

Principal Investigator

Name	Research Unit	Faculty
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Investigators from the University of Luxembourg

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Project Description

Project Acronym	WATGOV
Project Title	Citizen science for improved water governance
Start Date	01 July 2017
Duration	54.5 months
End Date	14 January 2022

Report Data

Summary of project and its results

Evidence on the interdependent acceleration of biodiversity loss, declining water quality, and land degradation across many world areas, including Western Europe and Luxembourg, suggests that merely reducing human impacts on the environment is no longer sufficient to safeguard life on earth as we know it. Likely consequences of climate change including extreme weather events such as summer droughts will most probably reinforce these dynamics. Regenerative actions for healthy terrestrial and aquatic ecosystems are required to safeguard their functions and enhance their resilience to stress and shocks. However, evidence from over thirty years of case studies on the governance of common pool resources suggests that traditional modes of social coordination including sectoral government regulation and market forces are largely ineffective for the sustainable management or regeneration of common pool resources such as water and fertile top soil (Ostroem, 2009). Regenerative initiatives should take account of complex interdependencies between changes across social and environmental spheres, and across a wider range of spatial and temporal scales (Garmestani et al., 2020). Actions and experimentation will thus benefit from being networked across a range of spatial and temporal scales and levels of governance; at the same time they should take account of changes in different place-based circumstances and human needs and wants in diverse local groups. Accordingly, the WATGOV project is concerned with the interplay of science, policy and practice for the protection and regeneration of surface water bodies. The decline of water quality is conceived as emergent phenomenon in complex social-ecological-technological systems. Our research approach, 'transformative sustainability science', relies on participatory processes to combine scientific knowledge and expertise from the natural and social sciences with place-based knowledge and experiences (König, 2018).

We develop concepts, methods, processes and spaces for participatory scientific inquiry such that they can embrace complexity, contingency, uncertainty and contradictions between diverse experts and interest groups. Citizen science, defined as a process of scientific inquiry to which volunteers contribute as well as expert scientists, presents a promising approach to engage diverse groups across different places, governance levels and across time, in collaborative processes to better understand and enhance our action repertoire to reverse environmental degradation, including declining water quality. The project responds to calls for greater citizen participation in water governance of the EU water framework directive, the CSDD expert opinion on sustainable water governance, as well as Vision 2020 of the to the European Statistical System for the generation of data and statistics from more diversified sources. The WATGOV project presented my team with a first opportunity to engage in developing citizen science approaches for Luxembourg, and beyond. We could engage an internationally leading scientist Prof. Muki Haklay from the University College London as a member of the Committee d'Encadrement de Thèse of the doctoral researcher who was funded through the WATGOV project, and in capacity building efforts in environmental citizen science in Luxembourg. Karl Pickar successfully defended his Dissertation on 16.12.2021, accepted a job as manager in the 'Natur Park Our' in January 2022, with a continued interest in citizen science and collaboration. The final revised version of the Ph.D. Dissertation is to be submitted in due course. The research explored the potential of citizen science as a non-traditional source of data to complement the current data production process for evidence-based policy-making. Conceptual frameworks helped to explore the official data production process in relation to different purposes of environmental policies. These frameworks highlight different challenges that the current official data production process sees itself confronted with in relation to the different purposes of the policies and associated monitoring regimes. The empirical evidence from interviews, workshops and public data collection campaigns demonstrates that citizen science can meaningfully contribute both to the evidence base for policy and practice, as well as to an improved governance process. The project served to co-design a citizen science approach with tools including a detection kit, sets of indicators for different types of water bodies, a prototype mobile application with decision trees to determine data input possibilities (e.g. sets of site-specific or behavioural data including photos and other observations), which respond to quality criteria from diverse stakeholders and citizen volunteers for the co-creation of actionable knowledge. The co-design process engaged stakeholders from relevant administrations, municipalities, a nature parc and environmental NGOs (in four workshops); engaged organisations are interested in continuing collaboration to deploy the tool once it is launched. The process helped to better understand and compare quality and design criteria for tools, processes and spaces (virtual, institutional, social) for citizen science by diverse stakeholders including experts and lay persons, in diverse settings. The programming of the corresponding API and data base is expected to be completed by July 2022. Furthermore, two data collection campaigns were organized in 2019 and 2021 in collaboration with the NGO Earthwatch, using an existing tool set that offers a subset of physico-chemical indicators. The campaigns received public media coverage in which helped to engaged over 300 volunteers and thus contributed to awareness raising on water quality issues and possibilities for remedial action from an accompanying website we developed for the purpose. Together with Earthwatch we also worked with RBC Dexia, who offered employees in the frame of their CSR programme to engage in voluntary data collection. The data clearly highlighted areas where water quality was of concern in that point in time and was used by the national water administration. The data was complementary to official data in that it was geographically more spread out and included small streams in biodiversity rich regions.

