interest is heard. When issues like water level regulation or fisheries policy arise, the Platform often creates working groups that include experts and stakeholder reps to produce joint recommendations, which are then reported back to the full forum. This process has functioned as ongoing outreach to stakeholder leaders, preventing surprises and giving each sector a sense of ownership in decisions.
- **Public engagement via NGOs and media:** For broader public outreach, the presence of respected NGOs has been key. For example, Natuurmonumenten (a Dutch conservation NGO) spearheaded public-facing campaigns about the ecological restoration of Markermeer. They organized well-publicized boat tours to the new Marker Wadden islands, ran articles in national media ("The return of nature to Markermeer"), and set up a visitor centre. These efforts built widespread public support for funding nature development in the lake. Similarly, the national fishing association communicates with local fishing communities about new fish passages or protected zones, often holding info evenings at harbours. The general public is kept informed through frequent media coverage (the Dutch press extensively covered the Afsluitdijk fish migration river and other IJsselmeer innovations, usually with quotes from Platform stakeholders explaining the benefits). In short, the communication burden is shared: the Platform focuses on stakeholder reps, who in turn communicate to their constituencies and via media, creating a loop of information dissemination.
- **Education and cultural linkage:** Given the cultural significance of the IJsselmeer (a product of Dutch water engineering history), outreach has also taken the form of educational projects. There are traveling exhibits and school programmes (often coordinated by Rijkswaterstaat and museums) about the Zuiderzee/IJsselmeer story, which emphasize current challenges like climate adaptation. By framing modern lake management as part of a proud tradition, these programmes engage citizens' interest and willingness to participate (for instance, a volunteer monitoring network for migratory fish has participants from local communities, ignited by their exposure to these educational initiatives).

- **Complex messaging due to multiple agendas:** One challenge in IJsselmeer communications is that the lake serves many masters – safety, water supply, nature, recreation – and messaging hasn't always aligned. In the early 2000s, for example, conservationists warned Markermeer's ecology was collapsing, while water managers were publicly assuring that "water quality is fine" (focusing only on chemical standards). This mixed messaging confused the public and even policymakers. The Platform was essentially created to harmonize this: now, stakeholders craft integrated messages (e.g. stating that turbidity and habitat loss are issues even if basic water quality is acceptable). It took time to arrive at a unified narrative. In the interim, lack of a clear story meant less public pressure to act until conditions became visibly dire (mass bird declines). The lesson learned was that speaking with one voice increases public resonance – a role the Platform's integrated communications are now fulfilling.
- **Stakeholder fatigue and breadth:** IJsselmeer's governance involves long, technical discussions, which can tax stakeholder representatives. There's a risk that some groups (especially smaller NGOs or local user groups) can't always send delegates to every meeting, leading to gaps in representation. If those voices aren't present, decisions may skew and later face resistance. The Platform has tried to mitigate this by scheduling well-spaced meetings, providing travel support, and consulting absentees separately – but it's an ongoing juggling act. Occasionally, a sector has felt under-heard (e.g. recreational sailors initially felt the new Marker Wadden islands limited open water for boating). When the Platform realized this (thanks to a critical op-ed by a boating club), they proactively engaged that group and adjusted navigation channels. It highlighted that even in a robust structure, outreach must continuously adapt to include all relevant parties. Missing even a small stakeholder can create hiccups that require retroactive outreach and tweaks.
- **General public apathy:** Because IJsselmeer issues are often complex and not as visibly acute (there's no city dumping sewage or neon-green algal crises), wider public engagement can be lukewarm compared to other lakes. The Platform mostly interfaces with organized stakeholders; the average Dutch citizen is not deeply engaged in IJsselmeer policy details beyond high-profile projects. The potential consequence is a lack of broad public mandate for costly measures. To combat this, stakeholders piggyback on iconic Dutch themes – for instance, framing fish migration improvements in terms of national passion for nature and mottos like "connecting our waters again." Still, the communications tend to resonate more when tied to cultural identity (as with Marker Wadden's narrative of pioneering ecological engineering) than when framed in dry technical terms. The risk remains that if the lake's problems don't capture public imagination, securing future resources could be harder. The IJsselmeer team acknowledges this and hence works closely with media and education to keep the lake relevant to the public.

Leveraging history & culture through communication

Historical legacies and cultural values have a significant influence on how each of the six FutureLakes demo basins is managed. Past events shape current challenges and stakeholder attitudes, while local culture and identity affect engagement and decision-making. Lake managers often leverage history and culture through tools like community storytelling, heritage preservation, and consideration of cultural ecosystem services.

Tools such as **storytelling** (sharing the lake's history through newsletters, museums, or events), **heritage mapping** (identifying cultural sites and traditional knowledge relevant to the lake), and **participatory "memory work"** (engaging elders or longtime locals to share experiences) have proven valuable. They help translate the more intangible aspects of a lake's (intrinsic) values into concrete support for policies and measures. Moreover, considering cultural ecosystem services – recreation, aesthetic enjoyment, sense of place – in decision-making ensures that management actions align with what communities care about, thereby boosting compliance and enthusiasm.

Summary

Across these cases, successful lake restoration has gone hand-in-hand with proactive outreach and genuine stakeholder involvement. Tools range from local newsletters and data portals (to arm the public with facts), to formal multi-party platforms (to negotiate interests), to participatory events and education (to build community buy-in and stewardship). These practices have mobilised funding and volunteers, smoothed the implementation of tough measures, and maintained trust through ups and downs. Conversely, when outreach is insufficient or messaging is fragmented, lakes suffer setbacks: misinformation spreads, stakeholders resist, or apathy stalls progress. The clear lesson is that lake governance is as much a social process as a technical one – sustained communication and engagement are critical assets in mobilising support and ensuring long-term resilience of restoration efforts.

6.5 Fundraising (IV)

Fundraising for lake restoration across the six FutureLakes cases illustrate a range of resource mobilisation strategies, from large public infrastructure funding to grassroots and innovative financing. It involved a mix of public, private, and community-based sources, with strategies tailored to each lake's context. Successful approaches included leveraging EU and national funds, forming public–private partnerships, mobilising municipal co-financing, engaging local stakeholders through donations or in-kind support, and aligning restoration goals with broader policy agendas to access diverse funding streams.

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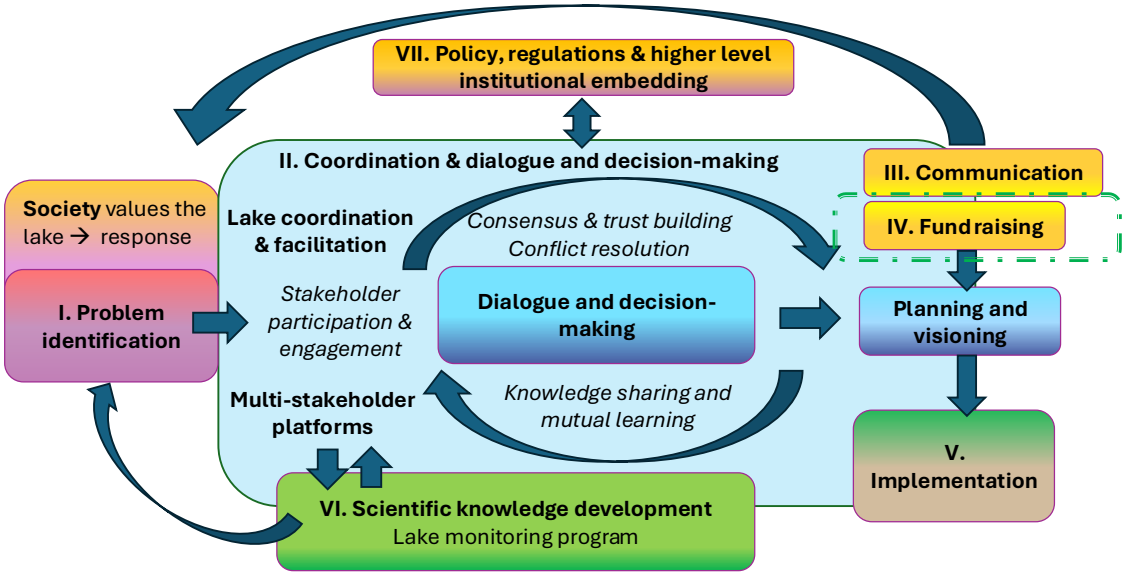

Figure 20 IV. Fundraising - The climate-resilient ecosystem-based governance framework. Source: The authors.

- **Loch Leven (Scotland)** – *Public Agency Funding & Research Support:* Restoration at Loch Leven was primarily financed by government and utility investments. In the 1990s, regional authorities and the water company invested millions of pounds to upgrade sewage treatment and reduce phosphorus loads (driven by UK environmental regulations). This public funding halved external nutrient inputs and was crucial for the lake's recovery. Ongoing scientific monitoring has been sustained by research grants (e.g. UKCEH's long-term lake monitoring programme), but a dedicated local management budget lapsed after initial success. Lack of continuous funding for coordination has been a challenge – after 2007, no single body had core funding for Loch Leven's upkeep, leading to renewed algal blooms. Recently, stakeholders are reviving a catchment group and seeking new government support (e.g. climate adaptation funds for wetland buffers), but at present the lake's management relies on ad-hoc agency resources and the goodwill of researchers. **Key lesson:** strong evidence from science helped unlock substantial one-off public funds (to fix sewage works), but maintaining improvements may require establishing a steady funding mechanism or agency commitment beyond the project period.
- **Lake Karla (Greece)** – *Major EU & National Co-Funding for Restoration Infrastructure:* Lake Karla's regeneration was implemented as the largest environmental project in the Balkans, drawing on EU structural funds and Greek national budgets. Starting in the early 2000s, the project was co-financed through successive development programmes (3rd EU Community Support Framework, then the NSRF 2007–2013), with a total budget of about €245 million. These funds covered the construction of a dam, pumping stations, canals, and reservoir works to partly refill the dried lake. The scale of public investment reflects Lake Karla's multi-purpose goals – flood control, water supply for agriculture and cities, and ecological restoration – which helped justify funding from agricultural and regional development pots in addition to

environmental funds. However, after the capital works were completed by 2018, funding for operations and management became fragmented. Responsibilities (and budgets) are split between ministries (irrigation vs. environment) and local authorities, leading to gaps in maintenance. For example, adequate budget for pump operation and wetland management has at times been lacking due to unclear mandates. Recently, the new regional water management organization is streamlining management, which may improve access to national funds for ongoing needs. **Key lesson:** vast one-time investments can enable lake restoration at scale, but they need to be matched with secure, long-term financing for operations. In Karla's case, aligning institutional roles (now underway) is expected to make it easier to allocate and request the necessary recurring funds from government. Karla's experience also shows the value of packaging restoration within broader socio-economic programmes to attract major funding (framing it as a regional development and climate resilience project, not just an environmental one). Regeneration of Lake Karla

