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Water Resources Management for a Sustainable and Just Future

CoRE Webinar Series 1.0

BOOK OF ABSTRACTS

August 2025 – March 2026

WATER SECURITY | SUSTAINABILITY | EQUITY & JUSTICE | RESILIENCE | INNOVATION

Water Resources Management for a Sustainable and Just Future CoRE Webinar Series 1.0

Book of Abstracts

August 2025 – March 2026

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August 29, 2025

Healthy waterscapes, healthy people: Bringing river health into being

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We explored the interconnected relationship between river health and human health through the concept of healthy waterscapes. Drawing on recent research on citizen science, river commons governance, and living landscapes [1, 2], we argue that river health extends beyond technical problems to include the social, cultural, political, and relational dimensions through which people live with rivers and care for water. Building on a One Health perspective, we position rivers as lifelines that sustain human health, biodiversity, culture, and economies. We highlight how degradation of catchments, pollution, failing infrastructure, and unequal access to water threaten both ecosystems and people. River health and human health are inseparable, requiring approaches that recognise rivers as socio-ecological systems shaped by interactions between ecological processes, governance arrangements, and everyday human practices. Drawing on research on river commons co-learning and citizen science [1], we explores how healthy waterscapes come into being through practices of collective monitoring, reflection, and action. Health is a process of practice and commoning, linking science with lived experience, and shaping community mindsets around care for the river commons, communities contribute to restoring and sustaining river health. Healthy waterscapes therefore emerge through social-ecological relationships, together with technical metrics, and include healthy people and community engagement. We further emphasise that water is not just material but also cultural, political, and embodied. Building on the concept of healthy landscapes, healthy people [2], we argue that health is made with landscapes and waterscapes through drinking, washing, rituals, recreation, and everyday practices of living. Waterscapes are understood as socio-natural commons, entwined with histories of inequality, infrastructure, governance, and diverse forms of knowledge. Using examples such as cholera outbreaks, we illustrate how human health challenges can be understood as the product of a breakdown in the relationship between humans and the microbial world. The findings suggest that effective water governance requires moving beyond reductionist approaches to integrate social, cultural, ecological, and health perspectives. Citizen science as a mode of co-learning recognises rivers and as commons, fostering community participation are identified as important pathways towards healthier rivers, more resilient communities, and improved public health. We conclude that healthy waterscapes are made, not found. They come into being through relationships between people, rivers, water, institutions, and ecological processes. To care for water is ultimately to care for ourselves and our health.

[1] Mickelsson, M., Thifhulufhelwi, R., Mvulane, P., Brownell, F., Russell, C., & Lotz-Sisitka, H. (2024). Bringing river health into being with citizen science: River commons co-learning and practice. South African Journal of Science, 120(9/10). https://doi.org/10.17159/sajs.2024/17795

[2] Mickelsson, M., Mandikonza, C., & O'Donoghue, R. (2025). Healthy landscapes, healthy people: living landscapes as sites for the integration of heritage and modern health knowledges. Critical Public Health, 35(1). https://doi.org/10.1080/09581596.2025.2505753

The critical development of water resource models for Africa, with a particular focus on emerging socio-hydrology tools

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Water scarcity is an intensifying challenge across Africa, where climate variability, growing water demand, ecological vulnerability, and inequitable access increasingly strain water governance systems. In South Africa's Koue Bokkeveld region of the Western Cape, recurrent droughts, low rainfall, expanding agricultural demand, and altered river flows caused by farm dams have intensified competition between upstream and downstream users, while placing Environmental Water Requirements and endemic aquatic biodiversity at risk. This study presents an integrated socio-hydrological modelling and stakeholder engagement framework developed to support fair, adaptive, and environmentally sustainable water sharing in the Koue Bokkeveld.

The project combined hydrological modelling, water-balance tools, agent-based modelling, and participatory planning processes to understand catchment dynamics and test alternative water allocation strategies. Established hydrological models, including the Pitman model (developed in South Africa) and SWAT+ (developed in the USA), were used alongside farm- and catchment-scale water-balance to assess water availability and human impacts on streamflow. An Agent-Based Model (developed in France) was co-developed with local stakeholders to simulate farmer water-use behaviour, catchment stress, Environmental Water Requirement deficits, and adaptation options under future climate and development scenarios. This was complemented by a Water Sharing Tool tools (developed in South Africa), which used stakeholder-defined user groups, community weighting, vulnerability assessment, impact curves, and alternative allocation strategies to explore equitable approaches to water distribution.

Results show that human water use, particularly reservoir storage and irrigation abstraction, significantly alters streamflow and worsens downstream water scarcity during dry years. Climate change scenarios indicate increasing catchment stress, more frequent water shortages, and greater risk of Environmental Water Requirement non-compliance. However, adaptive strategies such as increased dam storage and a shared reservoir managed through the Water User Association substantially reduced farm water deficits and improved maintenance of environmental flows. Stakeholder engagement, supported by Adaptive Planning Process and ARDI approaches, was central to model development, validation, trust-building, and the emergence of a shared catchment vision.

The study demonstrates the value of integrated socio-hydrological modelling for addressing complex water allocation challenges in Africa. By combining hydrological evidence, agent-based simulations, participatory tools, and locally grounded stakeholder engagement, the approach provides a practical basis for collaborative water governance, conflict reduction, ecosystem protection, and climate adaptation. The findings highlight the need for continued investment in long-term stakeholder engagement, science communication, data sharing, and transdisciplinary modelling capacity to support sustainable and equitable water resource management in water-scarce regions.

[1] Gwapedza, D., Barreteau, O., Mantel, S., Paxton, B., Bonte, B., Tholanah, R., Xoxo, S., Theron, S., Mabohlo, S., O'Keeffe, L., Bradshaw, K., and Tanner, J. (2024) Engaging stakeholders to address a complex water resource management issue in the Western Cape, South Africa. Journal of Hydrology, 639.

[2] Xoxo, S., Tanner, J., Mantel, S., Gwapedza, D., Paxton, B., Hughes, D. and Barreteau, O., (2023). Equity-based allocation criteria for water deficit periods: A case study in South Africa. In International Conference on Decision Support System Technology (pp. 137-155). Cham: Springer Nature Switzerland.

[3] Tanner, J.L., Mantel, S., Paxton, B., Slaughter, A. and Hughes, D. (2022) Impacts of climate change on rivers and biodiversity in a water-scarce semi-arid region of the Western Cape, South Africa. Frontiers in Water, 4 p.143.

September 26, 2025

Photoreactor Engineering for Water Treatment: Projects and Field Deployments

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This presentation synthesizes over 25 years of research and practice in photoreactor engineering for water treatment, spanning solar and UV–LED radiation modeling, process modeling and evaluation, and (photo)catalytic materials, applied to drinking water, wastewater reuse, industrial water, and disinfection (UV and SODIS).

