



NEXUS FUTURES Project Report

- Executive Summary -

2017 - 2021

Final project report to the Ministry of the Environment, Climate and Sustainable Development



NEXUS FUTURES

Sustainable engagement
with water and land

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The achievements and deliverables are described with reference to the research questions and deliverables of the research proposal that is part of the NEXUS FUTURES Convention (2017-2021).

Executive summary

How can we learn to better safeguard and regenerate the earth's life support system, constituted of healthy water and soil systems and the interdependent web of diverse life forms, when our land use and socio-industrial emissions largely undermine their self-regenerating capacities? How can we overcome systemic challenges to such regenerative action in an age in which diverse human influences on environmental systems and processes are all pervasive and interconnected across local and global scales?

The five-year NEXUS FUTURES project explored approaches to participatory governance of water and land. The project served to identify systemic challenges, and to develop concepts, processes, methods and tools as basis for more concerted regenerative actions by individuals, groups, organisations and society at large. The project design started from the assumption that *what and how we know shapes how we think and act* as we engage with water and land. One central question therefore concerned how we can change knowledge production processes and what role science can play as basis for regenerative actions, acknowledging that our social and ecological systems co-constitute each other. A related question was how we can stimulate collaboration and co-creation of knowledge and science across disparate sectors (of government, expertise and professions, the economy and society) in a way that emergent knowledge is accessible, understood and acceptable to all as evidence-base for more concerted action.

Funding and commitments: The project was co-funded by the MECDD and the University of Luxembourg. The NEXUS FUTURES project is the first example of transformative sustainability research in Luxembourg. The research approach consisted of participatory action research and was carried out by the research group on social-ecological systems at the University of Luxembourg. Outcomes of such transformative research approaches in general terms that were listed as commitments in the 2016 Project Convention included new concepts to structure future-oriented dialogues across differences in interests and expertise, development and capacity building for new approaches to understanding and acting on complex social-ecological systems, changing relations and network effects, innovative tools, technologies, and sequel projects to leverage the achievements. The project had three interlinked research strands, outputs and outcomes of which are described below. An overview on all scientific deliverables is provided in Annex I.

Project governance: We worked with a reference group with 15 stakeholders engaged in water governance or farming at the local or national level, who were consulted on substantive and procedural choices throughout the

projects' duration. The Scientific Advisory Board with four internationally leading experts provided advice on related international research, suitable methodologies, and representations of the work.

1. What knowledge for more concerted action on water governance in Luxembourg?

The first research strand conducted in contribution to a doctoral dissertation by Kristina Hondrila asked **what knowledge serves action for sustainable water governance and social learning in two river partnerships**. First insights from empirical data on case studies of implementing water protection zones and river restoration/renaturation projects help to identify factors that help or hinder regenerative projects such as a river renaturation project at the Syr or the institution of additional water protection zone at the Upper Sure. Research design and methods included close to 60 narrative and walking interviews, three collaborative workshops, numerous site visits and observations and documentary review.

The research describes concrete implementation challenges of government measures largely arising from different understandings of issues and potential solutions by actors from different professions active at different levels of governance or in different sectors of government or society. The thesis provides a historical perspective on how these situations and misunderstandings across actor groups arose. This conceptual framing helped us to pin-point important barriers to local actions for improving water quality in two river partnerships and provide recommendations on how to overcome these (Hondrila, 2021). Regenerative initiatives, such as river restorations are always rooted in place-based implementation actions by motivated people, who feel and are empowered to act in an enabling policy, financial and social environment. Insights from the research highlight that regenerative initiatives require an in-depth understanding of local unique dynamics, diverse interests, and interactions between relevant factors across the ecological, social, personal and technological spheres. Design of such initiatives should also embrace salient uncertainties in relevant knowledge and the fact that futures are open and prone to disruptive events in turbulent times. Learning from actions and experimentation will benefit from networks across a range of spatial and temporal scales and levels of governance. In addition, taking human needs and wants in diverse local groups into account, as well as circumstances of people who lead the regenerative initiatives helps shaping a better understanding of local/regional interrelations. The findings as such can be seen to underline risks of focusing policy-making on promoting detailed measures in to the form of one-size-fits-all policy and market solutions; the research highlights merits of opening rooms for experimentation with place-based initiatives by actor groups supported with public funds that come with few or no strings attached. The work points to needs to improve learning across places in networks with the help of learning platforms.

Scientific deliverables include one Ph.D. Dissertation on knowledge for action in water governance in Luxembourg, contributions to two scientific papers, and three conference presentations. A related action research project Aktioun-Nohaltegkeet ([link](#)) in our group is also drawing on these insights to further improve a fit-for-purpose learning platform. A more detailed account of the research approach and insights are given in section 3 of this report.