- **Kartuzy Lakes (Poland)** – *EU Structural Funds Leveraged by Local Initiative:* The small urban Kartuzy Lakes were restored through an exemplary use of EU cohesion funds combined with municipal co-financing. After decades of severe pollution, local citizens pressured the town to act. The municipality partnered with university experts to develop a science-based restoration plan (2012–2013). Critically, they succeeded in embedding the project into higher-level water management plans, which made it eligible for external funding. Together they applied for the national Operational Programme "Infrastructure and Environment" (2014–2020) – and their proposal was ranked *1st in the region*, virtually guaranteeing funding. This brought in the bulk of the resources (the EU fund covered ~85% of costs, with the municipality providing the rest). *"We applied for European Union funds and we were successful… it was the Infrastructure and Environment programme 2014–2020"*. The total project budget was about €13–14 million, of which the largest expense (~€8–9M) was for dredging polluted sediments. That dredging was innovatively managed by pumping sludge to the town's wastewater treatment plant for processing into fertilizer, turning waste into a product (albeit provided free to farmers as an incentive). The EU grant also enabled sewer system upgrades to stop ongoing pollution. Throughout implementation, the city tapped its own funds for complementary actions and stayed closely engaged, even dropping an underperforming dredging contractor mid-way – a risk to the budget and schedule that the city navigated by procuring a new company. In the end, the project was completed within the funding period, meeting EU requirements despite the hiccup. **Key takeaways:** Kartuzy's case shows the importance of strategic alignment and collaboration: by getting the project recognized in official water plans and producing a top-quality funding application, a small town secured a very large external investment that it could never have afforded alone. The municipality's willingness to co-finance and actively manage the project (even contributing staff time and political capital) was also crucial. Community support and scientific backing were leveraged to unlock structural funds – an approach transferable to similar communities seeking restoration funds.
- **Lake Vesijärvi (Finland)** – *Public–Private Foundation and Community Donations:* Vesijärvi's long-term rehabilitation has been enabled by a unique public–private lake foundation model. Recognizing that ongoing restoration required dedicated coordination and funding, the City of Lahti and local partners established the Vesijärvi Foundation in 2007. This foundation pools resources from multiple municipalities, local industries, and research

institutes, and it runs fundraising campaigns targeting the community. For example, it launched a popular "Lake Godparent" scheme where citizens and businesses donate money to "adopt" a part of the lake, providing a steady stream of private donations for restoration activities. Municipal governments remain the backbone financiers – the City of Lahti contributes an annual grant to the foundation (treating lake health as basic infrastructure), and neighbouring towns chip in smaller amounts – but the foundation structure allows flexibility to attract other funding. It has secured corporate sponsorships (local utilities and companies often sponsor specific projects or research), and it has won competitive grants (e.g. from EU LIFE and national innovation funds for pilot projects). The CEO of the foundation, emphasizes that while public funding covers core actions like biomanipulation (fish removals) and water quality monitoring, the added private and civic contributions enable extras – education programmes, volunteer initiatives, and continuous outreach that keep Vesijärvi's restoration high on the local agenda. A key to fundraising success has been demonstrating results: as water quality improved markedly in the 2000s, stakeholders saw the payoff of their contributions, building trust. The foundation also communicates transparently how funds are used (publishing annual "State of the Lake" reports and acknowledging donors publicly), which maintains goodwill. **Key lesson:** Vesijärvi shows an effective model for sustaining lake financing through a hybrid governance organization. By institutionalizing collaboration (foundation board seats include city officials, scientists, and community members) and mixing public base funding with private donations, it achieves stable finances and broad buy-in. This model is particularly suited to lakes in developed areas where local stakeholders have both the motivation and means to invest in their lake's health. It also buffers against political shifts – even if city budgets tighten, the foundation can rally community support or tap new sponsors to fill gaps, keeping restoration on course.

- **Lake Vansjø (Norway)** – *Inter-Municipal Cooperation & State Agro-Environmental Funds:* Lake Vansjø's cleanup has relied on a coalition of local governments pooling their resources and tapping national support. In 1999, nine municipalities in the Vansjø–Hobøl catchment formed the Morsa Water Board, agreeing to co-finance a joint catchment restoration plan. Each municipality allocates part of its budget annually to fund a shared watershed coordinator and agreed measures. This collective pot, supplemented by County and State grants, funded a range of actions: upgrading scattered sewage systems, installing farm pollution controls, creating wetlands, and intensive stakeholder outreach. A notable practice was using government agri-environmental subsidies to encourage farmers' participation – for instance, the project distributed about 20,000 free trees for farmers to plant as riparian buffers along streams, an incentive that reduced erosion while building good will. The Board also leveraged Norwegian state programmes (since Vansjø was chosen as a national pilot under the EU Water Framework Directive) for extra funding of technical studies and mitigation measures. Over the two decades, the municipalities collectively invested significant funds, but sharing the burden made it manageable – roughly NOK 1–2 million (€85,000–€170,000 EUR) per year split among nine municipalities, plus in-kind contributions (staff time for local implementation). Importantly, by working together they unlocked state co-financing (matching grants from the Norwegian Environmental Agency for pollution control projects, etc.). The Morsa coordinator indicates that consistent local funding and political commitment were as vital as one-off grants: even after the worst algal blooms subsided, the municipalities kept funding the coordinator and monitoring, preventing backsliding. They also

adjusted strategies to secure new resources over time – recently, the Board has looked into climate adaptation funds (since many water measures double as climate measures) and formed links with research projects that bring in some external financing. **Key insight:** Vansjø's case highlights the power of local collaboration in fundraising. By forming a legal federation, small municipalities spoke with one voice to higher authorities ("we have a plan, we are investing, please support us"), which helped attract steady support. It also shows creative use of existing funding streams – aligning lake restoration with agricultural subsidy programmes and sanitation grants – to finance measures indirectly. The approach was very pragmatic and institutionally grounded, which made it sustainable. Community engagement, too, led to in-kind resources (volunteer labour for tree planting days, etc.), stretching the cash budgets further.

- **Lake IJsselmeer (Netherlands)** – *Integrated Funding & Public-Private Partnerships:* The IJsselmeer, being a large multi-use system, has benefited from integrating budgets across sectors and occasional private co-funding. On the public side, the Dutch national government has dedicated substantial funding through its Flood Safety and Water Management programmes – these core budgets maintain dikes, sluices, and water levels for IJsselmeer's primary functions (flood protection and freshwater supply). In recent years, policy shifts have allowed some of those funds to be used for ecological improvements simultaneously. For example, when reinforcing flood defences, Rijkswaterstaat allocates extra money to incorporate nature-friendly designs (like gradual shores or marshes) rather than bare dikes, thereby funding habitat creation as part of safety projects. A flagship example of blending funding sources is the Marker Wadden project: this archipelago of artificial islands in Lake Markermeer (the southern part of the IJsselmeer complex) was co-financed by a €15 million donation from the Dutch Postcode Lottery alongside roughly €35 million from the national water agency. It was essentially a public–NGO partnership, unprecedented in scale – the lottery (a private charitable fund) covered a huge portion of the ecological costs, while the state covered infrastructural costs. The success of Marker Wadden has since attracted additional public funding. Moreover, the Platform IJsselmeergebied – the regional multi-stakeholder governance body – plays a key role in linking and coordinating funds. Provincial and municipal authorities invest in shoreline recreation, bird habitats, and fisheries initiatives, often in coordination with national projects. By synchronizing goals, they have unlocked co-financing arrangements. For instance, if a province wants a new recreational beach that also serves as flood overflow space, it can cost-share with the Rijkswaterstaat's flood budget. In interviews, the Platform coordinator noted that this integrated approach is crucial: *projects that meet multiple objectives can "pull from multiple wallets."* Another emerging mechanism is tapping EU funds for nature restoration – the Ijsselmeer region has started to receive EU LIFE grants for specific species recovery and is positioning for future Nature Restoration Law funding due to its Natura 2000 status. **Key lesson:** in large systems with diverse stakeholders, a collaborative platform helps braid together different funding streams. This diversification increases the overall resource envelope and buffers against any one source drying up.

Patterns & Lessons Learned: Despite varying contexts, some common fundraising themes emerge:

- **Multi-purpose framing to unlock funds:** All cases tied lake restoration to broader agendas – Loch Leven to public health compliance, Karla to regional development (irrigation, flood control and biodiversity), Kartuzy to urban renewal and tourism, Vesijärvi to community well-being, Vansjø to drinking water safety, IJsselmeer to flood safety and biodiversity. This enabled access to funds not solely earmarked for "environment." Successful fundraisers made sure lake projects were inserted into official plans or programmes (as seen in Kartuzy and Karla), making them eligible for large-scale public funding.
- **Seed funding from government is often critical:** In most cases, significant public money – whether EU, national or municipal – formed the financial backbone. Even Vesijärvi's foundation leans on city grants, and Vansjø's work was built on municipal budgets. External private funds tend to augment (Marker Wadden being a notable exception where private/lottery money led). A lesson is that governance arrangements should position lakes to compete well for public funds (through strong proposals, partnerships, and aligning with policy priorities). Kartuzy is a textbook example: expert guidance and political will converted a local problem into a top-funded EU project.
- **Collaborative governance boosts funding access:** Lakes with formal cooperation bodies (Vansjø's inter-municipal board, IJsselmeer's Platform, Vesijärvi's foundation) are better at mobilizing resources than fragmented governance. These bodies serve as "fundraising coalitions" – they unite stakeholders to pitch for funds and manage them transparently. They also pool small local contributions into a meaningful sum. For instance, Vansjø's municipalities each paid a share to support a full-time coordinator, who in turn was able to secure extra grants and ensure money was used effectively. In contrast, where governance was fragmented (as in Lake Karla's early years), available funds were not always utilized optimally (maintenance suffered even after huge capital investments). Thus, investing in governance structures can pay dividends in fundraising outcomes.
- **Community involvement and co-financing increases buy-in:** Nearly every case saw local stakeholders contributing financially or in-kind. In Kartuzy, the town's willingness to co-fund and residents' pressure were key to landing EU money. In Vesijärvi, citizen donations via the 'godparent' programme both raise money and signal community commitment, which helps convince politicians to continue public funding. In Loch Leven's recent efforts, local angling and conservation groups volunteering time is helping to leverage new grants. This highlights that fundraising for lakes is not just about money – it's also about cultivating stewardship. Even modest local contributions (volunteer work, small donations) strengthen the narrative when approaching big funders: it demonstrates that "we are also investing ourselves," making external funders more willing to match or support.
- **Innovative financing and cost-sharing:** Some lakes have pioneered creative approaches. Vesijärvi's foundation is essentially a local environmental trust that could be replicated elsewhere. Kartuzy's project turned lake sludge into fertilizer, offsetting disposal costs and appealing to circular economy funders. IJsselmeer's projects blend objectives to tap multiple budgets. Vansjø tapped agricultural grants for water goals, an early example of policy integration. A future opportunity is payment for ecosystem services – e.g., downstream utilities or industries paying upstream communities for lake management that secures water supply or carbon storage. None of the cases have a full PES scheme yet, but discussions

in IJsselmeer and Loch Leven circles have considered whether beneficiaries (like breweries using lake water, or tourism operators) might contribute financially.

