frontiers | Frontiers in Water

TYPE Editorial
PUBLISHED 26 November 2024
DOI 10.3389/frwa.2024.1516711

OPEN ACCESS

EDITED AND REVIEWED BY
Saket Pande,
Delft University of Technology, Netherlands

*CORRESPONDENCE
Francis O. Arimoro
francisarimoro@gmail.com

†PRESENT ADDRESS
Gordon C. O'Brien,
Gulbali Institute, Charles Sturt University,
Albury, NSW, Australia

RECEIVED 24 October 2024
ACCEPTED 11 November 2024
PUBLISHED 26 November 2024

CITATION
Arimoro FO, Masese FO and O'Brien GC (2024) Editorial: Advances in biomonitoring of African aquatic ecosystems, volume II. *Front. Water* 6:1516711. doi: 10.3389/frwa.2024.1516711

Editorial: Advances in biomonitoring of African aquatic ecosystems, volume II

Francis O. Arimoro[1]*, Frank O. Masese[2] and Gordon C. O'Brien[3†]

[1]Department of Animal Biology, Federal University of Technology Minna, Minna, Nigeria, [2]Department of Fisheries and Aquatic Sciences, University of Eldoret, Eldoret, Kenya, [3]School of Biology and Environmental Sciences, University of Mpumalanga, Mbombela, South Africa

KEYWORDS

biomonitoring, riverine ecosystems, sustainability, Africa, water resource management, conservation, biodiversity

Editorial on the Research Topic
Advances in biomonitoring of African aquatic ecosystems, volume II

Introduction

Biomonitoring has emerged as a crucial tool for the sustainable management of vulnerable African riverine ecosystems. Studies across Africa emphasize the significance of biomonitoring for assessing river ecosystem health, despite existing challenges that hinder its widespread adoption (Masese et al., 2013; Mangadze et al., 2019; Feio et al., 2021; Ogidi et al., 2024). Effective biomonitoring strategies can inform conservation efforts, support sustainable water resources management, and promote ecosystem resilience (Babafemi et al., 2024). African researchers and policy makers increasingly recognize biomonitoring's value in maintaining healthy river ecosystems.

One of the primary challenges hindering biomonitoring efforts is the limited financial resources available. Additionally, inadequate technical capacity, including a shortage of skilled taxonomists, poor knowledge of the taxonomy of most species, lack of adequate taxonomical literature and identification guides, limited infrastructure, and insufficient data collection across broad spatial and temporal scales further constrain biomonitoring initiatives (Masese et al., 2013). Existing biomonitoring programs primarily focus on physical and chemical parameters alongside biological communities, but often lack comprehensive guides (Masese et al., 2024). To make biomonitoring programs more comparable across regions and countries, there is a need to standardize and widely test existing indices, such as multimetric and biotic indices. Moreover, recent studies emphasize the significance of community engagement in biomonitoring efforts (Aura et al., 2021). Citizen science initiatives that empower local volunteers with training and accessible monitoring tools have been advocated. Such initiatives enhance data quality and foster community involvement in environmental stewardship (Kitaka et al.). Strengthening the scientific rigor of biomonitoring programs is essential to avoid potential negative consequences, such as unjustified burdens on water users or unrecognized environmental damage. Novel biomonitoring indices and models have been proposed to address current gaps in monitoring practices. These innovative approaches encourage broader participation from communities (Kitaka et al.).

Biomonitoring's continued advancement relies on exploring innovative methods and technologies, such as the use of biomarkers like eDNA, that complement traditional approaches. Integrating these advances is vital for sustainably managing Africa's vulnerable riverine ecosystems. As emphasized by Masese et al. (2021), developing accessible, affordable, and reliable biomonitoring tools is essential for informed conservation efforts. Empowering local communities through training and accessible monitoring tools fosters community-led environmental stewardship. Combining traditional and innovative assessment practices ensures comprehensive monitoring and informed decision-making (Kouril et al., 2016; Kelly et al., 2022).

Africa's riverine ecosystems face numerous threats, including pollution, habitat destruction, invasive and alien species, land use change, climate change, and unsustainable water management practices. These pressures compromise ecosystem health, affecting biodiversity, human wellbeing, and economic development (Keke et al., 2021; Arimoro et al., 2021). Biomonitoring has emerged as a vital tool for assessing and managing riverine ecosystem health, providing comprehensive insights into ecosystem conditions and enabling informed decision-making.

This second volume in the series, "*Advances in biomonitoring of African aquatic ecosystems*," emphasizes the vital importance of biomonitoring in evaluating and ensuring the sustainability of Africa's vulnerable riverine ecosystems. These ecosystems face numerous, interconnected threats, including pollution, habitat destruction, and climate change. To effectively address these complex challenges, a multidisciplinary and collaborative approach is crucial, necessitating the integration of diverse methodologies, data sources, and expertise to inform management and conservation efforts.