Building on this technical foundation, a portfolio of European and international initiatives is showcased, including WATERSPOUTT, PANIWATER, REWATERGY, DEEP PURPLE, HYSOLCHEM, MOTREM, and ArtiFUEL, which collectively advance context-appropriate, low-energy, and scalable solutions across the water sector. Field deployments highlight how technology and community partnerships intersect at the WASH, Water–Food–Health, and Water–Energy–Climate nexuses. In refugee-camp settings in arid regions, the SAHARAPONICS project demonstrates aquaponics-based local food production with minimal water consumption, from installation through operational stages with end users. In Tanzania, the MAJI SALAMA project focuses on the provision of safe drinking water at the Amani Children's Home, showing pathway-to-impact from laboratory innovation to social implementation. Alongside these deployments, peer-reviewed outputs document the feasibility and performance of solar-driven disinfection and integrated water–food systems under real-world constraints.

Together, these efforts present a practice-tested blueprint for sustainable and just water resources management: leverage photonic processes and robust reactor design; validate under resource-limited conditions; and collaborate with local stakeholders to co-create solutions that are technically effective, affordable, and socially embedded.

[1] J. Marugán, C. Pablos, L. Le Goueff, M.M. Sidi and F.O. Mohamed. SAHARAPONICS Project: Local production of food of high nutritional quality and minimal water consumption in refugee camps in arid areas. Societal Impacts 5: 100110 (2025). https://doi.org/10.1016/j.socimp.2025.100110

[2] S.S. Nair, R. Marasini, L Buck, R. Dhodapkar, J. Marugán, K.V. Lakshmi, K.G. McGuigan. Life cycle assessment comparison of point-of-use water treatment technologies: solar water disinfection (SODIS), boiling water, and chlorination. Journal of Environmental Chemical Engineering 11: 110015 (2023). doi:10.1016/j.jece.2023.110015

[3] A. García Gil, R.A. García Muñoz, A. Martínez García, M.I. Polo López, A.G. Wasihun, M. Teferi, T. Asmelash, R. Conroy, Kevin G. McGuigan, J. Marugán. Solar water disinfection in large volume containers: from the laboratory to the field. A case study in Tigray, Ethiopia. Scientific Reports 12: 18933 (2022). doi:10.1038/s41598-022-23709-5

[4] A. García-Gil, R. García-Muñoz, K.G. McGuigan, J. Marugán. Solar Water Disinfection to Produce Safe Drinking Water. A Review of Parameters, Enhancements, and Modelling Approaches to Make SODIS Faster and Safer. Molecules 26: 3431 (2021). doi:10.3390/molecules26113431

[5] J. Moreno-SanSegundo, S. Giannakis, S. Samoili, G. Farinelli, K.G. McGuigan, C. Pulgarín, J. Marugán. SODIS potential: a novel parameter to assess the suitability of solar water disinfection worldwide. Chemical Engineering Journal 419: 129889 (2021). doi: 10.1016/j.cej.2021.129889

Enhancing Water Security and Climate Resilience

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Water security is increasingly threatened by climate change, population growth, competing water demands, and uneven distribution of water resources. In Tanzania, declining per capita annual renewable water resources, climate variability, and increasing development pressures have intensified challenges related to water availability, accessibility, quality, and resilience [1]. Great Ruaha River Catchment within the Rufiji Basin exemplifies these challenges, where growing water demand, ecosystem dependence, and climate variability have heightened water stress and increased competition among water users [2,3]. Evidence from hydrological and climate analyses indicates significant shifts in water availability patterns, including declining low flows, increasing rainfall variability, more frequent high-intensity rainfall events, and rising temperatures under both SSP2-4.5 and SSP5-8.5 scenarios [2]. Wetland assessments show that evaporation accounts for the largest proportion of water losses, while groundwater infiltration and storage changes contribute smaller fractions of the water balance [2,3]. These changes are expected to affect both surface and groundwater systems, with implications for water allocation, ecosystem sustainability, and the reliability of water supplies for multiple users.

Different water demand allocation scenarios under the dynamic conditions were evaluated using the Water Evaluation and Planning (WEAP) model to assess alternative management strategies. The approach emphasizes on flexibility, scenario-based planning, stakeholder participation, and the integration of multiple water sources and management options. The results demonstrate that improving irrigation efficiency and promoting conjunctive use of surface and groundwater resources provide more favorable outcomes for reducing unmet water demands than infrastructure expansion alone [2]. The analysis further highlights governance constraints and power dynamics as significant barriers to effective water resources management.

Enhancing water security and climate resilience therefore requires a transition towards adaptive and integrated water management approaches that recognize the catchment complex nature of hydrological, ecological, social, and economic systems. Participatory governance provide the foundation for informed decision making, equitable resource allocation, and sustainable development under conditions of increasing climatic uncertainty and competing water demands.

[1] Ministry of Water. (2020). Water Sector Status Report (WSSR) 2015–2020. United Republic of Tanzania. https://www.maji.go.tz/

[2] R. Twaha, J. Nobert, A.C. Alexander, D.M.M. Mulungu, T. Ndimbo, G. Mollel, … A. Porroche-Escudero, (2026). Evaluating water allocation scenarios to inform water resource development decisions in the Great Ruaha River Catchment, Tanzania. International Journal of River Basin Management, 1–22. https://doi.org/10.1080/15715124.2026.2629607

[3] R.Twaha, J. Nobert, A.C. Alexander, D.M.M. Mulungu and M,Senga (2024) Delineating groundwater potential zones with GIS and analytic hierarchy process techniques: the case of Great Ruaha River catchment, Tanzania. Hydrogeology Journal. https://doi.org/10.1007/s10040-024-02769-z

Water sciences and governance[**]

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This lecture explored the relationship between water science, hydrogeology, and governance in the sustainable management of transboundary groundwater resources. Using the Senegal-Mauritanian Aquifer Basin as a case study, the presentation demonstrated how scientific knowledge can support cooperation among countries sharing groundwater resources and contribute to regional water security. The basin extends across Senegal, Mauritania, The Gambia, and Guinea-Bissau and represents a critical source of freshwater for millions of people, supporting domestic consumption, agriculture, industry, and ecosystem functions.

The lecture began with an overview of the hydrogeological characteristics of the basin and its strategic importance for socio-economic development in West Africa. Groundwater was described as an essential but often poorly understood resource whose management is complicated by limited monitoring data, uneven institutional capacities, and the invisible nature of aquifer systems. These challenges are further intensified by population growth, urban expansion, increasing agricultural demand, groundwater overexploitation, contamination risks, and the impacts of climate change.