In summary, fundraising for lake restoration is most successful when it is treated as a shared responsibility and linked to broader benefits. The FutureLakes cases show that there is no one-size financing model – instead, each lake assembled a unique portfolio of funding sources. However, all drew on a combination of top-down support (government or EU funds) and bottom-up initiative (local co-investment or donations). Ensuring long-term money for maintenance remains a challenge in some cases, underlining that fundraising is an ongoing process, not a one-off task. The positive news is that these lakes also demonstrate innovative paths forward: establishing lake-focused entities, aligning projects with big funding programmes, engaging the public in financing, and leveraging partnerships across sectors. These practices and lessons are informing new strategies in the FutureLakes project – for example, developing guidance for lake managers on navigating EU funding schemes, and exploring community crowdfunding for smaller-scale interventions. By learning from each other, lake communities can diversify and strengthen their funding approaches, increasing the resilience of restoration efforts in the long run.

6.6 Implementation practices (V)

Implementation of lake management plans across the FutureLakes cases involved a wide range of grey infrastructural and ecological interventions. While governance, coordination and funding structures varied, this summary focuses on the practical execution of restoration measures and the challenges encountered in delivering them.

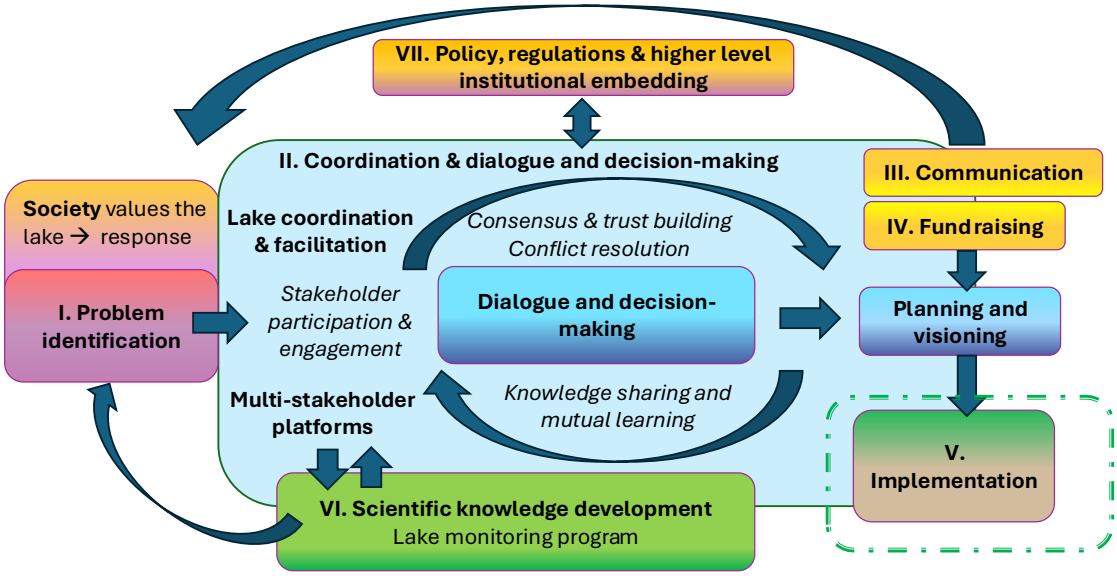

Figure 21 V. Implementation - The climate-resilient ecosystem-based governance framework. Source: The authors.

Loch Leven (Scotland)

Implementation focused on reducing phosphorus inputs through major upgrades to sewage treatment works and agricultural runoff controls. These included tertiary treatment installations[2] and voluntary buffer strips along fields. While these measures initially succeeded in halving phosphorus loads, the resurgence of algal blooms in recent years—despite continued low external inputs—highlighted the challenge of internal loading and climate-driven stressors. The absence of follow-up in-lake measures (e.g. sediment capping or biomanipulation) and limited operational flexibility constrained further progress.

Lake Karla (Greece)

Lake Karla's implementation was dominated by large-scale engineering: dam construction, canal systems, and pumping infrastructure to re-flood the former lakebed. While technically successful in restoring open water, the ecological functioning of the lake remains unstable. Challenges included the lack of operational protocols for water level management, absence of a local authority to manage infrastructure, and insufficient integration of ecological needs into the engineering design. The 2023 flood crisis exposed these gaps, prompting a shift towards more adaptive and integrated operational planning.

Kartuzy Lakes (Poland)

Kartuzy's implementation was highly structured and technically intensive. Key actions included full sewerage system upgrades, large-scale dredging of nutrient-rich sediments, and phosphorus inactivation using aluminium salts. Biomanipulation (fish removal) complemented chemical treatments. A major challenge was the underperformance of the initial dredging contractor, which required contract termination and re-tendering—delaying the project and testing the municipality's project management capacity. Despite this, the project was completed within the EU funding timeframe, and water quality improvements were significant.

Lake Vesijärvi (Finland)

Vesijärvi's implementation is a model of long-term adaptive management. After initial sewage diversions in the 1970s, the lake underwent decades of biomanipulation, with annual removal of tens of tonnes of coarse fish. Complementary measures included wetland construction, pilot sediment treatments, and shoreline vegetation restoration. The Vesijärvi Foundation oversees these actions, adjusting them based on intensive monitoring. A key challenge is the need for continuous effort—without annual fish removals and catchment controls, the lake risks reverting to eutrophic conditions. Climate change has added new pressures, requiring further adaptation of operational strategies.

Lake Vansjø (Norway)

Implementation in Vansjø was catchment-focused, targeting both point and diffuse pollution. Municipalities upgraded sewage systems, while farmers adopted best management practices (BMPs) such as buffer strips, reduced tillage, and constructed wetlands. The Morsa Water Board's working groups coordinated implementation, and a full-time watershed coordinator ensured follow-through. A key success was the voluntary uptake of measures by farmers, supported by advisory services and

[2] The final, advanced stage of treatment designed to produce high-quality effluent that meets stringent safety and environmental regulations for discharge into sensitive areas or for reuse purposes (like irrigation or industrial use).

incentives. Challenges included maintaining momentum after early successes and expanding the scope to address nitrogen and climate-related pressures.

Lake IJsselmeer (Netherlands)

Implementation in IJsselmeer is characterised by large-scale, multi-objective projects. The Marker Wadden islands were constructed to improve habitat and reduce turbidity, blending ecological goals with sediment management. Other actions include fish migration infrastructure (e.g. Afsluitdijk fish passage) and flexible water level pilots. Implementation is coordinated through the Platform IJsselmeergebied, which ensures alignment across sectors. Challenges include the complexity of balancing flood safety, water supply, and ecological goals, and the slow pace of consensus-based planning. However, the integration of ecological measures into infrastructure upgrades has proven effective in delivering multiple benefits.

In summary, implementation success across the FutureLakes cases hinged on a combination of technical execution, adaptive management, and stakeholder involvement. While each lake faced unique challenges—ranging from contractor issues to institutional fragmentation—common success factors included strong local leadership, continuous monitoring, and the ability to adjust measures based on evolving conditions. These experiences offer valuable insights for future lake restoration efforts, particularly the importance of pairing technical interventions with operational flexibility and long-term maintenance planning.

6.7 Knowledge development and monitoring (VI)

All six lake cases invested in science and monitoring to guide restoration, though with varying scope and success. Long-term data collection proved invaluable in diagnosing problems and adapting management, whereas gaps in knowledge and continuity posed challenges in some projects.

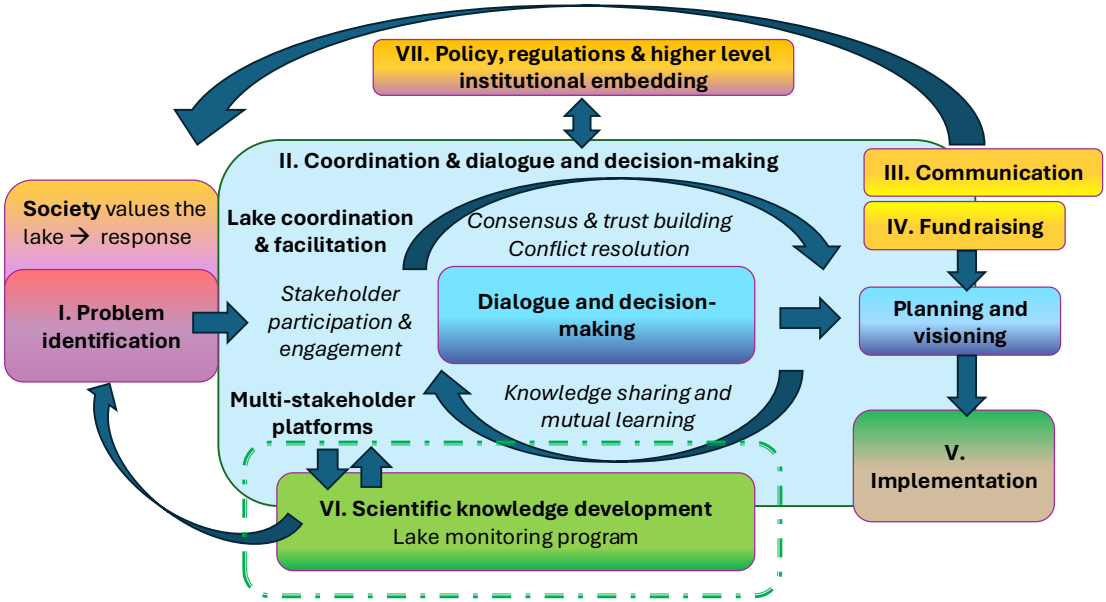

Figure 22 VI. Scientific knowledge development - The climate-resilient ecosystem-based governance framework. Source: The authors.

Loch Leven (Scotland): Long-term ecosystem research. Loch Leven hosts one of the world's longest lake monitoring programmes – UKCEH scientists have sampled the loch fortnightly year-round since 1968. This 50+ year dataset has been instrumental in understanding nutrient dynamics and tracking recovery. For example, data showed that after sewage upgrades in the 1990s, phosphorus and algal levels dropped, confirming the efficacy of those measures. The monitoring also revealed new challenges: by the mid-2010s, despite low external P loads, algal blooms resurged due to warming-driven internal loading. This evidence prompted managers to consider additional steps (e.g. sediment treatment, climate adaptation). A recent initiative launched an online data portal to share Loch Leven's rich data with local stakeholders and decision-makers. **Challenge**: While scientific knowledge at Loch Leven is strong, for years there was no single body to translate it into coordinated action (the catchment group lapsed post-2000). As a result, some early warning signs (increasing water temperature, sediment P release) were not addressed until problems reappeared. This underscores that data alone isn't enough – it must feed into governance (a gap now being closed by reviving the management group and open data sharing). Loch Leven Monitoring Data Now Available Through New Online Portal – Open Data News Wire

Lake Karla (Greece): Reconstructing knowledge after decades without a lake. Draining Lake Karla in 1962 meant local ecological knowledge was largely lost for 40 years. Implementation of the 2009–2018 reflooding relied heavily on expert studies (hydrological models, water quality projections) by national institutes and consultants, since no recent in-lake data existed. Initial monitoring after refilling was limited and fragmented – different agencies tracked irrigation usage, floods, and bird counts, but there was no integrated ecological monitoring programme. This lack of baseline data made it difficult to set management targets or anticipate issues (e.g. nutrient release from newly submerged soils). **Challenge**: Establishing a cohesive monitoring framework has been slow. Only in recent years has a local unit (under NECCA) begun regular water sampling and aquifer monitoring and organized a citizen science workshop to involve the community in data collection. Lake Karla's experience highlights how

a knowledge gap can hinder adaptive management – problems like rapid algal growth and botulism outbreaks caught authorities off guard. Going forward, the new regional water authority is prioritising a unified monitoring strategy (combining hydrological sensors, water quality sampling, and biodiversity surveys) to build the knowledge base needed for informed lake management. Interestingly, the regeneration of the lake has also affected the water cycle with more rainfall on the neighbouring farmer fields. These rainfall data is captured by the local university. As such the lake provides ecosystem services in the form of rainfall to farmers, supporting agricultural production.

