THE REPUBLIC OF UGANDA

UGANDA W&E WEEK

MINISTRY OF WATER AND ENVIRONMENT

UGANDA WATER AND ENVIRONMENT WEEK (UWEWK) 2026

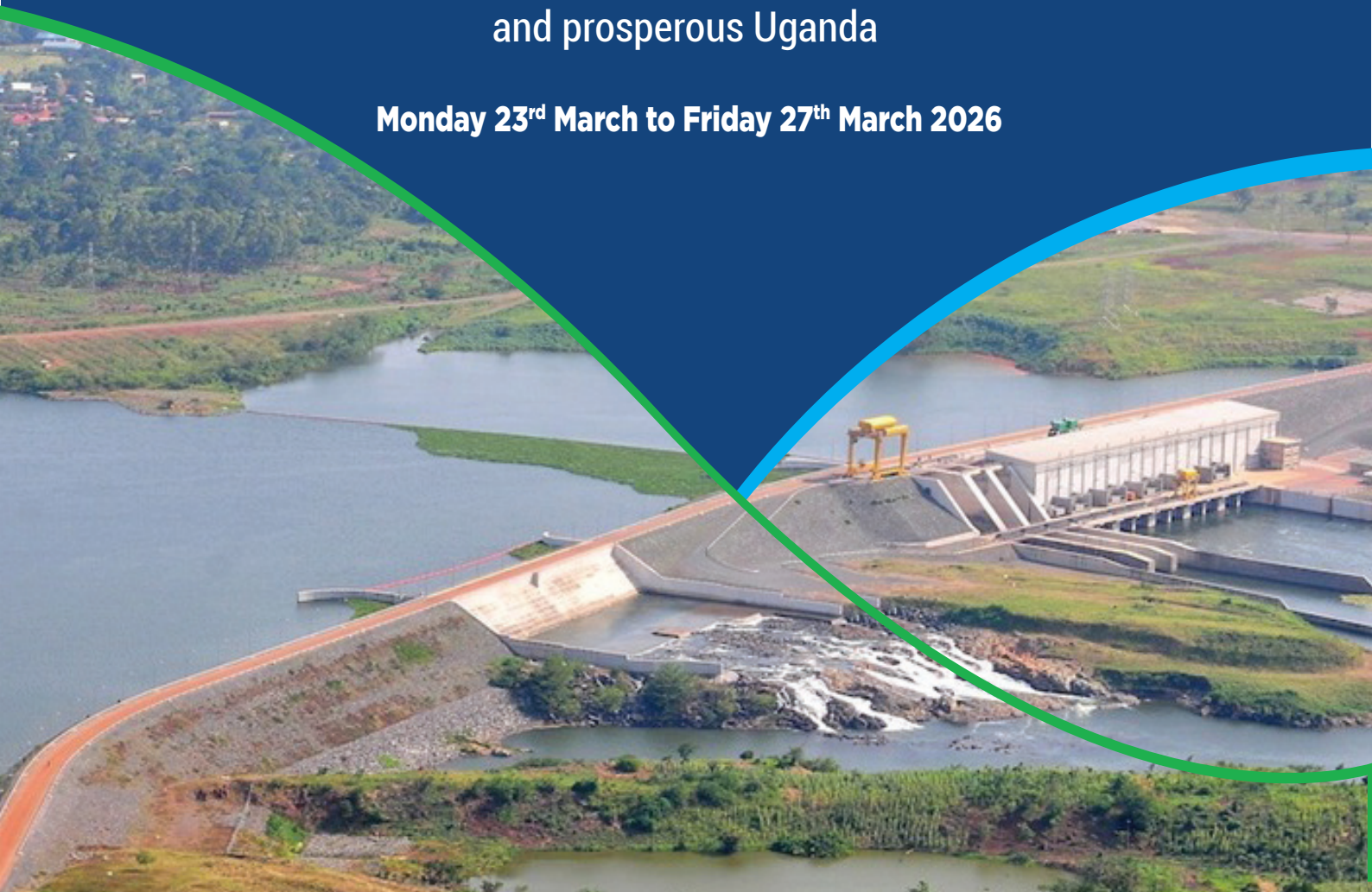
BOOK OF ABSTRACTS

Abstracts for Applied Research in Water, Environment and Climate Change: Policy, Practice and Science

Overall Theme:

Water and Environment for an inclusive and prosperous Uganda

Monday 23rd March to Friday 27th March 2026



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Foreword

The Ministry of Water and Environment (MWE) was established in 2007 with the overall responsibility for development, management and regulation of water and environment resources in Uganda. The vision of having sound management and sustainable utilization of water and environment resources for betterment of Uganda's population inspires the Ministry to promote rational and sustainable utilization, development, and effective management of water and environment resources for socio-economic development. The MWE has been organizing the Uganda Water and Environment Week (UWEWK) for the last eight years. This year, 2026, the 9th Uganda Water and Environment Week took place from 23rd to 27th March 2026. During the week, oral and poster presentations were made after a rigorous process of selecting and identifying relevant works from abstracts submitted. A Book of Abstracts of Applied Research in resonance with Water and Environment Week theme is usually compiled and published. A hybrid approach comprising physical and online presentations allows presenters to share applied research outputs to the audience of relevant stakeholders.