A central theme of the lecture was the need to bridge the gap between scientific research and policy-making. Effective governance of shared aquifers requires reliable hydrogeological information, coordinated monitoring systems, and mechanisms that facilitate communication between scientists, decision-makers, and stakeholders. The presentation highlighted ongoing initiatives aimed at developing a common knowledge base for the aquifer, including groundwater assessments, data-sharing platforms, and collaborative research programs involving all participating countries.

The lecture also examined the legal and institutional dimensions of transboundary groundwater governance. Particular emphasis was placed on establishing cooperative frameworks that promote equitable resource allocation, prevent conflicts, and support long-term sustainability. Capacity-building programs, regional partnerships, and stakeholder engagement were presented as essential components for strengthening governance structures and improving decision-making processes.

The case study demonstrated that water governance extends beyond technical water management and plays a significant role in regional stability, environmental protection, and socio-economic development. The lecture concluded that integrating water science with governance mechanisms can provide a foundation for sustainable groundwater management and foster cooperation among neighboring countries facing shared water challenges. Such approaches are increasingly important in a world where water scarcity and climate-related pressures continue to grow.

[**] The abstract is an AI generated summary of the Webinar lecture carried over zoom.

Overview of water research at the IWR with a focus on water quality and water governance

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The Institute for Water Research (IWR) at Rhodes University is the home to two Centres: the ARUA Water CoE and the Centre for Environmental Water Quality (CEWQ). IWR is a leading continental water research institute. Water quality and governance research at the IWR focuses on emerging contaminants, antimicrobial resistance, environmental water quality, public health, freshwater ecology (biomonitoring, ecosystems ecology, functional ecology and community ecology). There is also an extensive focus on understanding how environmental change at different scale influence ecosystem processes, function and the services these systems provide. Water governance research has a strong focus on the intersection of equity, efficiency and sustainability in local water services institutions and at the nexus of water and food. In addition to these, the IWR has extensive experience in social-ecological system research, transdiscplinary scholarship, science-policy-practice interface work, hydrological modelling and uncertainty analysis as well as GIS and remote sensing.

Research within the Institute is organised into five themetic areas as follows:

1 Pollution and biodiversity loss

2 Water services delivery for equitable and socially just outcomes

3 Water for food, public health and the environment

4 Hazard, risks and catchment resilience

5 Data, tools and model for effective decision making

Across all five research themes, the IWR has implemented multiple projects such as developing national water quality guidelines for aquatic ecosystems in South Africa, modeling water quality in contested catchment areas, investigating equity related changes during drought implementation measures in local municipalities and developing early warning systems for emergence of zoonotic diseases spread in urban river systems.

The IWR offers degrees (PhD and MSc) in Water Resource Science, and in Hydrology. A third MSc degree is being developed in Water and Catchment Sciences with three streams: Hydrology, Ecology and Water Quality, and Transdiciplinary Water Science.

October 24, 2025

Advanced processes for removal of micropollutants from wastewaters

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Newly implemented Urban Wastewater Treatment Directive (UWWTD), 3019/2024/EU, requires the removal of micropollutants from urban wastewater. To cover at least 80% of the treatment costs, it requires extended producer responsibility schemes with two most impactful industrial sectors, pharmaceuticals and cosmetics producers. Based on recent 2024–2025 reports, approximately 52% to 56% of global household wastewater is safely treated before discharge. In contrast, in the European Union, over 90% of urban wastewater is collected and treated in compliance with EU standards. Therefore, there is a growing commitment to understand and manage pollution with persistent organic micropollutants such as pharmaceuticals, personal care products, industrial chemicals, additives and microplastics [1]. These contaminants show mostly long-term effects (carcinogenicity, mutagenicity, genotoxicity, disruption of endocrine system etc.), with already very low concentrations in the range of μg L^{-1}. Their persistency and bioaccumulation in the environment are of further concern, as well as the challenges of drinking and waste water treatment, because they can not be removed by traditional technologies (e.g. coagulation, flocculation, oxidation, filtration, biological treatment etc.). New treatment methods are being developed to improve and upgrade conventional systems to tackle these problems. Advanced oxidation processes (AOPs) are widely accepted for the degradation of resistant micropollutants or at least to enhance their biodegradability. Key methods include ozone, combined with UV or hydrogen peroxide, Fenton and photo-Fenton reactions, photocatalysis, electrochemical oxidation, and ultrasound-assisted cavitation [2]. AOPs are continuously being developed in the direction of 'low-cost, high-tech, chemical-free' ideal. The aim of this presentation was to discuss current trends aimed at solving problems in the research and application of such processes in: i) municipal wastewater recycling, ii) treatment of refractory industrial wastewater, iii) groundwater remediation; and iv) water disinfection to strengthen approaches world-wide.

[1] A. Pistocchi, H.R. Andersen, G. Bertanza, A. Brander, J.M. Choubert, M. Cimbritz, J.E. Drewes, C. Koehler, J. Krampe, M. Launay, P.H. Nielsen, N. Obermaier, S. Stanev, D. Thornberg, Treatment of micropollutants in wastewater: Balancing effectiveness, costs and implications, doi.org/10.1016/j.scitotenv.2022.157593.

[2] VSA, Evaluation of the energy and cost key figures of processes for the elimination of micropollutants in wastewater treatment plants (2025).

Watershed Restoration and Rehabilitation in the face of Climate Change

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Climate change threatens montane forest ecosystems globally, with profound implications for biodiversity, hydrological regulation, and watershed function. Shifting temperature and precipitation regimes are expected to alter the distribution and ecological interactions of dominant tree species in the Dry Evergreen Afromontane forests of Ethiopia, a critical component of the Eastern Afromontane biodiversity hotspot. Understanding these responses is essential for guiding climate-adaptive landscape restoration and watershed rehabilitation.

A study on two co-occurring keystone species, *Juniperus procera* and *Olea europaea* subsp. *cuspidata*, assessed future climate impacts using an ensemble species distribution modelling framework (MaxEnt, Random Forest, Boosted Regression Trees). The models were run under current and future climate scenarios (SSP2-4.5 and SSP5-8.5) for the period 2061–2080. Results revealed strongly contrasting responses. *J. procera*, a climate-sensitive montane specialist, is projected to experience substantial habitat contraction and upslope displacement. Highly suitable habitat for this species is expected to decline by 30.9% under SSP2-4.5 and 47.6% under SSP5-8.5. In contrast, the more drought-tolerant *O. europaea* shows greater resilience, with smaller reductions of 10.99% and 29.55%, respectively, and expansion into newly suitable areas. Environmental niche overlap between the two species declines progressively, indicating increasing ecological differentiation under future climates.