Kartuzy Lakes (Poland): Diagnostic studies guiding intervention. In Kartuzy, strong scientific input was a turning point. Earlier local efforts lacked limnological expertise – e.g. in the 1990s, the city installed an aeration system hoping to reduce algae, which failed because the underlying nutrient inputs were not addressed. These "quick fix" attempts wasted funds and illustrated a knowledge gap in the community. Recognising this, the municipality commissioned the University of Warmia & Mazury to conduct a comprehensive lake study (2012–2013). The researchers produced a detailed diagnosis of pollution sources, quantified internal nutrient loads, and modelled restoration scenarios. This knowledge base underpinned the successful EU-funded restoration (dredging and P-inactivation), and scientists continued to advise during implementation (e.g. adjusting alum dosing). **Success**: The project established a routine monitoring programme: the city now regularly tests water chemistry and biota in the lakes, with university experts reviewing the data annually. This post-project monitoring confirmed dramatic improvements (e.g. clear water, low chlorophyll) and helps ensure any signs of re-eutrophication are caught early. **Challenge**: Going forward, maintaining scientific support is critical – the city's capacity for advanced analysis is limited, so they plan to keep an advisory agreement with limnologists for periodic check-ups. Kartuzy's case shows the value of investing in upfront research and external expertise to design effective interventions, and the importance of continued data collection to secure long-term outcomes.

Lake Vesijärvi (Finland): Intensive monitoring and adaptive learning. Vesijärvi's rehabilitation has been science-led from the start. Since the 1970s, local authorities and researchers (e.g. at SYKE) have run an extensive water monitoring programme – covering water quality, plankton, and fish in all five basins – making it one of the most comprehensively tracked lakes in Finland. The data is compiled in annual "State of Lake Vesijärvi" reports, which highlight trends and inform management decisions. This long-term record (over 30 years) shows clear improvements in surface phosphorus and nitrogen levels (now generally "good"), but also flags emerging issues like worsening water clarity in some bays. Vesijärvi's restoration has been markedly adaptive thanks to this knowledge. For example, monitoring in the 2000s revealed that oxygen depletion in deep areas was releasing sediment phosphorus, thwarting recovery. In response, an aeration system was tried – but when data showed it had little effect, it was discontinued in favour of intensified biomanipulation (mass fish removal). Similarly, the Foundation piloted new methods (e.g. test wetlands, mussel reintroduction) and scaled them up or dropped them based on measured results. **Success**: The close partnership between the Vesijärvi Foundation, researchers, and the city of Lahti ensures a strong feedback loop: scientific findings translate into management tweaks almost annually. The foundation also engages the public in knowledge-sharing – open events on monitoring results, and even volunteer monitoring (e.g. a network of citizens measuring Secchi depth). This transparency maintains support and additional "eyes on the lake." **Challenge**: The breadth of monitoring is resource-intensive. It relies on a patchwork of funding (municipal budgets for compulsory monitoring, plus foundation-raised funds for extra studies). Securing sustained funding for research and keeping up with new threats (like climate-driven changes in the food web, as seen in the hot summer of 2024) will be ongoing challenges. Nonetheless,

Vesijärvi's case exemplifies how long-lasting, robust monitoring coupled with willingness to learn and adapt can drive continuous improvement in lake health. Extensive monitoring of the state of Lake Vesijärvi is a real source of pride - Hollola

Lake Vansjø (Norway): Targeted monitoring to measure progress. After severe algal blooms in the early 2000s, the Vansjø/Morsa catchment committee made comprehensive monitoring a pillar of its action plan. With help from the Norwegian Institute for Water Research (NIVA), an operational monitoring programme for the entire watershed was established in 2005. This programme involves monthly sampling at river inflows and in Lake Vansjø's basins, tracking nutrient concentrations, algal counts, and oxygen levels. Data are reported to the Morsa Board and stakeholders annually. Crucially, this allowed the team to quantitatively assess the effects of mitigation measures. For instance, monitored phosphorus levels in the lake's western basin dropped significantly by the late 2000s (from hypereutrophic to mesotrophic range), correlating with the implementation of farm BMPs and sewage upgrades. Seeing these improvements in the data helped bolster local political support to continue and expand measures. The Vansjø group also used monitoring to learn and adjust: when results showed total P was declining but chlorophyll wasn't dropping as fast as expected, they investigated and identified nitrogen limitation issues and food-web factors, leading them to address nitrogen sources and undertake fish stock management. Success: Vansjø's experience shows how a relatively modest investment in monitoring (~400k NOK/year, co-financed by local authorities) provided the evidence base to secure and refine restoration actions. It turned what could have been a contentious blame game into a shared, factual understanding of the lake's response, keeping stakeholders aligned. Challenge: One issue was ensuring data utilization – translating technical monitoring reports into plain-language updates that farmers and municipal leaders could grasp. The Morsa Board tackled this by issuing easy-to-read newsletters highlighting key indicators (e.g. "phosphate levels lowest in 20 years – our efforts are working" or warning when trends stagnated). Overall, Vansjø demonstrates that even in a large catchment, strategic monitoring focused on key parameters can drive adaptive management and maintain momentum. Monitoring Vansjø-Hobølvassdraget | NIVA

Lake IJsselmeer (Netherlands): Research-informed management in a complex system. IJsselmeer's monitoring is extensive (Rijkswaterstaat continuously tracks water levels, quality, and ecology), but a notable aspect is how knowledge development was used to resolve uncertainties and guide interventions. In the 2000s, the cause of Markermeer's ecological stagnation was debated – was it excess nutrients or resuspended sediment? This led the IJsselmeer Platform to commission joint fact-finding research, bringing together scientists to synthesize data. The consensus from studies (e.g. Noordhuis 2010) was that fine sediment and lack of habitat diversity were key issues, shifting the management focus towards sediment management and nature development. This directly paved the way for innovative measures like the Marker Wadden islands, essentially a science-driven solution to bind sediments and regenerate ecosystems. Ongoing scientific monitoring of these new islands (e.g. tracking water clarity improvements and species colonization) provides feedback to adjust island design and operation. Moreover, the IJsselmeer region has embraced pilot projects as learning tools – from small-scale field trials of flexible water levels to experimental fish passages – to gather evidence before wider rollout. **Success**: The integration of research institutions (e.g. Wageningen Marine Research, Deltares) into the Platform's working groups means policy decisions are grounded in up-to-date science. For example, ecological monitoring results are regularly presented to stakeholders, helping build support for adaptive measures like temporarily raising winter water levels to benefit

wetlands. **Challenge**: Given the lake's vast scale and multi-use nature, monitoring data can be complex and sometimes contradictory (different indicators improving while others lag). This complexity required sophisticated models to interpret – at times leading to delays while experts reconciled findings. However, the Platform's collaborative approach to knowledge (open data exchange, joint studies) has largely turned this challenge into a strength, ensuring that even contentious issues (like fisheries impacts or climate change scenarios) are discussed on the basis of shared evidence.

Patterns and lessons: Across these lakes, long-term monitoring and dedicated research were fundamental to success. Loch Leven, Vesijärvi, and Vansjø show that continuous data over decades not only measures improvement but also catches emerging problems, enabling timely adaptation. In Kartuzy and IJsselmeer, targeted studies plugged knowledge gaps and helped design effective interventions where local know-how was initially lacking. A common lesson is the importance of making data accessible and actionable: whether through public portals (Loch Leven), annual "state of the lake" reports (Vesijärvi), or plain-language summaries for stakeholders (Vansjø), turning monitoring results into shared knowledge builds trust and guides collective action.

Another insight is the value of adaptive learning. All projects encountered surprises – Karla's re-flooded lake behaving unpredictably, Loch Leven's climate-induced algae surges, Vesijärvi's mixed trends in water quality. The nimbler projects had structures to learn and adjust (e.g. Vesijärvi Foundation convening experts to revise plans each year; IJsselmeer's Platform iterating through pilot outcomes). This adaptive capacity often hinges on strong knowledge networks: collaboration between managers, scientists, and sometimes citizens. Conversely, where knowledge development was patchy or siloed (Karla's early years, Kartuzy before the university study), restoration suffered false starts or inefficiencies.

In summary, the FutureLakes cases underline that "knowing your lake" through robust science and monitoring is critical to restoring it. Investing in knowledge – and maintaining that investment long-term – yields dividends in more effective and resilient lake management. Each lake's journey illustrates that while money and organization matter, it is sound knowledge that ultimately guides restoration to success and helps overcome the inevitable ecological and social challenges along the way.

6.8 Policy, regulations & higher-level institutional embedding (VII)

Higher-level policies, legal frameworks, and institutional mandates played a pivotal role in both enabling and constraining lake restoration across the six FutureLakes basins. In general, supportive national/EU policies provided crucial momentum – e.g. compliance with EU water directives or integration into strategic programmes – while gaps or fragmentation in institutional mandates posed challenges. Below we compare each case.

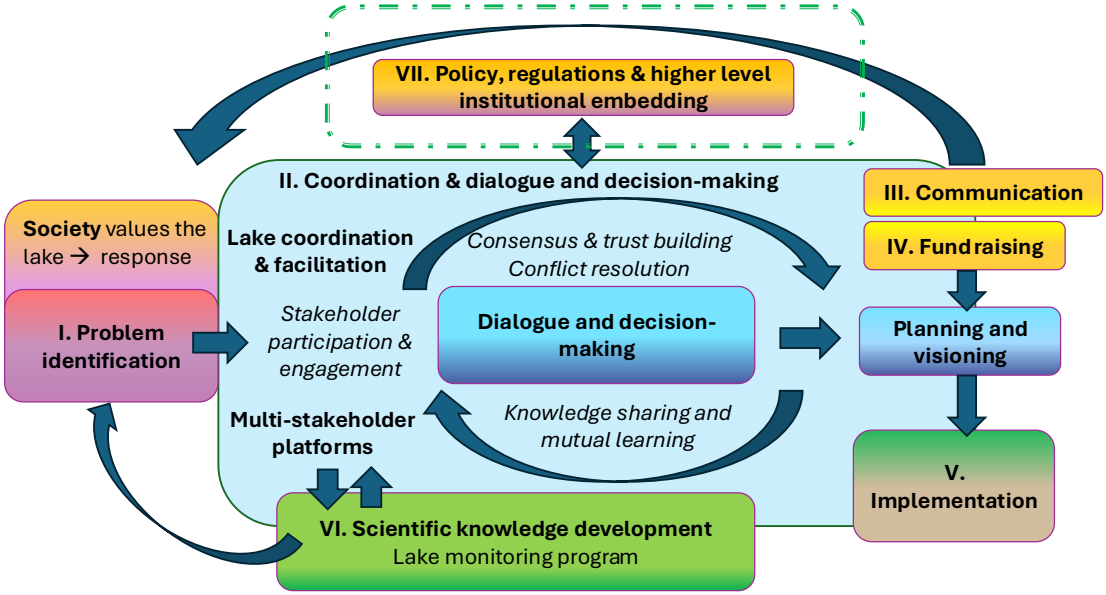

Figure 23 VII. Policy, regulation & higher-level institutional embedding - The climate-resilient ecosystem-based governance framework. Source: The authors.