A comprehensive framework is needed to evaluate riverine ecological health. The approach should be holistic, cost-effective, easy to use and rapid. Thus, assessment of the ecological conditions should consider a triad of approaches that evaluate the physico-chemical water quality, habitat quality and biological communities (Dallas, 2021; Masese et al., 2021). There is a significant correlation between high biodiversity and favorable environmental conditions, emphasizing the critical importance of ecological integrity in supporting diverse aquatic life. For instance, among macroinvertebrates, Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa, are renowned sensitive indicators of ecosystem health, and thrive in environments with minimal human disturbance, and characterized by stable substrates and clear water quality (Dallas, 2021; Masese et al., 2023). In this regard, biomonitoring tools play major roles in guiding conservation strategies and informing water resource management decisions. By leveraging biomonitoring tools, stakeholders can make informed choices to protect aquatic ecosystems, ensuring the long-term sustainability of Africa's riverine ecosystems (Masese et al., 2021).

Advances in biomonitoring II

This Research Topic (Volume II) showcases four exemplary research studies that demonstrate the effectiveness of biomonitoring in protecting and preserving African aquatic ecosystems. A study by Lubembe et al. on tilapia fish cage aquaculture in Lake Kivu, Democratic Republic of the Congo, reveals alarming environmental consequences. The research shows that this practice significantly alters the water's physico-chemical parameters, leading to increased nutrient levels, eutrophication, and loss of local biodiversity. These changes have far-reaching impacts on aquatic life and the communities that depend on these ecosystems for their livelihoods. The study's findings emphasize the urgent need for sustainable aquaculture practices that balance environmental protection with economic benefits.

A critical review of biomonitoring in East African rivers by Kitaka et al. emphasizes the importance of community-based collaboration for environmental change observation. The review highlights that integrating local knowledge through citizen science initiatives enhances data collection and ecological assessments, empowering communities and building awareness about river health and sustainability. To effectively engage communities, the study recommends developing user-friendly bioindicators and implementing training programs to equip community members with necessary monitoring skills. This collaborative approach fosters inclusivity, accuracy, and sustainability in biomonitoring, ultimately contributing to better conservation and management of East African river ecosystems.

Research conducted in QwaQwa, South Africa, by Avenant et al. presents a ground-breaking water quality monitoring approach that combines biological *in vitro* tests with chemical analyses, providing a comprehensive understanding of water quality. This dual methodology bridges the gap between chemical pollutant detection and biological response assessment, enabling researchers to better evaluate ecosystem health and identify potential risks posed by human activities. The integrated approach offers enhanced sensitivity, accuracy, and informed decision-making for environmental management, making it a model for vulnerable riverine systems in Africa where human activities pose significant environmental threats.

Nyagongo et al.'s study on the Lukosi River catchment investigates the impact of human activities on water quality, identifying key physico-chemical parameters as effective indicators. The research reveals that agricultural runoff, industrial discharges, and urbanization significantly degrade water quality, posing health risks to local communities. By establishing clear connections between human activities and water quality indicators, this study informs the development of targeted strategies to mitigate adverse impacts and promote sustainable practices, ultimately supporting the protection and restoration of the Lukosi River catchment.

Conclusion

In conclusion, biomonitoring is vital to protecting Africa's vulnerable riverine ecosystems. To ensure effective management and conservation, we must adopt multidisciplinary approaches, engage local communities, and leverage innovative methodologies.

This Research Topic (Volume II) on *Advances in biomonitoring of African aquatic ecosystems* represents a landmark contribution to this discourse, reinforcing the critical need for interdisciplinary collaborations, tailored region-specific monitoring protocols, and community engagement. This comprehensive resource enhances biomonitoring's scientific rigor and efficacy, fostering collaboration and evidence-based decision-making.

As we move forward, collective action is imperative. We urge governments, organizations, and individuals to support community-led biomonitoring initiatives, invest in cost-effective and innovative methodologies and technologies, foster collaborative relationships, and prioritize policy-making informed by biomonitoring data. By working together, we can safeguard Africa's riverine ecosystems, promote sustainability, protect biodiversity, and preserve ecological balance for generations to come, ensuring a resilient and sustainable environmental future.

Author contributions

FA: Conceptualization, Supervision, Writing – original draft, Writing – review & editing. FM: Writing – original draft, Writing – review & editing. GO'B: Writing – original draft, Writing – review & editing.

Acknowledgments

We extend our gratitude to Neels Kleynhans for his invaluable contributions to conceptualizing this Research Topic. His expertise significantly enhanced the Research Topic's success. We also appreciate the time and effort invested by all contributing authors and reviewers.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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