Beyond biodiversity, both species sustain watershed functions across Ethiopia's highlands. They contribute to soil stabilization, infiltration enhancement, runoff regulation, and groundwater recharge. These processes support dry-season base flows in rivers and streams. Such base flows are critical not only for Ethiopia's domestic water supply, agriculture, and hydropower but also for downstream neighboring countries. Sudan, South Sudan, Kenya, and Somalia depend on transboundary rivers originating in the Ethiopian highlands, including the Blue Nile (Abbay), Tekeze, Baro-Akobo, and Omo-Turkana basins. Projected habitat declines, particularly for *J. procera*, risk reducing dry-season base flows. They also threaten to accelerate soil erosion and sedimentation, diminishing reservoir storage capacity and hydropower efficiency across the Eastern Nile Basin and other transboundary systems. These changes could heighten regional water insecurity and downstream ecosystem degradation.

These findings have direct relevance for Ethiopia's Green Legacy Initiative, a national large-scale afforestation and landscape restoration program. While the Initiative has made substantial progress in tree planting, our results underscore the need to move beyond generic afforestation toward climate-smart restoration. Such an approach should prioritize climate-resilient native species (e.g., *O. europaea*). It must also protect high-elevation climatic refugia for vulnerable species like *J. procera* and maintain altitudinal connectivity to facilitate species migration. Integrating species distribution modelling into the Green Legacy framework can enhance the long-term effectiveness of restoration investments. This integration will help sustain transboundary base flows, reduce downstream sedimentation, and safeguard regional water-energy-food-ecosystem security. Climate-adaptive watershed rehabilitation must therefore align national restoration ambitions with transboundary hydrological realities.

November 21, 2025

Anomalies in water

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Water is a paradigmatic anomalous liquid, displaying counterintuitive thermodynamic, structural, and dynamic behavior. Notable anomalies include a density maximum upon cooling, increased compressibility and heat capacity at low temperatures, and non-monotonic diffusion under pressure. These phenomena arise from the competition between local tetrahedral ordering and more compact molecular arrangements driven by hydrogen bonding.

In this presentation, we summarize the main water anomalies, discuss their physical origin, and illustrate how simplified theoretical models and simulations capture the essential features of real water [1-3].

[1] URBIC, Tomaz, DILL, Ken A. Water is a cagey liquid. Journal of the American Chemical Society (2018), 140, 17106-17113. doi: 10.1021/jacs.8b08856.

[2] URBIC, Tomaz. Analytical modeling of thermodynamic and transport anomalies of water. Acta chimica slovenica (2021), 68, 505-520. doi: 10.17344/acsi.2021.7048.

[3] OGRIN, Peter, URBIC, Tomaz. Calculating a phase diagram of a simple water model using unsupervised machine learning on simulation data. Journal of chemical theory and computation (2025), 21, 3867-3887. doi: 10.1021/acs.jctc.4c01456.

Nature-based Solutions for African Resilience (NbS4AfrRes) Project Presentation

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Nature-based Solutions (NbS) are actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature [1]. NbS go beyond and complement land restoration efforts to stem biodiversity and ecosystem service losses by incorporating nature-conscious design principles. Increasingly embedded in international, national and local agendas [2-4], NbS can address complex societal challenges, since ideally, they are locally appropriate and ethical actions that align with natural ecosystem processes and support the natural adaptability of ecosystems.

The NbS4AfrRes project's overall objective is to enhance the capabilities of future professionals (current students) and current environmental specialists and engineers (through professional development courses) to facilitate climate resilience in Africa. Designing and implementing inclusive NbS requires specific knowledge and innovative approaches with close involvement of all affected and interested stakeholders. This means that we need to train built engineering and environmental science students in new ways and equip professionals with new insights and skills. This is an important strategy not only to combat the impacts of climate change but also to stem brain drain and migration out of Africa.

The project is funded by Erasmus+, and the consortium consists of two universities in South Africa (Rhodes University and University of Cape Town [UCT]), two universities in Senegal (Ecole Polytechnique of Thies [EPT] and Université Cheikh Anta Diop [UCAD]), and three partners in the EU: TÜ Delft (Netherlands), AgroParisTech (France) and Institut National de Recherche Pour L'Agricuture, L'alimentation et L'Environnement (INRAE, France).

Two key instruments are being developed under the project. Firstly, our focus is on promoting NbS in Higher Education Institutions (HEIs) curricula, which aligns with Rhodes University's Institutional Development Plan's focus on research and postgraduate students. Secondly, the project extends beyond university curricula in HEIs and addresses the need to build the capacity of actors who are integral to the design, development, and implementation of resilient infrastructure. NbS sits high on the sustainable development agenda and is cited in the EU-Green Deal, AU-Agenda 2063, and national policy documents in both Senegal and South Africa. The project team members from African HEIs have contextualised and updated six postgraduate-level courses originating with European partners, as well as six short (2-3 days) courses for professionals. The project's dual-track approach, targeting both future professionals through HEIs and current practitioners through short courses, ensures both immediate and long-term impact. The emphasis on transdisciplinary, locally relevant, and practically applicable content, along with structures for accreditation and integration, positions the NbS4AfrRes initiative as a model for enduring educational transformation in support of Africa's green and just transition.

To learn more about the project, see https://shorturl.at/RqRI1 for The Conversation's popular article.

[1] UNEA-5. (2022). Resolution adopted by the United Nations Environment Assembly on 2 March 2022. In Report of the United Nations Environment Assembly of the United Nations Environment Programme. https://wedocs.unep.org/rest/api/core/bitstreams/48660288-8fac-4627-b9e0-34234496517b/content

[2] Bauer, W., & Titz, A. (2025). Manoeuvring barriers: Assessing adaptive strategies for and persistent barriers to urban Nature-based Solutions in Lilongwe, Malawi. Nature-Based Solutions, 7(March). doi:10.1016/j.nbsj.2025.100224

[3] Cohen-Shacham, E., Walters, G., Janzen, C., & Maginnis, S. (2016). Nature-based Solutions to Address Global Societal Challenges (S. Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis (Ed.)). IUCN International Union for Conservation of Nature. doi:10.2305/iucn.ch.2016.13.en

[4] Seddon, N. (2022). Harnessing the potential of nature-based solutions for mitigating and adapting to climate change. Science, 376, 1410–1416.

The role of water and clean water supply in Sub-Saharan Africa - A social science perspective

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This presentation discusses the role of water from a social science perspective, highlighting large-scale empirical research on water access, consumption behavior, and socioeconomic impacts, alongside the potential for collaboration using geospatial indicators developed by the Global Data Lab.

My research focuses on understanding the uptake of improved water services and their consequences for health and economic outcomes. Using both secondary data and original surveys and field experiments, my research examines access to safe drinking water, behavioral responses to improved water quality, and the economic impacts of water infrastructure expansion.