Loch Leven (Scotland): Enabler: UK environmental regulations drove early action – the loch's failing water quality in the 1980s violated national targets, prompting investment in sewage upgrades. Loch Leven is also a protected site (SSSI and Natura 2000 SPA), which added legal impetus to reduce pollution and monitor ecological status. **Challenge**: No single authority was legally mandated to manage the catchment holistically. After initial targets were met, the absence of a statutory catchment body meant responsibility defaulted to individual agencies (SEPA for water quality, NatureScot for conservation) acting under their narrow remits. This fragmented institutional setup made it hard to address emerging issues (like climate-driven algal blooms) that fell between mandates. Only recently has a voluntary catchment group been re-established to fill this governance gap.

Lake Karla (Greece): Enabler: The lake's reconstruction was framed as a national development project co-funded by the EU. Embedding Karla's restoration in Greece's EU Structural Funds programme ensured high-level political support and ~€245M investment. Karla is now part of a Natura 2000 area, theoretically ensuring ecological protection in law. **Challenge**: Institutional fragmentation severely hindered Karla's management post-restoration. The Ministry of Agriculture built the reservoir for irrigation, while the Environment Ministry oversaw biodiversity – with no integrated mandate or coordinating law bridging the two. The result was unclear responsibility (e.g. who controls lake water levels) and weak enforcement of environmental flows. Only after extreme flooding in 2023 did the government create a Regional Water Management Agency to consolidate authority. This late institutional embedding – essentially a policy correction – was needed to align Karla's operation with Greek water law (which, under the EU Water Framework Directive, requires basin-level management that had been lacking).

Kartuzy Lakes (Poland): Enabler: Despite being small urban lakes, their restoration aligned with higher-level policy via the EU Water Framework Directive (WFD). The lakes were classified as heavily polluted water bodies in Poland's WFD river basin plan, making them eligible for EU cohesion funding. The project's inclusion in the national Operational Programme Infrastructure & Environment was a critical

institutional embedding – it climbed to the top of regional priorities, unlocking 85% co-financing from EU funds. **Challenge**: At the national level, there was no specific law or programme for urban lake restoration – Kartuzy relied on local leadership and the ad hoc opportunity of EU funds. A potential vulnerability is that ongoing protection of the restored lakes relies on general environmental laws (e.g. wastewater discharge standards) and local ordinances. Consistent enforcement of land-use and pollution regulations in the catchment will be needed to safeguard these gains, since no dedicated legal status (like a protected area) was conferred on the lakes after cleanup.

Lake Vesijärvi (Finland): Enabler: Strong policy continuity and local institutional support underpin Vesijärvi's long-term efforts. The lake's recovery became a city policy priority for Lahti, reflected in municipal budgets and the creation of the Vesijärvi Foundation (a public–private body) to implement restoration. Nationally, Finland's enforcement of the EU Urban Wastewater Directive in the 1970s–80s led to sewage diversions that were the foundation of Vesijärvi's revival. Vesijärvi's monitoring and goals are embedded in Finland's WFD plans – two basins still classed as moderate status keep pressure on authorities to continue measures. **Challenge**: One notable challenge is that the Vesijärvi Foundation has no formal regulatory power – it operates through influence and partnerships. While this flexible institution has worked well, it means the lake's restoration is not codified in law but depends on sustained goodwill and policy support from city and state actors. So far, this hybrid model has thrived (helped by Lahti's political will and citizen backing), but it could be vulnerable if policy priorities shift, since it lacks a binding legal mandate.

Lake Vansjø (Norway): Enabler: Vansjø's clean-up was strongly guided by the EU Water Framework Directive, even though Norway isn't an EU member. Norway chose Vansjø (Morsa catchment) as a pilot to meet WFD objectives early. This higher-level policy driver provided structure (e.g., setting "Good Ecological Status" as a clear goal) and access to some state resources. It also forced cross-sector cooperation – municipalities, agriculture authorities, and the County Governor aligned their policies (e.g., tighter manure spreading rules, subsidies for buffer strips) with WFD targets. **Challenge**: Norway had to invent new local institutional arrangements since it historically lacked watershed authorities. The solution was an inter-municipal agreement, but this had no basis in national law initially – it was a voluntary coalition. Despite its success, one challenge was ensuring compliance from all parties without a legal enforcement mechanism. Over time, the Morsa Board gained quasi-official status as part of the national water management system (when Norway transposed the WFD into national regulation around 2006, Morsa's structure was recognized), but its authority still rests on consensus. In practice this worked, though occasionally a municipality would lag on investments, requiring soft political pressure rather than legal compulsion. Overall, Vansjø demonstrates that high-level policy (WFD) can catalyse local action, but the absence of a formal basin authority in law had to be overcome by creating a cooperative institutional embedding from the ground up.

Lake IJsselmeer (Netherlands): Enabler: IJsselmeer is deeply embedded in national water policy and EU environmental law. It is designated under the Natura 2000 network (Birds and Habitats Directives) which legally obligates the Netherlands to improve and maintain certain ecological values. Concurrently, it is central to the Dutch Delta Programme, which provides a high-level framework (and funding) for integrating flood safety, freshwater supply, and ecosystem restoration. The formation of the IJsselmeer Platform – essentially a policy integration body – has meant that measures like Marker Wadden and fish migration routes are embedded in official national programmes (PAGW – Programmatic Approach for Large Waters). These projects are thus backed by clear mandates and budgets, rather than being one-off initiatives. **Challenge**: Historically, sectoral policies led to siloed

management – e.g., rigid water level regulations for agriculture conflicted with ecological needs for fluctuation. Changing such entrenched regulations has been slow. It took years of research and negotiation to adjust water level policies (a minor winter level drop trial was only recently approved after demonstrating no harm to flood safety). Additionally, multi-tier governance can delay decision-making: four provinces, multiple ministries, and water boards all have statutory roles in IJsselmeer, so aligning them requires continuous effort (the Platform's consensus approach, while an enabler of integration, can be a hurdle for rapid policy shifts). Nonetheless, the IJsselmeer case shows how strong top-down policy embedding – via national legislation (Water Act, Nature Conservation Act) and strategic programmes – ensures that lake restoration objectives remain on the agenda and are pursued in tandem with other societal goals.

General patterns and lessons from all lakes: High-level policy and regulatory frameworks have generally been crucial enablers of lake restoration, providing goals (e.g., Water Framework Directive – WFD's "good status"), legal pressure (Natura 2000 obligations, pollution limits), and funding channels. Several lakes benefited from being embedded in a broader policy initiative:

- EU directives (WFD), Urban Wastewater Directive, Nitrates Directive) spurred action in Loch Leven, Karla (EU Bird and Habitat Directives, Natura 2000 WFD, Ramsar), Kartuzy, Vesijärvi, and Vansjø.
- European Union's **structural funding** played a pivotal role in funding the reconstruction of Lake Karla.
- Inclusion in national strategic programmes (Delta Programme for IJsselmeer, Greece's ESPA(ERDF) (funding for Karla) unlocked resources and political backing.

On the other hand, institutional fragmentation or policy gaps were common challenges. In Karla and Loch Leven, the lack of an integrated management authority or clear legal mandate for coordination hampered coherent implementation. Vansjø and Vesijärvi illustrate that voluntarism and local initiatives can fill these gaps, but formal embedding (through agreements or new institutions) eventually strengthens and sustains efforts. A key lesson is the need to embed lake restoration in the statutory institutional framework – either by assigning it to an existing body with a clear mandate or by creating a new one supported by law or official policy. Lakes that achieved this (e.g., IJsselmeer's Platform formalized via ministry cooperation, Vansjø's Board later recognized under Norway's water regulations) have more secure long-term governance.

Another insight is the importance of policy alignment across levels. When local, regional, and national policies all support the same objectives, restoration accelerates. For instance, in Vansjø, local voluntary measures were amplified by national agri-environment schemes and the EU's water directive expectations, creating a virtuous alignment. Conversely, misalignment causes friction – as seen in Karla, where national irrigation goals initially overshadowed ecological needs, or in Loch Leven, where catchment land-use decisions (like new housing approvals) sometimes conflicted with water protection aims due to different authorities handling them.

In conclusion, effective lake restoration is bolstered by being anchored in supportive policies and institutional structures beyond the local scale. Clear legal targets, well-defined responsibilities, and integration into higher-level programmes emerge as key enablers, while ambiguity in mandates or policy conflicts are common obstacles. Future efforts should seek to secure a strong policy mandate – ensuring, for example, that lake restoration objectives are written into regional plans, protected area

Funded by the European Union

management plans, or basin statutes – and to harmonize the actions of various institutions under a shared legal framework. This high-level embedding provides the authoritative backing and continuity needed for restoration initiatives to persist and succeed over the long term.

7. Comparison of frameworks across key dimensions

Multiple frameworks guide lake basin governance, each with different emphases. Here, we compare the FutureLakes unified governance framework (FutureLakes Deliverable 2.2) with four other approaches: Integrated Lake Basin Management (ILBM), Adaptive ILBM (AILBM), MoReCo (Monitoring–Restoring/Protecting–Community Engagement), and the EPIC Response framework. We examine how they differ in structure, guiding principles, and suitability for climate-resilient, adaptive governance. We also discuss the best application and target audience for the FutureLakes framework, envisioning it as a self-assessment tool and guidance for lake managers and other relevant actors requiring concrete insights into lake governance.

Despite different origins, these frameworks share a common trajectory toward integrative, adaptive, and participatory governance. All recognize that effective lake management (and water management broadly) must combine sound institutions ("rules of the game") with inclusive processes ("people playing the game") and be able to adjust to new challenges.

Structure vs. Process: ILBM and EPIC are more structure-oriented – they provide a blueprint of "what elements to have in place." ILBM says have institutions, laws, etc., and EPIC says have policies, plans, etc. In contrast, FutureLakes, AILBM, and MoReCo put more emphasis on process and quality: how well are these elements working? Is there trust? Is learning happening? For example, ILBM would ask "Do you have a monitoring programme?" while FutureLakes/MoReCo ask "Is the monitoring producing useful knowledge and is it acted upon promptly?" Thus, ILBM/EPIC set the stage, and FutureLakes/AILBM/MoReCo evaluate the process and interactions. A lake governance team might use ILBM/EPIC to ensure no major component is missing (e.g., a law or funding mechanism), then use FutureLakes or AILBM to assess if those components are effective (e.g., law is enforced, funds are sustained, stakeholders find the process legitimate).