Scientific output

The project is scientifically original in the way it conceptualised water quality as an emergent phenomenon in complex social-ecological, technological systems (König et al., 2021; Pickar, 2022), this is apparent both in the citizen science tool set's design and in the social processes for its design and use. New knowledge produced from semi-structured qualitative interviews, three workshops, and documentary review, includes a detailed and critical understanding of the implementation of laws and regulations relating to water quality, and the data landscape that supports regulatory action (König et al., 2021; Pickar 2022). Prevailing practices are discussed in relation to key criteria for adaptive governance in the literature. The doctoral researcher, then, examined different approaches to environmental citizen science in view of their potential to contribute to more adaptive surface water governance. The engagement of leading experts and practitioners working on water quality in Luxembourg in a research-based co-design process allowed to better understand needs and possible ways in which a citizen science can contribute to water governance in Luxembourg from diverse points of view. The co-design process, which involved officials from ministries and the water management agency, the nature and forest administration, as well as local actors of municipalities, river-partnerships, NGOs and activists engaged in water protection, resulted in unique sets of indicators that are deemed appropriate for citizen science for adaptive governance in Luxembourg (see e.g. the WATGOV Working Paper 1 by Pickar & König, 2020). From this co-design process we learnt that our initial focus on indicators such as nutrient levels was of interest (nitrate and phosphate content, high levels of which cause eutrophication, a process that undermines species diversity in aquatic habitats). The collaboration with Prof. Jo Hansen at the FSTC allowed to refine some of the indicators on physico-chemical properties (e.g. dissolved oxygen and ammonia levels in surface water) that are suitable for use in citizen science. However, in response to suggestions at the workshops, the original plan to develop a test kit for pathogenic bacteria was replaced with the development of a set of indicator species for the state of health of diverse types of aquatic ecosystems. This part of the project involved close collaboration with Luxembourg experts on aquatic ecosystems in different types for water bodies from the water management administration, the nature and forest administration and the NGO Natur & Umwelt, this work was mainly carried out by Lena Hirschler, a Master Student in Biology at the University of Trier (WATGOV Working Paper 2). Furthermore, an innovative set of indicators on human-environment interactions to invite data collectors to reflect on their sense of place and how it may relate to their well-being emerged from the process (Pickar, Ph.D. Dissertation, WATGOV Working Paper 3 König et al., 2022). After exploration of diverse options to developing citizen science tool kits, including with colleagues at UCL, we concluded that the most resource efficient solution is to outsource it to an enterprise offering the programming and management of citizen science APIs and databases as a service. The enterprise Spotteron is at present programming the citizen science tool (they already host a related project with some relevant functions). The API is expected to be completed and ready for use by July 2022.