2. Exploring the potential of citizen science for water governance

In the second research strand, Karl Pickar led the development of experiments with **citizen science on water quality** to explore whether it is possible to engage volunteers in collecting data on water quality and whether such data is acceptable to authorities and can complement official data in meaningful ways. The research points to advantages of a shift from informing policies and practical actions exclusively expert based to the co-creation of evidence and meaning making of it in participatory processes with the help of citizen science.

The work-strand on citizen science thus involved two large contributory data collection campaigns carried out in collaboration with the NGO Freshwater Watch, in which we engaged over 300 volunteers who sampled and assessed water quality across different water bodies in Luxembourg. Furthermore, we worked with one corporation some of whose staff engaged in more regular self-organised sampling activities on sites recommended by local experts from the river partnership Syr. Finally, we held three participatory co-design workshops to develop a citizen science tool with a systemic indicator set for a distributed approach to co-creating an evidence base for policy and local actions that directs attention to mutual influences in human-environment relationships (See Figure 0.1). The tool set is implemented in collaboration with Spotteron, who provides Citizen Science apps and data management as a service. The app will distinguish two different modes of data gathering: guided and structured visual observations by any volunteer or collecting quantitative data on water quality with test kits under the guidance of trained volunteers or staff from environmental organisations (e.g. for chemical substances such as nutrients). The observations include indicator species for ecosystem health as well as a visual survey of disturbance factors and easily visible structural parameters of stream impact models. Such observation campaigns can then potentially be implemented in all river partnerships to create a comparable mapping of the different river basins on a website. A simple didactically prepared toolkit for teachers and students and guided walks in nature parks and exhibitions will be developed as follow-up to the project.

Scientific deliverables include one scientific publication to date, two other papers that are in preparation and two invited to presentations at conferences of statisticians organized by EUROSTATs European Statistical Advisory

Committee and the German Federal Statistical Office to explore the potential of citizen science to serve as data pool for official statistics. In sum, this systemic citizen science tool set offers a approach to institute a more distributed approach to co-create an evidence base for policy and local actions. A more detailed account is provided in section 2 of the full report.

3. National scenarios on engagement with water and land in 2045

The third strand served to develop **national scenarios for anticipating potential future challenges and changes in ways of how we engage with water and soil in 2045**. This set of three scenarios provides a systemic understanding of how behavioural patterns for engaging with water and land arise from the interplay of different circumstances in society, the economy, technology and the state of the ecosphere. The set of descriptions of three different worlds is designed to provide common points of reference for workshop discussions with different stakeholders, that have a very different understanding of the world, what matters most and what might need to be changed first. The scenarios also highlight that an argument merely based on past personal experience and established scientific facts will be inadequate in the face of disruptive changes in turbulent times. The participatory process to develop the scenarios drew on all interviews conducted for the other two research, and a dedicated set of interviews and workshops. Furthermore, the research approach included work with diverse experts contributing quantitative and qualitative studies, exploring different aspects and implications of the three scenarios in more detail. First, a quantitative study by Dr Andrew Ferrone, the Luxembourg representative to the IPCC provides plausible modelled ranges for frequency of occurrence of extreme weather events and seasonal distributions of temperatures and rainfall that served as basis to differentiate the climatic conditions in the three scenarios. A second quantitative study concerned water demand and supply. This study suggests that water will become a primary constraining factor for population growth and economic development at the latest in 2030 in spite of inauguration of the new SEBES plant. Based on this modelling approach, three different scenarios for water use and sourcing systems have been developed. Experts in spatial planning started from the recommendations of the participatory national process to develop goals of the 'Third Industrial Revolution' to explore implications for land use. Contradictions in terms of multiple competing land uses on certain areas of the country were resolved into three scenarios with different underlying logics for spatial organisation.

As such, the scenario set offers a tool for policy makers, individuals, organisations or mixed stakeholder groups to switch from prediction and control-based management to embracing open futures, uncertainty, accelerating and disruptive change in deliberations on promising pathways and concerted action to regenerating a resilient life support system in Luxembourg. Trade-offs that can arise from placing primacy on growth and technological progress, regional autonomy and well-being, or ecosystem health become apparent through work with the scenario set.

Deliverables produced from this work strand include capacity building for scenario work in over four national workshops and working groups with national experts, contributions to a first advanced text book on sustainability science (two manuscripts for international peer reviewed publications are in preparation), two workshops in Luxembourg, and a video and project website with tools to effectively leverage the scenario set for thinking out of the box in future workshops with public and private sector organisations and civil society. A more detailed account is provided in section 4 of the full report.