Formality and Informality: FutureLakes explicitly bifurcates formal vs. informal aspects, ensuring that "soft" aspects like trust and leadership are not overshadowed by formal criteria. ILBM originally lumped them (hence participation was just one pillar among six, possibly underemphasized) and EPIC, focusing on government capabilities, might risk focusing more on formal side (though it does advise public participation). MoReCo inherently merges formal and informal – its community axis is informal, its monitoring loop is more technical/formal, and they interlock. AILBM also blends them by evaluating outcomes that result from both. The major difference is **language and perspective**: EPIC talks the language of government policy ("integrate plans, invest in infrastructure" etc.), whereas MoReCo talks the language of adaptive management practitioners ("engage community, set indicators, adjust actions"). FutureLakes being a research-project result, acts as a bridge – it's conscious of policy needs (coordination, plans) and of practice needs (trust, adaptation). Notably, **all frameworks acknowledge human and ecosystem dimensions**, but with different weight. ILBM from 2005 did so at a high level; by 2024 MoReCo gives them equal weight in a unified model.

Dealing with climate change: Each framework has evolved to put more emphasis on climate adaptation. ILBM didn't explicitly mention climate in early 2000s (the focus was general sustainable

management), but recent ILBM applications incorporate climate scenarios (Nakamura, 2022). AILBM was inherently motivated by climate resilience – e.g., Songkhla's case was about how to adapt governance to climate impacts (Cookey et al., 2016). The FutureLakes framework is squarely focused on climate-resilient governance. Many of its examples involve climate-driven issues (e.g. warming climate causing algal blooms) and recommendations like integrating flood/drought planning and using nature-based solutions in lake plans. MoReCo's authors cite climate change as a key reason their framework is needed: it is meant to be *preparatory* as well as reactive, highlighting early detection of change and addressing multiple stressors that may worsen with climate shifts (Cianci-Gaskill et al., 2024). EPIC is entirely about climate extremes – it's perhaps the most climate-focused, but on a specific axis (hazards). If we consider adaptive capacity as a measure of climate resilience, AILBM and MoReCo explicitly cultivate it by design, FutureLakes highlights factors that contribute to it, ILBM provides a foundation that needs to be made adaptive, and EPIC strengthens the broader regime (laws, funding, etc.) to support adaptation. They are complementary pieces: e.g., a lake could have a robust EPIC-style national support (climate-informed policies, emergency funds) and a robust MoReCo-style local management (community engaged and agile) – together that would be an ideal climate-resilient governance scenario.

Audience and applicability: ILBM and EPIC are aimed at policy-makers and planners at fairly high levels – ILBM to national environment ministries or basin agencies, EPIC to national governments and international development agencies. They provide a common language for officials (pillars, components) and are useful for making the case for reforms or investments (e.g., "we need financing mechanisms for our lake" – ILBM gives that legitimacy). FutureLakes and MoReCo, being products of ecological and social research, are aimed at practitioners and local/regional managers who are trying to make governance work on the ground. The FutureLakes framework could guide a workshop of lake stakeholders to self-identify what's working or not (like "we gave ourselves a low score on Trust – how do we improve that?"). MoReCo is practically a manual for lake managers to do adaptive management with community involvement. AILBM sits somewhat in between: it provides a scholarly evaluation tool that could be used by either consultants or agencies wanting an external assessment of their governance performance.

Scientific underpinnings: Academically, ILBM's pillars echo older IWRM and governance theory, AILBM draws on resilience theory and Ostrom's principles for governing the commons (Ostrom, 1990), MoReCo draws on environmental monitoring and community engagement literatures (the authors discuss citizen science, translational ecology, etc.), and EPIC draws from disaster risk management and climate adaptation studies. Despite this, they all talk to each other. For example, MoReCo cites the need to address the critique that many regulations are *reactive* and fail to protect lakes (Zellmer & Glicksman, 2013; Spears et al., 2022) – ILBM was also critiqued on similar grounds that it didn't prevent lakes from deteriorating in some cases (Brillo, 2023). EPIC's creators note that flood/drought governance often suffers when handled separately – something that people working on integrated water management (like ILBM proponents) have long argued. So, we see a convergence of water governance, lake management, and climate adaptation communities on a set of best practices: integration, participation, continuous learning, equity, and sustainability (Hirji & Duda, 2025; Cookey et al., 2016; Cianci-Gaskill et al., 2024).

In practical terms, one difference is **scope of application**. ILBM and MoReCo deal with lakes as socio-ecological systems at the basin scale. EPIC deals with broader water management (catchments, countries). This means EPIC might not dive into, say, in-lake ecological restoration methods, whereas

ILBM/MoReCo do cover that indirectly (through tech/restore actions). Conversely, EPIC covers things like disaster response which ILBM/MoReCo do not explicitly focus on (though MoReCo's protection loop could include preventative actions that overlap with disaster risk reduction, like controlling invasive species or planting vegetation to stabilize water flows). If writing a formal report for a water agency: one might recommend ILBM or FutureLakes for developing a lake governance plan, MoReCo for implementing a lake management programme, and EPIC for embedding that lake programme into a wider climate risk strategy. AILBM can be used as a diagnostic tool or research evaluation to measure improvements over time or compare governance between lakes (as done by Cookey et al., 2018).

FutureLakes framework – application and audience: The unified framework from FutureLakes is particularly well-suited as a self-assessment and planning tool for lake managers, basin agencies, or multi-stakeholder lake committees focused on climate-resilient governance. Because it was derived from real-world case studies, it resonates with the challenges practitioners face (silos, lack of trust, funding discontinuities, etc.). It can be used in workshops or surveys to score how a lake's governance is doing in each category (e.g., rating coordination, participation, etc.), facilitating a structured discussion among stakeholders. This makes it accessible to a broad audience: local government officials, community representatives, NGO project leaders, and researchers can all engage with its categories without needing advanced theoretical knowledge.

If developed into an **assessment framework** (which could be a checklist or questionnaire with indicators under each category), the primary audience would be those managing or evaluating lake restoration and conservation projects. For example, a lake basin management agency could use it annually to review progress ("Did we improve stakeholder engagement this year? What evidence of increased trust do we have?"). Government ministries could use it to evaluate national lake restoration programmes as part of their review of National Restoration Plans (for the EU Nature Restoration Regulation). Funding agencies or environmental ministries could also use it to identify needs – e.g., if a city applies for funds to restore a lake, the ministry might ask them to do a FutureLakes governance assessment to ensure the project addresses not just the technical fixes but also governance weaknesses (much like how a Social Impact Assessment is now standard for projects, one could envision a Governance Readiness Assessment for lake projects).

The FutureLakes framework is also helpful for communicating the state of governance to a non-specialist audience (e.g., informing a local lake association that "we have strong monitoring and finances, but our collaboration among stakeholders is lacking, which could hinder the project's success"). In that sense, it educates stakeholders on the multifaceted nature of governance, beyond just blaming a single agency or looking at biophysical issues alone.

Compared to ILBM, which would appeal to high-level planners, FutureLakes is more tailored to collaborative groups at the lake/basin level who want to improve day-to-day and year-to-year management. It provides a common language for different parties (community members can voice concerns in terms of categories like transparency or trust, lending weight to those issues in a policy context). And since it deliberately includes climate adaptation considerations (e.g., asking if governance is forward-looking and flexible), it prepares the audience to think of long-term resilience, not just static targets.

In summary, the FutureLakes unified framework's best application is as an **assessment and dialogue** tool for lake governance improvement. The ideal users are lake coordinators, basin councils, or project managers who need to ensure that **formal structures (plans, laws, budgets)** and **informal processes**

(stakeholder relations, learning culture) are all addressed. Given that the FutureLakes project is Europe-focused, its framework might initially gain traction in European countries or EU-projects, but it is general enough to apply globally, especially when combined with frameworks like ILBM for structure and MoReCo for implementation. Ultimately, using the FutureLakes governance framework can help an audience of practitioners and decision-makers move toward governance that is inclusive, integrated, and adaptive, which is precisely what is needed for lakes to thrive under the pressures of the 21st century.

8. References

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Annex 1: Survey (part I) and interview protocol (part II)

Below are the main components and definitions of key concepts of the framework:

Part I: Questions for the interviewee to fill in beforehand

If the requested information can be found in another FutureLakes document (e.g., D2.1, T3.1 or T4.1 report), you may also refer to this document or copy-paste from this document in your answer. Additionally, for these preparatory questions, we understand if there are time constraints to fill in this form. If this is the case, please don't feel the pressure to write long blocks of text, a few lines will be sufficient. Although we appreciate also long elaborations.

Stressors

In the context of lake governance, a stressor is defined as any physical, chemical, or biotic factor that has the capacity to affect another response variable in a linear or non-linear way, be it positive or negative in direction. Examples of stressors are: Societal activities, emerging substances, climate influences (floods, drought, warming), polluting substances.

- **What are the stressors to the system?** *Please list and detail all stressors as much as possible. How severe are they? Please estimate roughly on a scale 1 (not severe) - 10 (severe)*

- **Which stressors are new, and which are long known?** *Comparing new and long known stressors (what is new to you?) – are the long-known stressors also better addressed by governance and management?*

Resource systems

Resource systems include the ecosystem services (ESS) and the biodiversity value of the lake basin. ESS are typically categorized into four main types:

2. Provisioning services. Defined as the products obtained from ecosystems, such as food, water, raw materials, genetic resources, etc.
3. Regulating services. Defined as the benefits obtained from the regulation of ecosystem processes, e.g., temperature control, water purification, nutrient cycling.
4. Cultural services. Defined as the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences.
5. Supporting services. Defined as the services required to produce all other ecosystem services.