Societal / Industry relevance

The co-design process: This transdisciplinary research approach relied on collaboration with partners from public bodies, organized civil society and private sector enterprises. Continued collaboration and exchange with officials and practitioners informed the research and development process to ensure appropriate framing of research questions to address salient problems in practice. These activities helped establish a network of engaged organisations for further work on citizen science and the decentralization of environmental governance. Working with these experts in turn also helps to legitimate to our findings and methods, and to increase chances that they gain traction in practice. Last but not least, partnerships with public bodies and active involvement in advisory committees, and our interactive research style aiming at dialogic learning by all engaged in interviews and workshops, contribute to capacity building relating to citizen science for decentralized or 'polycentric' water governance in practice with professionals. Public data collection campaigns: In 2019 and 2021 my team lead by doctoral candidate Karl Pickar and I organized two large sampling campaigns with a citizen science tool in collaboration with the Non Governmental Organisation Earthwatch, 's subgroup Fresh Water Watch (FWW). There was significant media coverage both times (Luxemburger Wort, Télécran, Radio 100,7, amongst others). In 2019 we had 113 data points collected by over 80 engaged volunteers collecting and analysing water samples. In 2021 we had just under 311 data points by over 250 volunteers who used a detection kit to assess the nutrient content of water, suggesting awareness raising and learning (invited presentations at the 30. Wissenschaftliches Kolloquium der Deutschen Statistischen Gesellschaft 'Von der Umweltstatistik zur Nachhaltigen Entwicklung' on 19.11.2021, and at the European Statistics Day organized by the European Statistical Advisory Committee: Workshop on non-traditional data sources and data science for official statistics' on 20.10.2021, and Stankiewicz et al., manuscript in preparation). A participant survey with 81 respondents suggested the campaigns contributed to awareness raising on water quality issues and possibilities for remedial action from an accompanying website we developed for the purpose (https://sustainabilityscience.uni.lu/nexus-futures_/citizen-science/; this site is being improved for the virtual Transformation-Lab site we will be launching in the summer). The survey also indicates that a majority of participants are prepared to engage again, also on a more regular basis. Corporate Social Responsibility programme: Furthermore, in the collaboration with Freshwater watch we worked with the bank RBC Dexia. The bank instituted a corporate social responsibility programme inviting their staff to contribute to citizen science data collection over time. At the initiative lunch time presentation 60 employees participated, and about 30 persons attended a training workshop to collect a more extensive data set on water quality. The staff self-organised and continued a planned sample collection over 12 month period in an area of ecological interest with sampling site suggestions by colleagues from the river partnership, finally 6 employees engaged over 12 months collecting 51 data points. The experience points at the potential of working with firms on a larger scale. Press coverage 2021 Télécran 28.4.21. pp. 12-13 Die Belastungen steigen. <https://gemengen.lu/web/2021/04/19/pour-une-gestion-durable-de-leau/> <https://delano.lu/d/detail/news/lux-residents-called-contribute-freshwater-analysis/214356> <https://www.wort.lu/de/panorama/die-wasserqualitaet-in-luxemburg-auf-dem-pruefstand-60897349de135b9236c9dcf6>

Next Steps

The encouraging outcomes of the WATGOV 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 with 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 just been secured. The citizen science approach that emerged from this project is one of several pillars of our national Transformation Lab that we will launch with our partners in government and NGOs in the summer of 2022 (<https://transformation-lab.lu/?ucp-access=ea7f3880>).

Were there any major difficulties that might significantly have hampered the project? If so, describe briefly



The onset of the pandemic and the start of the Lock-Down in March 2020 coincided with a critical phase of the research Ph.D. several planned collaborative participatory events had to be cancelled. The Ph.D. candidate experienced the dissertation writing process in such isolation as difficult. The quality of the output did not match quality of prior work of the candidate, due to the lack of social interaction (inspite of frequent webex meetings and chapter commentaries in the critical writing periods). Nevertheless, most of the main research hypotheses were tested and most of the initial objectives were achieved. However, as the finalization of the definition of the indicators during the pandemic and implementation of the tool took longer than expected we could not proceed to develop exact guidance on how to institute a quality-assured scientific inquiry process, in which citizen volunteers, scientists, policy makers, administrators and private sector water users play a role. The literature review in the Ph.D. thesis as well as the two papers (one published and one close to submission) do however elaborate on the issue of quality assurance in more detail. We could not assess the use or learning of our tool, but instead worked with a suitable place holder of the Earthwatch tool.

The latest expense account statement sent to you by the finance department is Correct

Any other remarks and suggestions

The initial IRP project might lead/facilitated to the submission of the following research applications/projects for external funding

	Project	Funding	(Foreseen) Submission Date	Status	Budget	Project Duration
1	Convention 'Participation and Sustainability' Part 5. NEXUS FUTURES II: Drought resilience: Towards a citizen science-based drought early warning system	Funding Body : Ministry - Government of the Grand Duchy of Luxembourg Funding Program : OTHER Funding Category : National	15 October 2021	Submitted	Requested Budget : 801,000€ Approved Budget - All partners : Approved Budget Split for the University of Luxembourg - FNR / EU or other contribution :	60.0 months

Publications / Outputs

	Type	Publication/ Output	Peer reviewed	Is this journal in the 25% in the field
1	Scientific journals Article	König, A., Pickar, K. A., Stankiewicz, J., & Hondrila, K. (2020). Can citizen science complement official data sources that serve as evidence-base for policies and practice to improve water quality? Statistical Journal of the IAOS, vol. Pre-Press, 1-16. http://hdl.handle.net/10993/46491 Peer reviewed (verified by ORBilu) ORBilu viewed: 96 (20 UL) ; downloaded: 2 (2 UL) — WOS: - — SCOPUS®: 0	YES	

Publications/ Outputs Metrics Synthesis

Number of references	1	Downloads	2
Number of Peer-Reviewed items	1	UL Downloads	2
Views	96	WOS	0
UL Views	20	SCOPUS	0