I briefly highlighted three studies I conducted to illustrate the type of research I do. Experimental research on experiential marketing of clean drinking water in Kenya and Rwanda investigates how consumer experiences influence adoption of improved water sources. Another project analyzes the economic impacts of rural water infrastructure in Senegal using a rich panel dataset of 1,319 households collected in 2016 and 2020. The evaluation compares government-led water supply infrastructure with community-led systems using rigorous methods including propensity score matching, inverse probability weighting, difference-in-differences, and quantile regression. Results show that government-provided tap water significantly increases agricultural employment and water consumption while reducing time spent fetching water. In contrast, community-led systems generate negligible economic benefits. The findings suggest that large-scale public investments in water infrastructure are effective but should be complemented by pro-poor policies, as non-poor households benefit disproportionately. Another research project examines the consumption of low-cost bottled water among bottom-of-the-pyramid consumers in Kenya, Uganda, and Rwanda. Based on a survey of 713 consumers, the study finds that more educated individuals adopt bottled water earlier, often through purposeful search for improved drinking water solutions. The results indicate that bottled water markets may be supply-driven and that companies often reach middle-income rather than low-income consumers, highlighting challenges in targeting vulnerable populations.

The presentation also introduced the Global Data Lab, a theme-driven data platform covering domains such as health, climate, education, gender, governance, and human development. The platform enables visualization of indicators at country and subnational levels through maps and charts. The presentation outlined possible opportunities for collaboration through the development of geospatial indicators and showcasing them through the Global Data Lab. Advances in remote sensing and increased availability of spatial data enable the creation of ready-to-use indicators linked to the Global Data LabÕs sub-national regions. These indicators transform satellite data into accessible measures that can support research and policy analysis on water and related development challenges.

[1] Howell, R., K. Mani Sinha & N. Wagner (2025). Exposing non-consumers to the taste and experience of bottled water: Evidence from a randomized controlled trial in two African countries. Review of Development Economics. doi: 10.1111/rode.70046.

[2] Magbonde, K. G., D. Thiam & N. Wagner (2024). The economic impacts of rural water supply infrastructures in developing countries: Empirical evidence from Senegal. Environmental and Resource Economics, 87, 2571-2628. doi: 10.1007/s10640-024-00897-4.

[3] Howell, R., K. Mani Sinha, N. Wagner, N. van Doorn & C. van Beers (2020). Consumption of bottled water at the bottom of the pyramid: Who purchases first?. Journal of Macromarketing. 40(1): 31-50. doi: 10.1177/0276146719866890.

Sustainable Options for Household Drinking Water Quality Improvement in low income Communities

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Unsafe drinking water has been implicated in causing about half a million diarrhoeal deaths in low- and middle-income countries. A sizeable proportion of this number were children under five years of age. Household water treatment and safe storage (HWTS) is an important public health intervention to improve the quality of drinking-water and reduce diarrhoeal disease, particularly among those who rely on water from unimproved sources [1]. This paper presents outputs of empirical studies on household drinking water quality, nature-based low-cost treatment methods (such as use of *Moringa Oleifera* seed powder, dried fruits of *Xylopia aethiopica* and *Tetrapleura tetraptera*, sand filters), and improved storage containers for improving water quality at point of use in line with the Sustainable Development Goal No 6.1.

Findings revealed that 77.4% of the households used dug wells as the primary source of drinking water which was collected and stored in plastic containers of various shapes and sizes. Water sources were highly contaminated, and quality significantly deteriorated at the household (HH) levels due to unsafe storage and handling practices. Little or no treatment was undertaken at the HH levels [2-4]. The use of multiple barriers in protecting the integrity of household drinking water quality cannot be over emphasized. One of our studies showed that improved storage containers (covered containers with small openings and taps/spigots) provided between 37–57% reduction in total coliform [5]. *Moringa Oleifera* seed powder used as a coagulant in combination with "Do it Yourself" (DIY) sand filter showed great promise by achieving a high percentage reduction in total coliforms of 99.94% and *E. coli* 99.97% [6]. Assessment of an indigenous water treatment method for rural households in Illah community using dried fruits of *Xylopia aethiopica* and *Tetrapleura tetraptera* showed *E. coli* counts reduction of 52% and 38% respectively [7]. Even though some of these methods fell below the WHO performance target of being protective, studies are still on-going with methods such as earthenware sand filter, ceramic filter, micro-filters and point of use filters to get the combination of methods that can help in achieving this.

The paper recommends sustainable household water safety through integrated approaches that combine source protection, with appropriate household water treatment and safe storage techniques, education, and strict policy implementation.

[1] WHO, 2020. Household water treatment and safe storage https://www.who.int/water_sanitation__health/water-quality/household/en/

[2] Oloruntoba, E.O., Agbede, O.A. and Sridhar, M.K.C. (2006). Seasonal Variation in Physico-Chemical Quality of Household Drinking Water in Ibadan Nigeria. Journal of Agricultural Sciences, Science, Environment and Technology ASSET, Series B Vol. 5 No. 1:107-118pp

[3] Oloruntoba, E.O. and Sridhar, M.K.C. (2007). Bacteriological Quality of Drinking Water from Source to Household in Ibadan, Nigeria. African Journal of Medicine and Medical Sciences Vol. 36 No. 2:169-175pp

[4] Oloruntoba, E.O. and Oloruntoba, A. (2008). Household Characteristics, Water Handling and Sanitation in Ibadan, Nigeria. Aquaterra Journal of African Resources and Environment Vol. 2 No. 2:1-12pp

[5] Oloruntoba, E. O., Babalola, T.F., Morakinyo, O.M., and Adejumo M. (2016). Effects of Improved Storage Containers on the Bacteriological Quality of Household Drinking Water in Low-Income Urban Communities in Ibadan, Nigeria. Water Science and Technology: Water Supply, Vol. 16, No. 2: 378 -387. doi: 10.2166/ws.2015.147. (United Kingdom).

[6] Adejumo, M., Oloruntoba, E.O., and Sridhar, M.K.C. (2013). Use of Moringa Oleifera (Lam.) Seed Powder as a Coagulant for Purification of Water from Unprotected Sources in Nigeria. European Scientific Journal, Vol. 9, No. 24: 214-219. (Macedonia).

[7] Olannye, D.U., Oloruntoba, E.O. and Ana, G.R E.E. (2017). Effectiveness of Indigenous Household Water Treatment on the Bacteriological Quality of Drinking Water in Illah Community, Oshimili North LGA, Delta State, Nigeria. African Journal of Environmental Health Sciences, Volume 4: 41-50. (Nigeria).

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Predicting properties of nanoadsorbents using theoretical modeling

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Nanoadsorbents have emerged as highly promising materials for advanced water purification due to their exceptionally large surface area, tunable surface properties, and high adsorption efficiency. As industrialization continues to increase the release of toxic contaminants into aquatic environments, the development of effective and sustainable water treatment technologies has become a critical challenge. Conventional purification methods often suffer from limited efficiency, particularly at low pollutant concentrations, and may generate secondary pollutants. Nanoadsorbents offer an attractive alternative through rapid and selective removal of contaminants, including heavy metals, dyes, pesticides, pharmaceuticals, and pathogens.