This year, a Book of Abstracts- Issue UWEWK 2026 was published and presented a summary of oral presentations on applied research pertinent to water and environment policy, practice, and science that aligns with the overall theme for UWEWK 2026: "Water and Environment for an inclusive and prosperous Uganda". The UWEWK 2026 abstracts covered emerging issues in water and environment under the following four (4) sub-themes:

1. *Role of water and environment in achieving Uganda's Tenfold Growth strategy*
2. *Investment in science, technology, innovation and capacity building to enhance progress in water and environment management and development*
3. *Ensuring environmentally sustainable and climate resilient economies and communities*
4. *Leveraging the power and capacity of women, youth and children in delivery of water and environment services.*

These subthemes attracted abstracts related to policy, practice and science. The policy mainly included papers that analyze the current state of policies (local, national, regional and international policies) but also proposed policies from research findings to guide water and environment conservation, and sustainable development. The science component targeted research papers with an underlying problem addressed from existing gaps, with clear approaches and methodologies deployed and with key scientific or field-based findings. On practice, this targeted programs, innovations, projects and studies that provide community impact from interventions. The practice component offers an opportunity for partners to share progress and future plans.

For this book, each abstract is a concise summary on mainly highlights of key water and environment problems or issues at hand, methods applied, key results, conclusions and key take-away messages to inform stakeholders. Abstracts in this UWEWK 2026 issue are expected to contribute to addressing topical issues and informing decisions for sustainable development in the water and environment sector.

Special thanks to the Technical sub-committee committee, Communication and Publication committee and the entire National Organizing Committee of UWEWK 2026 for supporting the processes from the call of abstracts, reviewing, technical guidance, training of authors and compilation of this Book of Abstracts.

Editorial Team, Access and Copy Rights

Editorial Team (UWEWK 2026 Book of Abstracts)

This Book of Abstracts-Issue UWEWK 2026 has been compiled with the support of a Scientific Support Team. The team comprised of members of the UWEWK 2026 Technical Subcommittee and communication and publication committee, the UWEWK secretariat (Ministry of Water and Environment) and Academic Professionals from Makerere University. The editorial team leaders were Prof. Nicholas Kiggundu (Makerere University), Dr. Patrick Musinguzi (Makerere University), and Dr. Rosemirta Birungi (Development Practioner - AFID/ Nile IWRMNet). The abstract review process was supported by; Mibulo Tadeo, Asingya Alvin, Musaazi Isaac, Dr. Semyalo Dennis, Dr. Kiraga Shafik, Dr. Baidhe Emmanuel, Dr. Sempiira John Edison, Dr. Nsubuga Denis, Dr. Mukasa Pires, Dr. Cherotich Sam, Dr. Okori Francis, Mugenyi David, Dr. Jude Byansi Zziwa, Eng. Joseph Michael Okoth, Dr. Ritah Nakanjako, Dr. Robert K.Kambugu, Ainebyona Paddy, Kemigyisha Fortunate, Jjagwe Joseph, Eng. Diana Keesiga, Stacey Natukunda, Dr. Aminah Nalweyiso, and Henry Beliga Ssemuyaba.

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About the UWEWK 2026 and the Call of Abstracts

The 9th Uganda Water and Environment Week was held on Monday 23rd March to Friday 27th March 2026, as an annual event of Ministry of Water and Environment under auspices of the Water Resources Institute (WRI). A call for abstracts was published on December 1st, 2025 and ended on February 1st 2026. The call attracted interested researchers, practitioners and policy makers to share their research findings and practical work, findings based on experiences in line with the theme and sub-themes of UWEWK 2026. The theme and sub themes were as follows:

Main Theme:

"Water and Environment for an inclusive and prosperous Uganda."

Sub- themes:

1) Role of water and environment in achieving Uganda's Tenfold Growth strategy

This subtheme explored innovations related to water-environment-energy-food nexus to ensure balanced and resilient development. It explored innovative ways of how water and environment resources development and management as well as climate change mitigation and adaptation can support achievement of Uganda's ten-fold economic growth through ATMS: i) Agro-Industrial Development; ii) Tourism Development; iii) Mineral-based Development plus Oil and Gas (petrochemical industry); and iv) Science, Technology, ICT and Innovation. The sub theme further showcased high-impact growth areas for water and environment resources that would propel a double-digit growth over the NDPIV period and subsequently contribute to 10-fold growth of the economy over the 15 years leading up to 2040.

2) Investment in science, technology, innovation and capacity building to enhance progress in water and environment management and development

This theme explored the integration of science, technology, and innovation (STI) with capacity building to develop and scale solutions for challenges such as climate change and water scarcity as an investment. This approach included investing in research and development, adopting new and digital technologies such as Artificial Intelligence (AI), big data for monitoring infrastructure, developing new water purification and desalination technologies, and implementing cyber-physical systems for smart management of water and environment resources. It further explored the advancement of water and environment management systems, and building human and institutional capacity through training and knowledge sharing. Strategic partnerships and financing are crucial to implementing these initiatives, particularly to achieve global goals such as the Sustainable Development Goals (SDGs), specifically SDG 6, 13 and 14. It further looked into establishing strategies for strengthening individuals, organizations and institutions to innovate, use science technology and innovation. It also explored innovations on spatial data and remote sensing as solutions in the management of the resources. Early warning systems as tools to mitigate floods and droughts in the country were also explored.