4. Methods and capacity building

During the NEXUS FUTURES Project we engaged in stakeholder analyses and developed methods for contradiction mapping from interviews with diverse stakeholders and workshops. We developed approaches in and for Luxembourg for collaborative conceptual systems mapping to identify promising action fields in the face of complex and dynamic problems in social-ecological systems, and for working with scenarios to embrace possible disruptive events, uncertainties and open futures. The main shared aim of all these methods is to foster dialogue across differences in expertise and interests to offer engaged participants the opportunity to reframe issues and challenges and to see them with new eyes, through multiple perspectives (a first step towards a transformative learning experience). Apart from presentations at scientific conferences, two Ph.D. theses were completed. So far one paper fully dedicated to a work strand in the NEXUS FUTURES project was published in an international peer reviewed journal (König et al., 2021). We have contributed to papers by colleagues on related research topics (Caniglia et al., 2020; Luederditz et al., 2019). For our projects we have further developed and leveraged collaborative conceptual systems mapping of complex social-ecological-technological systems (Newell and Proust, 2018) as well as scenario and visioning approaches (Ramirez and Wilkinson 2016) with other international research groups over the past five years. We are at present writing a set of five papers on the past five years of research, however the pandemic has slowed us down as we had to develop participatory approaches for virtual settings. The papers outline our contributions to fields of knowledge relating to complex social ecological systems with a focus on the water-land nexus, and the academic literature on futures and scenarios, and citizen science.

In sum, in this research project we developed cross-scale participatory processes that served to explore alternative and open futures for our engagement with water and land, as well as an original and systemic citizen science tool set for water governance. With these processes we are seeking to facilitate the emergence of *transformative governance approaches* in Luxembourg and beyond. We also seek to create spaces for participatory evaluation and reflection on

relevant policies and initiatives. These are distributed decentralised governance processes that seek to engage with uncertain futures to steer action in the present. Both our scenario set and the citizen science tool kit have been co-created by collecting and considering salient local ‘seeds of change’ (how salient place-based, including social innovations may disrupt current prevailing structures, practices, and norms).

The encouraging outcomes of the citizen science project strengthened our resolve to dedicate the next 10 to 15 years to further facilitating the establishment of innovative structures and practices for evidence-based learning for the regeneration of the life support system through place-based actions and policies in cross-scale participatory processes including citizen science approaches. We will extend these activities internationally with our network of partners. The ministerial support for a five-year follow-up project on drought resilience with a citizen science-based early warning system has been secured.

Transferability and scalability of the research approach and insights gained: Whilst our research is at present firmly embedded in the setting of Luxembourg, it is carried out in an internationally networked manner, also thanks to the international experts on the project’s scientific advisory boards. **The situation in Luxembourg proved an excellent case study** as the pressures on land are well pronounced and more visible than elsewhere as it has been the fast-growing EU country. The sustainability of the social welfare system depends on growing numbers of cross border workers and associated economic growth is given primacy over other objectives. Given the clear limits of the biophysical carrying capacity of the land and impossibility of pure reliance on a more networked resourcing approach in turbulent times, transformation on how we engage with life support systems is required. Luxembourg has only two levels of governance, national and municipal, and serves well to explore the following questions. This presents unique opportunities for a better understanding of cross-scale interactions in transformation processes, and current disconnections between sectoral organizational regimes and governance levels.

**Outcomes of co-design workshops:
Data structure of the WATERLINX APP and engaged user communities**

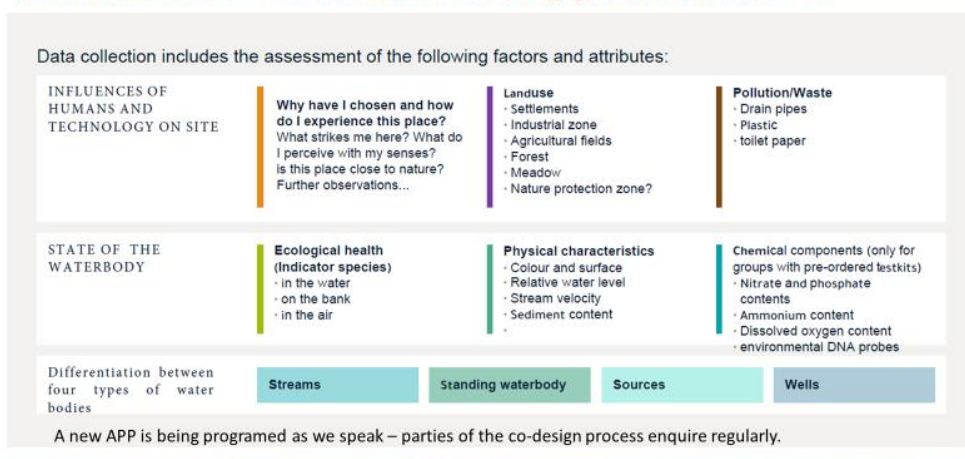


Figure 0.1 Outcomes of co-design workshops: Data structure of the WATERLINX APP