Despite their potential, the practical development of nanoadsorbents is hindered by high synthesis costs, lengthy optimization procedures, environmental concerns, and challenges associated with large-scale implementation. To address these limitations, theoretical modeling provides a powerful approach for predicting material performance before experimental synthesis, thereby reducing both development time and cost.

This lecture presents a statistical thermodynamics framework for modeling adsorption processes in nanoadsorbent systems. Adsorbents are treated as partly quenched disordered matrices, while the adsorbing species remain in thermodynamic equilibrium. The methodology combines structural characterization, interaction potentials, numerical solution of Replica Ornstein–Zernike (ROZ) equations, and calculation of chemical potentials and exclusion coefficients to predict adsorption behavior.

The applicability of the approach is demonstrated through two representative examples: adsorption of electrolyte mixtures in charged porous media [1] and water adsorption in hydrophobic adsorbents [2]. These case studies illustrate how theoretical models can reveal adsorption selectivity, predict ion partitioning, and explain water uptake mechanisms in complex porous materials.

The results highlight the important role of theoretical modeling in the design and optimization of nanoadsorbents for environmental applications. By enabling reliable prediction of adsorption properties at early stages of development, such approaches can accelerate the discovery of efficient, sustainable, and cost-effective materials for water purification.

[1] M. Lukšič, V. Vlachy, B. Hribar-Lee, Modelling the ion-exchange equilibrium in nanoporous materials, Cond. Matt. Phys. (2012), vol. 15, 23802:1-12.

[2] B. Hribar-Lee, Applicability of a central force water model to study adsorption in disordered hydrophobic matrices—replica Ornstein–Zernike theory, AIP Advances (2023), vol. 13, 125320.

The Invisible Cocktail: Quantifying Water-Borne Endocrine Disrupting Chemicals (EDCs) and Pediatric Health Risks in the Lagos-Ogun Industrial Axis

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The Lagos-Ogun industrial axis represents one of Nigeria's most densely populated and heavily industrialized regions, characterized by intense manufacturing activity and rapid urban expansion. Industrial discharge into local waterways introduces significant chemical pollution, yet the specific burden of water-borne Endocrine Disrupting Chemicals (EDCs) and their corresponding impact on child development remain poorly quantified.

This study seeks to quantify the concentrations of key water-borne EDCs within the Lagos-Ogun industrial corridor and evaluate the associated endocrine-related health risks among the local pediatric population.

An environmental-epidemiological framework will be utilized, involving systematic water sampling across high-risk industrial, agricultural, and residential zones along the axis to measure specific EDCs (including plasticizers, heavy metals, and agricultural runoff). Concurrently, a pediatric cohort from the catchment area will be assessed to monitor clinical indicators of endocrine disruption, including growth velocity, pubertal timing, and metabolic markers.

The study anticipates mapping precise contamination gradients of water-borne disruptors and establishing critical baselines linking environmental exposure levels to atypical pediatric endocrine outcomes.

By uncovering the hidden chemical profile of regional water sources, this research aims to provide crucial empirical evidence to guide environmental safety regulations, safeguard pediatric health, and inform targeted public health interventions in rapidly industrializing sub-Saharan settings.

Keywords: Endocrine Disrupting Chemicals (EDCs); Puberty, Growth, Development; Environmental Toxicology; Industrial Pollution; Lagos-Ogun Axis; Water Quality.

Sustainability of Water Supply Management: A Case Study of Lagos State

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Sustainable water supply management remains a critical development challenge in rapidly urbanizing coastal cities, especially in contexts where population growth, infrastructure limitations, environmental degradation, and climate change combine to intensify water insecurity. This paper examines the sustainability of water supply management in Lagos State, Nigeria, a coastal megacity characterized by rising water demand and persistent deficits in formal public water provision. Although Lagos is surrounded by abundant surface water bodies, public water supply currently meets only a limited proportion of total demand, compelling a large majority of residents to depend on self-supply systems such as boreholes, water vendors, and sachet water. This pattern has contributed to groundwater depletion, declining water quality, contamination risks, land subsidence, and heightened vulnerability to flooding and saline intrusion.

The paper traces the historical development of water supply infrastructure in Lagos and identifies the major causes of the present crisis, including rapid urbanization, inadequate investment, aging and underperforming facilities, weak maintenance culture, fragmented institutional arrangements, regulatory challenges, and inequitable access to safe water. Anchored in the principles of sustainable water supply management, the study emphasizes the need to balance social, economic, and environmental water needs through integrated and forward-looking strategies.

A five-pillar pathway is proposed to support long-term sustainability in Lagos State: governance and investment, infrastructure revolution, diverse and resilient water sources, demand management and equity, and community engagement supported by technology. The study concludes that sustainable water security in Lagos will depend on integrated water resources management, institutional reform, strategic financing, infrastructure renewal, improved efficiency, and active citizen participation. The Lagos experience provides important lessons for other rapidly growing cities in the Global South seeking to achieve resilient, inclusive, and sustainable urban water supply systems.

Biogas Recovery from Wastewater in the Developing Lagos Megacity

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Rapid urbanisation in developing contexts is intensifying the interlinked challenges of wastewater management, energy insecurity, and environmental degradation. In Lagos, Nigeria, these pressures are especially acute. Limited sewerage infrastructure, the expansion of informal settlements, weak urban service delivery, and rising demand for affordable household energy have produced a landscape in which untreated wastewater and organic waste are both major public health risks and underutilised resources. At the same time, persistent electricity shortages and continued reliance on polluting cooking fuels highlight the urgency of identifying decentralised, low-carbon energy alternatives that can be embedded within urban sanitation systems. Wastewater-to-biogas recovery presents one such opportunity, yet its adoption in Lagos and comparable cities remains limited despite significant technical potential.

Wastewater in Lagos constitutes a viable feedstock for anaerobic digestion because of its high biodegradable organic content and potential for methane generation. Existing studies highlight important opportunities to improve biogas yield and system efficiency [1], while also identifying persistent barriers linked to operational reliability, infrastructure deficits, financing constraints, and weak institutional coordination [2]. Emerging evidence further suggests that the scale-up of biogas systems in Nigeria will depend not only on technical optimisation, but also on stronger policy support, targeted investment, and governance reforms that can enable adoption across diverse urban settings [3]. However, the literature remains disproportionately focused on engineering performance and environmental outcomes, with limited engagement with questions of deployment model, community uptake, gendered patterns of energy use, and the extent to which wastewater-derived biogas can meaningfully address household energy poverty and clean cooking needs. These gaps provide the research questions being interrogated by our research group around biogas recovery from wastewater in developing contexts.