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- **Can you describe the resource system in terms of Ecosystem Services (ESS) and biodiversity value?** *See Figure 1 below which illustrates these and their links. (The responses will help assess if all ESS governed or are there gaps).*

    - *1) Provisioning services*
    - *2) Regulating services*
    - *3) Supporting services*
    - *4) Cultural services*
    - *5) Biodiversity value*

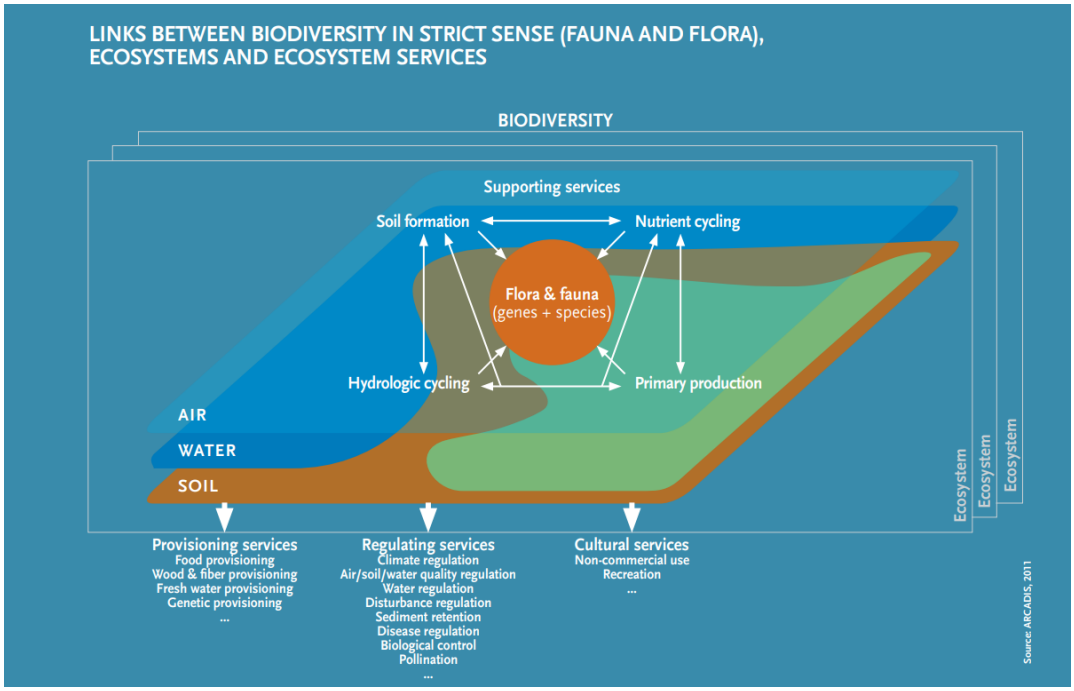

Figure 1. Source Cefic. 2019. Biodiversity and Ecosystem services What are they all about? https://cefic.org/app/uploads/2019/01/Biodiversity-and-Ecosystem-services_What-are-they-all-about_BROCHURE-sustainability.pdf

- **Which Ecosystem Services (ESS) and biodiversity value are being affected by the (old and new) stressors?**

Resource management systems

Resource management systems are the core of the lake administration. They include the entirety of resources management, administration and technology for pollution/stressor control and funding mechanisms for resource management for the lake. In this section we ask you to describe the main features of the resource management system. For example, is it fit for purpose given new stressors?

- **Is there a baseline assessment carried out of ecological status?** *Including water quality, biodiversity, and habitat conditions?*

- **Is there a vulnerability/risk assessment of the lake ecosystem and surrounding communities to climate change impacts?**

- **Is there ongoing monitoring of the lake ecosystem to track changes of water quality, species and other ecological and climatic indicators?** *For example, what information and data of the stressors is being collected? Which units are used to measure the stressors?*

  We will harvest the data from Task 4.1 on monitoring. Feel free to add more information, however, if you think this is covered through Task 4.1 you can skip this question.

- **What are the warning systems in place to respond to changes in the lake systems?** *Are critical levels/thresholds identified?*

Institutional aspects (sectors)

Major social and economic activities in the lake area may affect the quality and quantity of water and other natural resources in the lake basin area. These activities are often divided in sectors and managed by a diversity of institutions. Stakeholders have already been mapped for the lake ecosystems. Here we will aim to identifying gaps.

In the context of lake governance, a sector refers to a distinct area of focus or activity that involves various stakeholders, policies, and management practices aimed at the sustainable use and conservation of lake resources. This can include sectors such as water quality management, fisheries, tourism, and community engagement, each playing a crucial role in the overall governance framework to ensure the ecological health and socio-economic benefits of the lake (Brillo 2023).

Sectors are key diagnostic component of the AILBM framework. In the EPIC response framework, the key focus of the initial assessment involves National Sectoral Frameworks (e.g. water resources management, flood and drought risk and disaster risk reduction). Other sectors are relevant for the response/ measures taken.

- **Do you think the relevant sectors and institutions are involved?** *Also given the new challenges of climate change/ increasing pressures from development, e.g., emerging pollutants?*

  We will harvest the data from Task 2.1 on stakeholders. Feel free to add more information, however, if you think this is covered through Task 2.1 you can skip this question.

- **Is there any sustainable planning and/or management implemented at present?** *Please check the boxes and add if relevant:*

- ❑ *Land use planning and practices that minimize negative impacts on the lake ecosystem, such as erosion control and buffer zones*
- ❑ *Fisheries management practices that balance ecological health with economic benefits*
- ❑ *Sustainable water use, including allocation, conservation*
- ❑ *Conjunctive groundwater management (when surface and groundwater are managed jointly).*
- ❑ *Other, namely.....*

- **Have resilience building strategies been implemented?** *Examples of which are: climate-smart agriculture, carbon sequestration.*

- **Are there collaborating/coordinating mechanisms among different governance bodies and sectors?** *If yes: are they fit for purpose to address the risks/carry out (resilient) lake management, or should sectors be collaborating more for (better) integration?*

- **Are there clear roles and responsibilities in the governance structure for different actors and stakeholders?**

Policy and regulatory framework

- **Are there adequate regulations that protect lakes and ensure resilience?**

- **Are policies integrated and coherent?** *For example, are the policies related to water management, land use, agriculture, and industry integrated and aligned with lake governance objectives?*

- **Are there compliance and enforcement mechanisms to ensure adherence to regulations?**

Equity

Effective governance ensures that management processes and benefits are equitable and inclusive, addressing the needs of marginalized and vulnerable groups.

- **Is lake governance equitable and inclusive?** *For example, is water allocated in an equitable way? For example, are cultural values and traditional knowledge recognized and integrated in lake governance practices?*

- **Are sustainable livelihoods supported that depend on the lake?** *Examples of such livelihoods would be eco-tourism, sustainable fishing, and agriculture.*

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Financing

Lake management and restoration rely on the availability and stability of funding, which should come from diverse sources to ensure resilience. Current business models often include mechanisms for value capture, such as grants and private sector investments, but it is essential to assess whether all ecosystem services (ESS) are adequately valued and funded, and to identify areas where additional resources are needed. Furthermore, innovative financial arrangements could be developed to recognize and capture the value of non-valued ESS, strengthening the overall sustainability of lake governance.

We will harvest the data from Task 3.3 on finance. Feel free to answer the questions below, however, if you think this is covered through Task 3.3 you can skip questions.

- **How is the lake management and restoration funding and financed currently?** *For example, is there financial stability and are there diverse funding sources?*
- **What are the business models including value capture arrangements that are used?** *For example, grants, private sector investments?*
- **Are all ESS valued/funded, or is more funding needed from other sectors and actors?** *For example, often lake management is funded by environmental budgets but not from other sectors, mitigating Disaster Risk Reduction and erosion risks?*
- **What innovative arrangements could be developed to value and capture other non-valued ESS?** *For example, what other sources of funding/financing of other types of actors would be possible to tap into?*

Knowledge and capacity (gaps)

Knowledge is the understanding and information acquired through learning and experience, while capacity is the ability or potential to perform tasks, solve problems, and make decisions.

Effective lake governance depends on robust systems for data collection, management, and sharing to support informed decision-making. It should promote research and innovation to develop new solutions and improve existing practices, while also fostering education and awareness programmes that engage stakeholders and the public in lake conservation and sustainable use. Governance must recognize the diversity of knowledge and perspectives by involving academic, practical, governmental, and political actors, ensuring that all participants have sufficient capacity and identifying areas where additional knowledge or skills are needed. Finally, cultural values and traditional knowledge should be acknowledged and integrated into governance practices to create inclusive and context-sensitive approaches.

Actors (or change agents) are key players or stakeholders involved in lake governance. An "actor" is defined as an entity possessing agency or power of action, linked with legal, technical, and cultural frameworks in which they operate (Bressers 2009). The actors driving the learning, make important

choices about who to engage in different stages of the learning process, and as such, what diversity of input to take onboard, steering the learning.

- **What are the systems for data collection, management and sharing data related to the lake ecosystem and management processes?**

  We will harvest the data from Task 2.1. Feel free to add more information, however, if you think this is covered through Task 2.1 you can skip this question.

- **What type of research and innovation is promoted to develop new solutions and improve existing practices for lake management?**

- **What education and awareness programmes are available to inform stakeholders and the public about the importance of lake conservation and sustainable use?**

- **What is the knowledge diversity, or different perceptions?** *This is related to how many different types of actors and knowledge are involved, e.g. academic, practical, government, political.*

  We will harvest the data from Task 2.1. Feel free to add more information, however, if you think this is covered through Task 2.1 you can skip this question.

- **Has everyone involved sufficient knowledge and capacity? If not, who needs more knowledge/capacity?**

Part II: Resilience and social learning questions

These questions will be used to drill deeper into the background knowledge of the system. These questions will be posed during the interview, and you don't have to fill out these questions beforehand.

Social learning

Social learning is key to resilience building in the context of climate change because it fosters collective understanding, adaptive capacity, and collaborative problem-solving, enabling communities to effectively respond to and recover from climate-related challenges.

Social learning is simply defined: “learning together by doing together”. Originally developed in organizational management, it is often discussed in context of **deliberating (i.e. discussing) on the job by a group of actors**, (in contrast to learning by training).

The social learning process involves to challenge, disrupt or alter the prevailing values, assumptions, behaviours, knowledge systems, modes of operation, or institutional structures (Haxeltine, Avelino, et al., 2016; Rogers et al., 2015).

When a social learning process takes place several phases are involved, including:

- *Problem identification* identifying a common understanding and shared interests.
- *Deliberation* involves joint fact-finding and thoughtful examination of issues, option evaluation and design of a common approach, (e.g., setting agendas, tabling a discussion, assigning a work group).
- The learning process ends with *implementation, monitoring and adaptation* enabling a restart of the often iterative learning process (Daniels and Walker, 2001).

Actors

Key players or stakeholders involved in the designing of the governance system are called actors. The actors can choose to work with different partners with different knowledge and as such steer the learning and knowledge integration. For example, a lake manager and his/her team, or key community volunteers.

Stakeholders are defined as "any group or individual who can affect or is affected by the achievement of an organisation's purpose" (Freeman, 2010). Stakeholder engagement is a broad concept with diverse processes and various intentions, that can refer to basic communication and consultation with stakeholders, but also describes more advanced forms of participation, representation, partnerships with co-decisions, co-production, and knowledge co-creation as the most ambitious form of stakeholder engagement (OECD, 2015).

Stakeholder engagement can be evaluated with reference to its ambition. The OECD framework is clearly rooted in Sherry Arnstein's "ladder of citizen participation", created already in 1969 to capture citizen involvement in planning processes in the United States to show participation ranging from high to low (Arnstein, 1969). Benefits of involving stakeholders include generation of results directly relevant to society and decision makers, enhanced communication of data and results to broader audiences, increased stakeholder understanding of and trust in science, active citizenship, and increasing adaptive capacity (Smyth et al., 2021). Benefits include acceptability and sustainability (with more effective implementation and ownership of decisions and outcomes), social equity and cohesion (by building trust and confidence), more capacity and knowledge (awareness) and finally a better economic efficiency (cost and time saving and better coherence) (OECD, 2015).

