eawag
aquatic research

Development Plan 2021-2024
Excerpt

Dübendorf, 5 November 2020

Executive Summary

Water is essential for life; the sustainable use and management of freshwater resources is one of the defining challenges of our time. Eawag is recognized worldwide as a leading institute for research, education, and expert consulting in aquatic science and technology and is thus ideally positioned to make key contributions to water sustainability and security. Eawag has unmatched capacity to conduct inter- and transdisciplinary research that is problem-driven and/or solution-oriented. This capacity depends on and benefits from effective cooperation with partners from both academics and practice, allowing Eawag's research to span the continuum from curiosity-driven to implementation. Furthermore, Eawag fulfills its mandate in education in partnership with degree-granting partners, including ETH Zurich, EPFL, the Cantonal Universities, and the Universities of Applied Sciences in Switzerland as well as international universities. To fulfill its mandate in expert consulting and KTT (knowledge and technology transfer), Eawag works closely with Federal Offices, Cantonal agencies, municipal utilities, consulting firms, professional associations, civil society organizations, and industry. The balance of these interactions reflects Eawag's focus on public, rather than economic, goods.

In the planning period 2021-2024, Eawag will pursue the following goals:

- Accelerate the application of scientific advances and technology innovations in the water sector. Eawag will continue to use its research capacity to demonstrate applications of novel concepts, methods and technologies in the water sector. Specific emphasis will be placed on applications of ***digitalization, data mining and data sciences for water research*** (D^3 for water).
- Align problem-driven and/or solution-oriented research with societal needs, using the targets for the Sustainable Development Goals (SDGs) as a organizing framework. Eawag is committed to working cooperatively to advance research for a sustainable future. Water is not only the focus of SDG 6 (*Ensure availability and sustainable management of water and sanitation for all*) but also a linking element across the SDGs. Eawag will communicate the alignment of its research with the SDG targets, addressing both national deficits and international spillover effects.
- Identify meaningful and critical knowledge gaps through engagement with partners in practice. Implementation in practice offers fertile ground for identifying new research questions and directions. Eawag will continue to co-develop research directions and approaches with implementation partners, facilitating the eventual uptake of research results into practice. The new ***Synthesis Center for Socio-Environmental-Technological Systems (SETS)*** will be a conduit for identifying and addressing relevant and timely topics.
- Provide a robust scientific evidence base for decision-making. Eawag will continue to communicate scientific information, based both on its own research results and on the integration and synthesis of knowledge from the broader scientific community. Eawag strives to provide such information in open and accessible forms in order to inform decision-making at all levels of society and, in particular, for national policies.
- Leverage synergies through effective cooperation. Eawag will continue to position its activities in research, education, and expert consulting to leverage synergies with both academic and non-academic partners.
- Performance of national tasks. For example, Eawag will continue to work productively with EPFL to host the ***Swiss Center of Applied Ecotoxicology*** (Ecotox Center).

Preamble

The ETH Domain comprises six autonomous institutions, which share a common mandate in education, research, and service. Within the ETH Domain, there are two different types of institutions – the ETHs (ETH Zurich and EPFL) and the Research Institutes (PSI, Empa, Eawag, and WSL).

The ETHs, as the only degree-granting institutions within the ETH Domain, bear the fundamental responsibility for tertiary education. Since the Research Institutes (RIs) cannot grant academic degrees, their educational mandate can only be fulfilled in partnership with the ETHs or other degree-granting institutions.

Unlike the RIs, the scope of the activities of the ETHs in science and engineering is not subject to any thematic constraints. Thus, the ETHs must maintain the capacity to meet the needs of education, research, and service in a broad range of fields. The RIs, however, are legally constrained in the thematic scope of their activities. These thematic constraints reflect political decisions regarding the importance of certain thematic areas to Switzerland.