[1] Ezekoye, V. A., Geraldine, O., Anthony, O., David, E.,& Ada, A. (2021, April). Improving Biogas Yield Using Organic Fraction of Plant and Animal Wastes by Co-Digestion. In IOP Conference Series: Earth and Environmental Science (Vol. 730, No. 1, p. 012037). IOP Publishing.

[2] Godfrey, O. U. (2024). Renewable Energy from Agricultural Waste: Biogas Potential for Sustainable Energy Generation in Nigeria's Rural Agricultural Communities. Journal of Engineering Research and Reports, 26(12), 341-367.

[3] Ayodele-Olajire, D., Sesan, T., & Clifford, M. (2025). Evidence-Based Rapid Review of Clean Cooking: Lessons for Nigeria and Other Developing Economies. Advances in Environmental and Engineering Research, 6(3), 1-23.

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Opportunities for water sensitive city transitions in South Africa

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As South African cities urbanise alongside climate change, resource constraints, and socio-economic challenges, the concept of water sensitive (urban) design (WSD) is slowly gaining traction as a framework to address water security goals and entrench resilience. This presentation reflects on the opportunities for implementation of WSD in South African urban areas and discusses the broadening of the concept's initial association with stormwater and physical infrastructure to include critical governance and institutional arrangements and social engagements at the core of a water sensitive transition. The approach is being adapted for the socio-economic challenges particular to South Africa, including basic urban water and sanitation service provision, WSD related skills shortages, a lack of spatial planning support for WSD, and the need for enabling policy. The Cape Town Water Strategy, 'Our shared water future' [1] is highlighted as an example of a new policy instrument that commits the city of Cape Town local government – as the water services authority – to supporting the transition to a water sensitive city alongside the equitable provision of basic services to its residents. With this as the starting point, and following the severe drought that plagued the region between 2015 and 2018, demonstration projects were conceptualised to identify opportunities for, and generate knowledge on, the physical and institutional integration of decentralised nature-based solutions into the urban water cycle to support and accelerate such a transition.

The 'Pathways to water resilient South African cities (PaWS)' project is a transdisciplinary research collaboration between the Universities of Cape Town and Copenhagen. It draws on physical experiments as well as governance and social processes to explore the potential for stormwater detention ponds to be adapted to function as multifunctional infrastructure supporting a transition towards water resilience. Cape Town's resilience agenda includes the development of sustainable stormwater management approaches (hybrid natural and engineered measures that address flood risk, improve water quality and restore ecosystems, enhance biodiversity, and support human well-being and urban liveability) as part of its vision to be a water sensitive city by 2040 [2]. Through learnings gained from a stormwater pond retrofit in Mitchells Plain, the PaWS project has lobbied for multifunctional stormwater infrastructure to be leveraged as key elements of a WSC – with stormwater and related infrastructures seen as an asset, and to consider developing organizational structures that allow for locally-led management and oversight of such spaces. The presentation reflects on what it takes to integrate and govern multifunctional stormwater ponds as blue-green infrastructure (BGI) in a city like Cape Town. A water sensitive city transition provides an opportunity for a more inclusive approach to urban design where stakeholders contribute to development processes to foster collaborative and restorative spaces that balance and build relations between city actors and marginalised communities.

[1] City of Cape Town (2019). Cape Town's Water Strategy – Our shared water future. https://resource.capetown.gov.za/documentcentre/Documents/City\%20strategies,%20plans%20and%20frameworks/Cape%20Town%20Water%20Strategy.pdf

[2] Tanyanyiwa, C.T., Abrams, A., Carden, K., Armitage, N.P., Schneuwly, R., Mguni, P., Herslund, L & Mclachlan, J. (2023) Managing stormwater in South African neighbourhoods: When engineers and scientists need social science skills to get their jobs done. AQUA - Water Infrastructure, Ecosystems and Society Vol 72(4), 456-464. https://doi: 10.2166/aqua.2023.

Water, mobile pastoralists and uranium mining in the north of Niger

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The north of Niger is dominated by desert, Sahel steppe and the Aïr mountain massif. All the rain, usually below 350 mm, falls during the rainy season between June and September. Mobile pastoralists use different water sources: open ponds in the rainy season and deep wells and pumps in the dry season. In Aïr massif, dry river bends permit access to water in wadi beds and in 10-20 m wells along its banks which enable irrigated gardening. Cities depend on unconfined and artesian deep groundwater.

Mobile pastoralism is adapted to the productive use of variable rainfall in drylands, where mobility is essential to reach the pastures [1]. Mineral rich pastures in the northwest are a rainy season destination for many Tuareg and Fulani nomadic groups. At the same time, corporate uranium mining is taking place on pasture lands. Mining has harmful consequences for environment and health: underground water levels have fallen, wells dried up, vegetation has diminished, radioactive waste has been spread by the wind (Arlit), waste liquid leaked into the environment (Azelik) [2]. Aquifers are not infinite, and their connections are not sufficiently studied to guarantee clean drinking water. Despite all this, the entire region was divided into perimeters to sell exploration and exploitation mining permits. Another uranium mine has opened recently.

Since 2018, environmental legislation has required Environmental and Social Impact Assessments (ESIA). As mining companies are neglecting mobile pastoralism, it is important to understand who is listening to pastoralists' voices and representing their interests in accessing pasture and clean water, the latter also being essential for gardening and urban areas. The state gives priority to mining. Regional authorities, village chiefs and youth organizations are ambiguous towards mining, because next to protection of pastoralists, they demand a greater share of revenues, investments in social services, and jobs. Civil society organizations were able to legally prosecute the new mining company to improve ESIA and achieve at least some commitments, including the deepening of wells. ESIA can be a tool in negotiating environmental rights. Independent monitoring of water levels and pollution is still needed.

[1] Krätli, S. and I. Köhler-Rollefson. Pastoralism: Making Variability Work. doi: 10.4060/cb5855en

[2] Gagnol L. and A. Afane. Convoitises et conflicts entre ressources pastorals et extractives au Nord-Niger. Verts pâturages et yellow cake chez les 'hommes bleus'. doi: 10.3917/afco.249.0053

Development of low-cost absorbents for water treatment and remediation

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Access to clean and safe water is fundamental to the growth of any nation in the world. The ever increasing population and industrial growth have resulted in a notable increase in wastewater generation, affecting the quality of water. According to the United Nations World Water Assessment Programme report in 2017, 90% of the wastewater generated globally is discharged into the environment without any prior treatment. The awareness that our environment is contaminated with myriads of pollutants both from anthropogenic and non-anthropogenic sources prompted our interest in developing cost effective adsorbent for water treatment. We have experimented with the following:

1. Adsorption with Clays and modified clays. We have worked with pristine kaolinite, bentonite, illite and feldspar mineral and their modified forms for the removal of both organic (Bisphenol A, 2, 4, 6-Trichlorophenol, tetracycline, diclofenac, PAHs and dyes) and inorganic (many metals e.g Pb, Cd, Cu, Ni, Cr (III), Cr (IV), As, etc and inorganc dye) pollutants from aqueous solution. This modification improved the cation exchange capacity of these clay minerals and also showed greater affinity for both organic and inorganic pollutants.

