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EDITED AND REVIEWED BY
Boris M. Van Breukelen,
Delft University of Technology, Netherlands

*CORRESPONDENCE
Deborah V. Chapman
d.chapman@ucc.ie

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Editorial: Water quality monitoring and sustainable use of ambient freshwaters

Deborah V. Chapman[1]*, Christopher Gordon[2] and Timothy Sullivan[3]

[1]Freshwater Quality Consultant, Kenmare, Ireland, [2]Institute for Environment and Sanitation Studies, University of Ghana, Accra, Ghana, [3]School of Biological, Earth and Environmental Sciences, College of Science, Engineering and Food Science, Environmental Research Institute, University College Cork, Cork, Ireland

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Editorial on the Research Topic
Water quality monitoring and sustainable use of ambient freshwaters

In the past, sustainable use of freshwater was considered mainly from a water quantity perspective; however, Sustainable Development Goal (SDG 6) target 6.3 (United Nations, 2015) highlights the equal importance of water *quality*. Sustainable water use requires monitoring of both quantity and quality, but the limited data on both water quantity and quality is reducing the efficiency of integrated water resources management, resulting in the deterioration of ambient water quality worldwide. Countries often focus primarily on managing water quantity to improve productivity in agriculture, and to supply urban and industrial sectors. Globally, irrigation is a major use of ambient water, and Karimi et al. argue that introducing simple water quality measurements into water accounting procedures (Vardon et al., 2023) in irrigation schemes could vastly increase information on water quality and contribute to better management of the impacts of agriculture on ambient waters. It would also contribute substantially to the need for more water quality data at a global scale and support the achievement of SDG 6, “Ensure availability and sustainable management of water and sanitation for all.” Karimi et al. present a simple framework that could assist irrigation scheme operators to collect relevant water quality data and assess the relative impact of agricultural activities at local and catchment scales.

Obtaining basic water quality information is feasible at all levels, from local communities to national programmes. However, monitoring newly emerging pollutants, such as pharmaceutical compounds and contaminants of emerging concern, is only possible at limited temporal and spatial scales, even in wealthy countries. To date, most monitoring has relied on advanced chemical analysis using sophisticated instrumentation, which is expensive, leading to spatially and temporally constrained results. Passive samplers, as used by Cacciatori et al., can help generate long-term records over greater spatial scales for a wide range of contaminants of emerging concern. They demonstrate that the combination of citizen science deployments of passive samplers with subsequent detailed chemical analysis in local or regional laboratories can be a highly powerful approach. This approach enhances communication and engagement between scientists and local communities as advocated by Warner et al.. Nevertheless, the review by

Schoenfuss and Kolok highlights that focusing on effects-based monitoring, e.g., adverse biological effects, can overcome some of the limitations of traditional chemistry-based analytical techniques.

The human and analytical resources needed for collecting water quality data can be substantially reduced by taking *in-situ* measurements with handheld or autonomous sensors. Consequently, the development of such instruments is advancing rapidly for an increasing range of parameters. As highlighted in the review by Kumar et al., current sensors are expensive with high power requirements, and they are vulnerable to biofouling-induced sensor drift that necessitates site-specific calibrations. The technology to address these issues is advancing rapidly. The use of multivariable and multi-method (fluorescence, absorbance, scattering, and reflectance) optical water quality monitoring has the potential to augment remotely sensed surface-reflectance datasets with improved *in-situ* monitoring that is critical for remote monitoring of large water bodies, particularly large lakes (Kumar et al.).

Three of the contributions to this Research Topic arose from an innovative hackathon event designed to stimulate discussion and future collaboration on this Research Topic (Chernov et al.). The hackathon was organized by five United Nations agencies and the European Commission, bringing together diverse experts and stakeholders to address challenges in water quality monitoring and assessment. It enabled participants to draw upon their collective knowledge, expertise, and skills to identify bottom-up solutions to water quality challenges and sustainable water use. Citizen science, despite growing in popularity, is currently making only a small contribution to water resource management at a global scale (Warner et al.). Concerns exist over the precision, accuracy, and reliability of monitoring methods used by citizens, making water management agencies reluctant to incorporate citizen data in water quality assessments. Nevertheless, examples such as those from Sierra Leone demonstrate that citizens can contribute to water quality reporting in the context of Sustainable Development Goal 6. One of the key recommendations for the successful engagement of citizens in monitoring (Warner et al.) is to facilitate bi-directional data and information transfer between citizen scientists, water resource managers, and policymakers. This involves including citizen data in national, regional, and global reporting and returning the information to citizens contextualized for local use. A further important outcome of the hackathon was a greater appreciation and understanding of how indigenous people's knowledge can potentially contribute to monitoring and managing ambient water quality. The paper by López-Maldonado et al. focussed on how indigenous knowledge can support water management, in combination with earth observations, with precise and accurate observations of changes in the hydrological cycle. Indigenous people can aid understanding of the different components of the hydrological cycle, e.g., through monitoring, and provide unique scientific knowledge to support protection of water quality. As a result of citizen engagement, local communities are encouraged to act as custodians of their water bodies.

As this Research Topic of papers has highlighted, affordable monitoring tools and approaches are needed that can be applied at local, national, and regional scales. Advances must be made in low-cost sensors, automated sampling and analysis, biological monitoring, remote sensing, engaging citizens, using artificial intelligence, and statistical and modeling techniques to optimize data collection and use and greater use could be made of citizen data and indigenous knowledge. However, more examples of validation and application of these methods and approaches are required to encourage and support their widespread adoption, especially for national-scale monitoring programmes.

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References

United Nations (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development*. New York, NY: Resolution adopted by the General Assembly on 25 September 2015. Available online at: https://sdgs.un.org/2030agenda (accessed March 25, 2024)

Vardon, M. J., Ha, T., Le, L., Martinez-Lagunes, R., Pule, O. B., Schenau, S., et al. (2023). *Water Accounts and Water Accounting*. Paris: Global Commission on the Economics of Water.