Eawag is legally responsible for the following thematic areas[1]:

- Chemistry, physics, biology and microbiology of water
- Ecology of aquatic systems
- Drinking water and wastewater treatment technologies
- Relationships between water, society and nature
- Sustainable management of water supply and resources

Together, the ETHs and the RIs share the responsibility to fulfill the mandate of the ETH Domain in education, research, and service. The ETHs and RIs are the operational units of the ETH Domain. As autonomous institutions, the ETHs and RIs develop strategies for each individual institution; they also participate in and support the development of the shared strategy of the ETH Domain.

In late 2019 and early 2020, there was intensive discussion within the ETH Domain about the need to increase cooperation among the ETH Domain institutions in order to contribute to solving complex societal challenges, particularly relating to sustainability. Eawag endorses this goal and will work closely with the other institutions of the ETH Domain and with the ETH Board to contribute to a sustainable future for Switzerland and the world.

[1] According to the Verordnung des ETH-Rates über die Forschungsanstalten des ETH-Bereichs (414.161), these areas are: Chemie Physik, Biologie und Mikrobiologie des Wassers; Ökologie aquatischer Systeme; Wasser- und Abwassertechnologie; Beziehungen zwischen Wasser, Gesellschaft und Natur; nachhaltige Bewirtschaftung des Wassers und der Gewässer. The German text is definitive.

Vision, Frameworks, and Mandate for Aquatic Science and Technology

Water is a basic necessity of life and underpins a wide variety of human activities, from food production, energy generation, and transportation to advanced industrial manufacturing. In addition, water is a critical component of the ecosystems that provide direct and indirect services to society – in the form of fish habitat, recreational venues, climate moderation, and assimilation of wastes including the carbon dioxide released by fossil fuel combustion.

Water resources are subject to stress in many regions of the world. This stress is anticipated to increase as a result of increasing population pressures, urbanization, and energy demand and changes in dietary consumption patterns, land-use and global climate. Historical practices in water use, water resource management, and water infrastructure development have often exacerbated this problem, but at the same time, leave ample opportunity for improvement.

The issues of water availability and quality must be addressed at multiple scales – local demand, regional climatic patterns, migration of invasive species via trans-boundary waters and international trade, and the global implications for economic development and food supply all represent different facets of sustainable water management. There is an urgent need to strengthen the scientific basis for decision making such that competing demands and pressures on the water environment can be balanced and mitigated.

The impacts of human activities on the water environment are ubiquitous and profound. The inter-sectoral importance of water calls for an integrated view of the water environment that encompasses various levels of control, impact, and function as a basis for informed management decisions. The major challenge for the future will be to meet direct human needs for water while preserving the capacity of the water environment to provide ecosystem services.

For the period 2021-2024, Eawag will use selected conceptual ***frameworks*** to emphasize the coherence and impact of its activities in research, education and expert consulting (including knowledge and technology transfer).

- Accelerating the uptake of ***D^3 for water***. Digitalization, data mining and data sciences (***D^3 for water***) offer a huge potential for water research, for improved management of water infrastructure, and for assessing the status and function of aquatic ecosystems. Eawag initiated significant investments in this area in the planning period 2017-2020 with exciting first developments. Eawag will expand these investments, continuing its fruitful collaboration with the Swiss Data Science Center and contributing to national and international digitalization initiatives.

- Alignment with SDG targets. Analysis of the SDG targets demonstrates that achievement of SDG 6 (*Ensure availability and sustainable management of water and sanitation for all*) would have many co-benefits for other SDGs. Unfortunately, the converse is not true, emphasizing that cross-referencing the SDGs at the level of the targets will be essential to avoid unintended consequences. Eawag will use the SDG targets as a tool for communicating the societal benefit of its research, leveraging synergies and avoiding unintended consequences across the SDG targets, and identifying potential opportunities to accelerate SDG implementation. Eawag's research is highly relevant for SDG 6. While much of this research is mainly relevant outside Switzerland, groundwater has been identified as a critical and vulnerable national resource. Two other topics also deserve special attention. Eawag's research on ***aquatic and riparian biodiversity*** addresses targets 15.1 (…ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater

ecosystems and their services…) and 15.5 (…reduce the degradation of natural habitats [and] halt the loss of biodiversity…). Eawag's research on ***a circular economy for water*** will help to achieve targets 11.6 (…reduce the adverse per capita environmental impact of cities…), 12.5 (…substantially reduce waste generation through…reuse), and 14.1 (…prevent and significantly reduce marine pollution… in particular from land-based activities…). Furthermore, Eawag's energy research helps to avoid unintended environmental consequences of achieving target 7.2 (…increase substantially the share of renewable energy in the global energy mix).

- Linking research and KTT through co-definition of projects and co-production of knowledge. Research projects have a tremendous potential to serve as a channel for KTT if implementation partners are involved at an early stage of project definition and, ideally, throughout the project. Research results that are co-produced with stakeholders have a much higher likelihood of acceptance and implementation. At the same time, a trustful relationship with stakeholders is likely to reveal questions that could be the basis of challenging new research projects.

These conceptual frameworks will guide Eawag's activities and provide a strategic basis for the allocation of its resources over the next planning period. Eawag will also emphasize cooperation and complementarity to leverage synergies in fulfilling its mandate in ***research, education, and expert consulting***.

In research, Eawag will use its focus on problem-driven and/or solution-oriented research to strengthen collaboration with academic and implementation partners. In particular, Eawag will use the insight gained from its engagement with practice to identify challenging questions that call for conceptual or methodological advances. These questions can serve as the basis for doctoral research conducted under the guidance of Eawag's joint and adjunct professors. Eawag's research is international in scope, but a key component of its research portfolio addresses issues of immediate concern within Switzerland, as determined in cooperation with the Swiss Federal and Cantonal agencies.

In its educational activities, Eawag supports the Federal Institutes of Technology, Cantonal Universities and Universities of Applied Sciences in formal course instruction and the supervision of student research. In particular, Eawag offers students at the Masters and Doctoral levels an opportunity to participate in large-scale, multi-investigator projects with strong connections to application and practice. Eawag researchers hold adjunct professorial appointments at many national and international universities. Eawag supports joint professorships with ETH Zurich, EPFL, the Universities of Berne and Zurich, and the School of Life Sciences FHNW and plans to expand such cooperation (see section 3.1.3). Eawag offers continuing education directed toward professionals and practitioners and has a strong tradition of training for capacity development in low- and middle-income countries (LMICs), most notably through the MOOCs offered in cooperation with EPFL. Eawag also has a long-standing program of vocational education, mainly for laboratory technicians.

In its expert consulting activities, Eawag provides support and guidance for stakeholders, practitioners, industry, government and politics through projects that address practical problems and implement solutions, as well as through continuing education for practitioners and service on expert committees and advisory boards. In addition, Eawag hosts several platforms (see section 2.3.1 and Appendix 5) to inform and advise stakeholders and to foster dialogue.

The results of research conducted at Eawag, including the development of novel concepts, methods, and technologies, are disseminated by various means, such as technical

publications and presentations and teaching. Consulting and expert services provide a venue for knowledge transfer, particularly to professionals and practitioners. This is also accomplished through participation of Eawag researchers in core activities of the Swiss professional urban water and environmental associations (including conferences, continuing education programs, and development of guidelines). Employment of former members of Eawag's research staff (including former doctoral students) in non-academic positions is also very important as a means of transferring knowledge and directly influencing decision making.

Outreach to the public and its elected representatives to promote a better public understanding of Eawag's research is achieved through active and attractive communication of research results. Eawag disseminates results and findings through its printed annual report (also available online), electronic newsletter and factsheets, and website, as well as through social media channels. The direct engagement of Eawag researchers with stakeholders is a key component of outreach and knowledge exchange. Eawag also works closely with media representatives who cover science and technology. In addition, Eawag seeks to engage the public in a dialogue on societally relevant topics through the participation of its researchers in events such as the annual "Infotag".