2. Adsorption on Waste Materials. In our bid to convert waste to wealth, we studied the potential of wastes from cocoa beans, mango stone, non-living moss biomass, coconut and peanut husks in the adsorption of inorganic and organic pollutants from aqueous solution. The studies showed that the prepared adsorbents are promising non-toxic materials for the removal of these pollutants from aqueous solution.

3. Hybrid Clays. This is a combination of clays/minerals with biomass. Synergistic combination of low cost adsorbents is a recent breakthrough in adsorption science. These combinations have led to better adsorbent properties such as high cation exchange capacity (CEC), reduced/eliminated bleeding, enhanced mechanical strength, pore size, better stability and durability, re-usability, sometimes larger surface area, and consequently higher sorption efficiency We have employed these hybrid materials in the removal of both organic and inorganic pollutants from aqueous solutions.

All the adsorbents developed compared favourably with activated carbon and are promising low cost adsorbents for the removal of both organic and inorganic pollutants. We are now working on biochar and nanobiochar for the removal of both organic and inorganic pollutants.

[1] Egbedina, A. O., Olu-Owolabi, B. I. and Adebowale, K. O. 2023. Porous Bentonite-Coconut Husk Composite for the Enhanced Adsorption of Selected Emerging Contaminants from Aqueous Solution. Environmental Science Advances. 2:1554-1565.

[2] Olu-Owolabi, B. I., Diagboya, P. N., Mtunzi, F. M. and Düring, R. 2021. Utilizing eco-friendly kaolinite-biochar composite adsorbent for removal of ivermectin in aqueous media. Journal of Environmental Management. 279:111619 https://doi.org/10.1016/j.jenvman.2020.111619

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Challenges of implementing machine learning projects in various domains

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Artificial Intelligence (AI) is increasingly becoming a key enabler of innovation across a wide range of scientific and professional domains. The talk presented several examples of interdisciplinary AI applications, including medical risk prediction and disease progression modeling, discovery of novel biomarkers from voice signals, secure communication systems, protein binding site prediction, and agricultural pest monitoring.

Drawing on these case studies, the presentation discussed the major challenges encountered when applying AI outside traditional computer science contexts, such as limited and heterogeneous data, privacy constraints, unrealistic expectations from domain experts, insufficient AI literacy, explainability and trustworthiness requirements, and publication - related barriers. Particular attention is given to the importance of collaboration between AI researchers and domain specialists, as well as the need for transparent and interpretable models.

The talk concluded with an overview of emerging opportunities for AI in water research, including water quality and availability forecasting, environmental monitoring, data fusion from heterogeneous sources, and decision support for sustainable resource management.

[1] Kukar, M., Vračar, P., Košir, D., Pevec, D., & Bosnić, Z. (2019). AgroDSS: A decision support system for agriculture and farming. Computers and Electronics in Agriculture, 161, 260-271.

[2] Klemenc, M., Pellarini, D., Papič, A., Poličar, P. G., Štepec, D., & Bosnić, Z. (2026). Predicting vasovagal syncope during head-up tilt test: three machine learning approaches. Frontiers in neuroinformatics, 20, 1740746.

[3] Ahmed, A., & Bosnić, Z. (2026). Complexity and Performance Analysis of Supervised Machine Learning Models for Applied Technologies: An Experimental Study with Impulsive α-Stable Noise. Technologies, 14(5), 252.

[4] Smole, T., Žunkovič, B., Pičulin, M., Kokalj, E., Robnik-Šikonja, M., Kukar, M., ... & Bosnić, Z. (2021). A machine learning-based risk stratification model for ventricular tachycardia and heart failure in hypertrophic cardiomyopathy. Computers in biology and medicine, 135, 104648.

[5] Demšar, J., & Bosnić, Z. (2018). Detecting concept drift in data streams using model explanation. Expert Systems with Applications, 92, 546-559.

[6] Bosnić, Z., & Kononenko, I. (2008). Comparison of approaches for estimating reliability of individual regression predictions. Data & Knowledge Engineering, 67(3), 504-516.

Water inequality in Africa: A Nigerian perspective on status and challanges

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Universal access to safely managed drinking water is a basic human right consistent with the Sustainable Development Goal 6 of the United Nations. Although Africa is endowed with abundant rivers and vast aquifers, nearly 300 million people still lack access to safe water, creating a unique paradox of scarcity amid abundance[1]. A closer look at the WHO and UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) report of increasing water access om the continent reveals that these gains are disproportionately concentrated in wealthier urban areas. This systematic difference in access, termed water inequality is often framed in the dimension of geographical disparities and physical scarcity; however, this perspective obscures the deeper systemic perspectives of socio-economic disparities. Drawing on recent evidence, the presentation highlights the status, drivers, and implications of water inequality in Africa, with illustrative insights from Nigeria.

In Nigeria, 95% of urban households have access to improved water sources, compared with 68% of rural households. However, as national access increased from 30% in 2000 to 70% by 2020, relaince on the centralized muncipal water supply decreased from 16.8% to 10.1% over the same period [2]. The decline of centralized municipal water supply systems has catalysed a transition toward a self-supply water system, where richer households have increasingly become the primary subscribers to private boreholes, and rural households depend on private for-profit providers for their water [3]. While groundwater development and private water provision have improves access, the approache often reinforce inequalities due to governance failures, affordability constraints, and weak regulation. The growing dependence on self-supplied water sources raises important questions regarding the sustainability and inclusiveness of current water service delivery models.

The presentation further explores the implications of water inequality in Nigeria for public health safety, gender equity, urban poverty, and agricultural productivity. It identifies research opportunities in mapping of water inequality hotspots in Africa, and groundwater sustainability modelling. Finally, it proposes public-private-community partnerships and improved groundwater governance as practical interventions for reducing disparities in access and addressing their underlying causes. The study concludes that water supply in Africa requires a shift from fragmented individual solutions toward inclusive, well-regulated, and sustainable water supply systems that ensure equitable access for all.

[1] J. Rajapakse, M. Otoo, and G. Danso, Progress in delivering SDG6: safe water and sanitation, Cambridge Prisms: Water, doi: 10.1017/wat.2023.5 (2023).

[2] V. Ojo and M. Sohail, Assessing the Performance of State Water Utilities in Nigeria: Towards Achieving the Sustainable Development Goal on Drinking Water, Sustainability, doi: 10.3390/su16010059 (2023).

[3] M. Obeta, Private for-profit rural water supply in Nigeria: Policy constraints and options for improved performance, Journal of Water and Land Development 41, 101-110, doi: 10.2478/jwld-2019-0033 (2019).

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