

Scaling Community-Based Citizen Science for Water Monitoring: Data Validation and Policy Integration Across Agricultural and Natural Catchments

Supervisors: Prof Jaanus Terasmaa, jaanus.terasmaa@tlu.ee; Researcher Marko Vainu, marko.vainu@tlu.ee
CV, publications and running projects can be seen from [ETIS](#) and [ResearchGate](#).
Information about the research group can be seen from [here](#).

National monitoring programmes covers only a fraction of the country's water bodies – In Estonian case approximately 3% of lakes and 14% of streams are monitored on a regular basis. Citizen science offers a scalable, cost-effective complement to professional monitoring, but key challenges remain: ensuring data quality, engaging diverse communities — including farmers in agricultural catchments —, applying AI and machine-learning tools to large heterogeneous datasets, and creating effective pathways from volunteer-collected observations to regulatory decision-making under the EU Water Framework and Nitrates Directives.

This PhD project is part of an active research infrastructure. The supervisor's working group has developed and operates two citizen science platforms: allikad.info (spring monitoring across Estonia and Latvia, with multilingual support and integration into governmental databases, soon widening to other countries) and veestik.info (volunteer surface water body observation and reporting for lakes, rivers, and coastal waters). The project is connected with two EU LIFE-SIP program projects (WetEST and AdaptEST) and the broader work of the Institute of Ecology at Tallinn University on ecohydrology, groundwater-dependent ecosystems, and environmental education. It adopts an Extreme Citizen Science (Level 4) framework and extends volunteer monitoring into agricultural landscapes, addressing nutrient pollution at the catchment scale.

The main research tasks include:

- Evaluating the fitness-for-purpose of citizen-collected hydrological and ecological data (photographs, field measurements, etc) against professional monitoring benchmarks.
- Analysing platform design features (allikad.info, veestik.info) that influence data quality, spatial coverage, and sustained volunteer engagement.
- Developing and testing standardised protocols and quality-control workflows for integrating citizen science data into national water body status assessments.
- Investigating institutional and governance pathways through which citizen science outputs can effectively contribute to River Basin Management Plans and EU Water Framework Directive reporting.
- Exploring the role of digital tools, gamification, and community-based approaches in scaling volunteer water monitoring around the world.
- Co-designing monitoring programmes with local communities using the Extreme Citizen Science (Level 4) approach, where residents co-formulate research questions, select indicators, and interpret results - shifting from data collection to community-led environmental knowledge production.
- Developing data management and quality-control workflows for citizen science datasets, including automated validation and the use of AI/machine-learning for image classification, gap-filling, and pattern detection in volunteer-collected water body data.
- Engaging farmers and rural communities in monitoring agricultural diffuse pollution, particularly nitrate and nutrient runoff, and evaluating how citizen-collected data can support compliance with the Nitrates Directive and inform catchment-level nutrient management.

The research draws on methods from environmental monitoring science, data quality assessment, human-computer interaction, and science and technology studies. Fieldwork will be carried out mostly in Estonian catchments linked to the project areas and the existing allikad.info/veestik.info user communities.

Candidates should hold an MA/MSc degree in environmental sciences, ecology, geography, hydrology, or a related discipline. Experience with GIS, environmental monitoring, or citizen science coordination is an advantage.

Keywords: Citizen science, water body monitoring, data quality, volunteer engagement, Water Framework Directive, springs, lakes, ecohydrology, science-policy interface, community co-design

More information about the Complex Systems in Natural Sciences PhD programme:

<https://www.tlu.ee/en/lti/complex-systems-natural-sciences-phd>