A first and fundamental exercise before stakeholder engagement activities is understanding the complexity of actor constellations in the given area. This should be done by a thorough stakeholder mapping approach.

- **Who is driving the initiated actions to adapt to change (and the stressors)?**

Institutional context: Facilitating/Constraining factors

Individual level: Different personalities can both facilitate and constrain processes. Examples of different personalities are people who challenge assumptions, employ unrestrained thinking, conduct open communication, have an inquiring mind, help in taking onboard new views and perspectives. Furthermore, trust is an important enabler/facilitating factor.

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Societal level: The institutional context can facilitate as well as constrain processes/actions. The institutional context is provided by, for example, policies, regulations, planning frameworks and guidelines, informational and financial arrangements and capacities.

- **What are the facilitating factors at the individual and social level?**
- **What kind of institutional context is supporting the monitoring and restoration?** E.g., horizontal or vertical (national level initiative to integrate/coordinate? Multi-level governance?) integration/collaboration?
- **How flexible and adaptive is the governance to be able to respond to changes in the lake environment?**
- **What are the individual and social *constraints*? Are there any lock-ins (barriers) due to past trajectories at either the social or institutional level?**

Process steps

Several (social learning) process steps may be involved, including problem identification, deliberation involving joint fact-finding and thoughtful examination of issues, option evaluation and design of a common approach. The learning process often ends with implementation, monitoring and adaptation enabling a restart of the (often iterative) learning process.

In this process there can be different levels of interaction (from informed, to more engaged co-creation) between traditional managers or decision makers and actors who will be impacted by management decision and varied levels of participation in implementation such as monitoring & management.

- **What are the (social learning) process steps that are often involved?**
- **When do you engage with the community?** *For example, in the planning phase of a process, or after a measure has been implemented?* **And if you engage, how do you do it?**

Examples of knowledge created

Social learning leads to **generation of knowledge** through single, double or triple loop learning, representing different learning "depths". If agents correct errors by modifying existing actions along the same objectives, this constitutes **"single-loop learning,"** requiring less effort. For example building a dike, but a bit better. If underlying assumptions about current actions are challenged leading to ***changing approaches*** to situations this represents "**double loop learning**" including reframing to comprehend or accept something significantly new or different (Illeris, 2009). For example, shifting approach to build nature-based solutions. This deeper learning often necessitates bringing together and bridging different perceptions and knowledge (Feurt 2008; Chaffin et al., 2016; IPCC, 2012). In "**triple-loop learning"** assumptions are challenged about the approach and the context in which the

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activities exist. It can change perspectives and opens the possibility of changing deeply held values, norms, beliefs, worldviews, or paradigms. To achieve such transformational change, addressing the underlying foundations of our knowledge is critical (Argyris & Schon 1978).

Knowledge generated can be very diverse from facts, innovations, to norms and values.

- **What knowledge is created in governance processes over time?**
- **How innovative or "transformative" is the knowledge generated?** *For example, is the knowledge going beyond established domains, geographies, duration or other frames? Is this knowledge challenging assumptions or 'just doing things a bit better'?*

Process attributes that facilitate learning

Actors or change agents learn **facilitated by different process attributes**. For example, people who challenge assumptions, employ unrestrained thinking, open communication, with an inquiring mind, help *individuals* in reevaluating existing frames of reference, and take onboard new views and perspectives. That can result in outcomes such as personal transformations or transforming relationships (Schusler et al 2003; Retolaza 2011; Wilber 1996).

Process attributes at *societal level* are part of the institutional context and can include different policy, regulatory, planning frameworks and guidelines, informational and financial arrangements and capacities that influence learning (Raadgever & Mostert 2005; Jiménez et al 2015). Some of these may even be **prerequisites** for learning, enabling the learning process to start (Johannessen and Hahn 2013). These can also be what some scholars argue to be critical (systemic) **leverage points**, where interventions can lead to significant changes (Meadows 1999; Abson et al. 2017).

Institutions in lake governance are responsible for creating and enforcing policies, coordinating stakeholder actions, and ensuring sustainable management of lake resources. They include local public institutions, government agencies, and non-governmental organizations that work together to address environmental challenges and promote conservation efforts. Effective lake governance requires strong institutional capacity, clear legal frameworks, and active stakeholder engagement (Faris, 2019). Institutions are key diagnostic component of the AILBM framework.

Policies in lake governance are principles and statement of intent that guide decisions and are implemented as procedures or protocols. They are often adopted by governance bodies to ensure the sustainable and resilient management of lake resources. These policies help in coordinating actions, setting priorities, and allocating resources effectively (ThePolicyGuide, 2024). An example is the governance of the Great Lakes in North America, where policies have been instrumental in managing water quality and invasive species. These policies are based on scientific research and involve collaboration between multiple stakeholders, including government agencies, local communities, and environmental organizations (Allan et al., 2013). Institutions are key diagnostic component of the AILBM framework (?).

External drivers as facilitating factors

Learning and collaboration can also be fostered by external drivers, such as crises and disasters. These 'focusing events' bring a subject to the policy making or action agenda, often by creating awareness of

individuals that in turn trigger change in society. Here, pre-existing (risk) perception of the problem, is often necessary for action (Kingdon 2014; Johannessen and Wamsler 2017; Huttunen et al., 2021).

Barriers to learning (or lock ins)

For an *individual*, it is often uncomfortable to change deeply held beliefs and ingrained values (Hornsey & Fielding, 2017). Knowledge resistance, is a result when individuals avoid assimilating available knowledge, believe what they prefer to believe, and dismiss or misunderstand relevant evidence. This defensive routine avoids inquiry (Argyris and Schön 1996).

At a *societal* level, weak **institutional structures** and limited capacity hinder effective management, emphasizing the need for good legal frameworks, resource capacity, and stakeholder integration (Faris, 2019).

When the existing institutional arrangements are no longer fit to address the ongoing lake management, needed restoration or additional stressors, they can provide path-dependencies and resistance to change or lock ins (Johannessen et al. 2019; Siebenhüner et al. 2021; Groen et al. 2022). Introducing new way of doing things, needs to be negotiated with the powers that maintain business as usual (Jongman et al., 2018). This can be perceived as a cost in context of the existing system setup and financial arrangements, where cost recovery mechanisms are not in place, and can also be costly in terms of transaction costs to reorganise (Pierson, 2000; Johannessen et al. 2025).

Outcomes / past adaptations/ change

The outcome of the social learning process is a result of re- shaping institutional processes and arrangements across scales, e.g. geographical and administrative levels, for system transformation (de Haan & Rotmans, 2018; Werbeloff et al., 2016). More specifically this can entail a **common purpose**, translating in technical measures, policies or strategies, or new **collaborative relationships** such as a new institution, institutional integration or public and political awareness. The outcome can be transformational when the institutional context (regulatory context, multi-level governance, management regimes) or social structures (patterns of social interaction) is reconfigured, including changes in power, norms and values that in turn influences the social learning process (Kotter, 2012; Johannessen et al. 2019; Medema et al., 2014; Baumann Feurt, 2008; Daniels & Walker, 1996; Argyris & Schön, 1996, Haxeltine, Avelino, et al., 2016; Mersmann et al., 2014). These structures thus provide a new context for the learning and process attributes, providing a positive feedback loop, reinforcing the new normal (or paradigm). Transformations are as such conditioned on the flexibility of the context (e.g. institutional structures) to change.

The outcome of the process can be, for example, a common purpose, translating in technical measures, policies or strategies, or new collaborative relationships such as a new institution, coalition building, institutional integration or public and political awareness.

- **What are (some of) the outcomes of past governance (change) processes?**
- Did these outcomes in turn provide further facilitating process elements?

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Annex 2 : Consent Form

FutureLakes Project

Consent Form for External Participants

Information Sheet

You are invited to participate in an interview for the FutureLakes project. FutureLakes is an Innovation Action funded by the European Union through a Horizon Europe Innovation Action under Grant Agreement Number 101156425. You can read more about our project at https://futurelakes.eu/.

Purpose of activity

Within the FutureLakes project, the aim of task 2.2 is to develop a **"Climate-resilient ecosystem-based water governance framework".** This framework will be developed based on existing knowledge and informed by the current water governance practices in all the 6 Demo Lake Basins. Task 2.2 has started with developing a draft version of the framework, and to help developing it further we need to understand the lake management and governance systems of the Demo Lake Basins better. Therefore, we would like to conduct semi-structured interviews in all Lake Basins to evaluate current water governance practices.

Description of Activity

The interview aims to enhance participation in lake basin management and co-development of the draft framework. The interview will consist of a preparatory stage that requires filling in a questionnaire, and a 1-hour during interview. We will record the interview for accuracy and transcription purposes. Upon completion of transcription, any recordings will be deleted.

After the interviews, we will derive the relevant insights from the interviews, to further develop the draft framework. This will be tested in two Demo Basins (Finland and The Netherlands). Subsequently, the draft framework will be presented to the stakeholders in the remainder of the Demo Basins for review. The final version of the framework will be described in FutureLakes Deliverable 2.2, which in turn will become part of the FutureLakes Blueprint (Deliverable 4.4).

Participant Selection

The participants of this interview should be key stakeholders knowledgeable on the governance and management structures of the Demo Lake Basin.

Confidentiality and Data Handling

1. The FutureLakes project is committed to processing information in accordance with the General Data Protection Regulation (GDPR).
2. All personal information will be securely stored on the FutureLakes project's data servers and will be accessible only to the FutureLakes research team.
3. Your personal information (name, organization, role) and any identifiable data will be anonymized for use in all public reports, publications and communications.
4. Anonymized data may be included in project deliverables, research publications, and presentations related to the FutureLakes project.

Voluntary Participation and Withdrawal

Your participation is voluntary, and you may choose to withdraw at any time without any negative consequences. If you decide to withdraw, all your provided data will be removed from our records to the extent possible.

Permissions and Agreements

Please check the boxes below to indicate your consent:

Your participation in this activity is entirely voluntary and you can withdraw at any time.

FutureLakes | Task 2.2 Team

Contact Name: Åse Johannessen

Contact details: Ase.Johannessen@deltares.nl

Consent Sheet

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT PARTICIPATION		
1. I have read and understood the information above, or it has been read to me. I understand the purpose of this activity and consent voluntarily to participate.	☐	☐
2. I consent to the activity being recorded for transcription purposes	☐	☐
3. I consent to the use of anonymized quotes from this activity in research publications and FutureLakes deliverables.	☐	☐
4. I understand that my identity will remain confidential and that no personally identifiable information will appear in any report or publication.	☐	☐
B: RESEARCH PUBLICATION AND DISSEMINATION		

5. I understand that the information I provide will be used in FutureLakes-related deliverables and potentially for educational purposes.	☐	☐
C: STORAGE, ACCESS AND REUSE		
6. I agree that anonymized data may be archived for future research within the scope of the FutureLakes project.	☐	☐
7. If you would like to receive copies of outputs (reports) resulting from your participation, please provide your email address here:	☐	☐

Signatures

_____ _____ _____

Name of participant Signature Date

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____ _____ _____

Researcher name Signature Date

Åse Johannessen| Deltares| Ase.Johannessen@deltares.nl