3) Ensuring environmentally sustainable and climate resilient economies and communities

This theme sought to promote awareness pertaining investment in green and grey infrastructure, sustainable and climate-resilient economic activities like diversified agriculture and local businesses, and implementing cohesive policies that integrate climate resilience into all levels of planning. It explored using both modern and local knowledge to empower local institutions and communities to take the lead in developing solutions. Additionally, it also explored approaches to ensure that environmentally sustainable and inclusive principles are at the forefront of all climate and water resilience planning, policies and financial instruments, human health and productivity for economic growth. It also highlighted the usefulness of

healthy ecosystems as essentials for climate-resilient infrastructure, protecting economies from natural disasters and ensuring the long-term availability of resources like water for economic stability.

4) Leveraging the power and capacity of women, youth and children in delivery of water and environment services

This sub-theme provided insights on opportunities and approaches to engage and leverage children, youth, women, persons with disabilities, marginalized, and vulnerable groups in water and environment service delivery. It deepened the understanding on the benefits of increasing representation of women and youth and having equal opportunities to participate in water and environment committees and other decision-making bodies at local, national, and global levels. It explored justification for strengthening and supporting of women-led and youth-led organizations and networks to create platforms for information exchange, policy influence, and cooperative action. It enhanced the provision of financial support e.g. offering grants, financing, and investment opportunities for women and youth-led enterprises focused on WASH, renewable energy, sustainable agriculture, and climate adaptation among other engagements and leveraging of women and youth in water and environment sector.

Expectations during abstract preparations and presentations

The authors of abstracts were expected to consider the following key aspects prior to making their submissions or presentations:

a) A hybrid approach for online and physical presentations to share their applied research work, studies and emerging innovations
b) Approved abstracts had to be line with the theme and sub-themes of the water and environment week
c) The abstracts were to be categorized as science, practice or policy papers that could provide policy recommendations, development and conservation direction measures in water and environment
d) All abstracts and presentations were to be made in English
e) Abstracts, oral and poster presentations would only be accepted after reviews and acceptance by the editorial team

Abstract format

All abstracts submitted met the following format that included the study title, names and contacts of the authors, the introduction, the problem at hand, the methodology/approach used to gather the data or information; results (key findings or experiences); conclusion/takeaway messages.

Capacity building for Abstract Authors

In order to enhance the quality of all presentations and abstracts, some abstracts were improved by engaging authors in further capacity building. Face-to-face trainings at the Water Resources Institute-Entebbe and online guidance sessions were conducted by the Abstract Reviewers, which helped the authors to improve the quality and articulation of their applied research for publication during the UWEWK.

1 SUB-THEME 1: ROLE OF WATER AND ENVIRONMENT IN ACHIEVING UGANDA'S TENFOLD GROWTH STRATEGY

1.1 Emerging organic pollutants in sediments from Lake Victoria: Spatial patterns, sources and ecological risks

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Abstract

This study presents the first evaluation of contaminants of emerging concern (CECs) in sediments from the Uganda, Kenya and Tanzania sides of Lake Victoria. We applied wide-scope target screening via ultra-high performance liquid chromatography coupled with high-resolution mass spectrometry (UHPLC-QTOF-MS) to 38 surface sediment samples collected in September 2019 (wet season) and detected 136 out of more than 2400 targeted compounds. These included pharmaceuticals, industrial chemicals, plant protection products (PPPs), hormones, artificial sweeteners, drugs of abuse, and naturally occurring substances. The CECs concentrations (μg/kg dry weight, d.w) were up to 2103.5 for pharmaceuticals, 506.8 for PPPs, 880.1 for hormones, 843.0 for artificial sweeteners, and 218.9 for drugs of abuse and 1306.0 for naturally occurring substances, with the highest loads of pollutants at the northern and northeastern shores of the lake attributable to majorly urban and riverine inputs. Kruskal–Wallis tests revealed no significant differences across the Uganda, Kenya, and Tanzania sides of the lake, underscoring trans-boundary pollution. Ecological-risk assessment (risk quotient, RQ) indicated that 46 % of detected compounds pose high risk (RQ >1: FoE >1 %) to sediment-dwelling organisms, with pharmaceuticals, PPPs, and industrial chemicals showing the greatest threat. Seven (7) out of these were prioritized for future monitoring based on their risk scores being >1 due to their potential eco-toxicity. The occurrence of carbamazepine and its TP(10,11-dihydro-10,11-dihydroxy-Carbamazepine), Ibuprofen TP(2- hydroxy-ibuprofen), 17-beta estradiol, Bis-(2-ethylhexyl)-Phthalate (DEHP), and simazine in the sediments is of concern, especially since they are listed among dangerous chemicals in the environment. These findings highlight the need for coordinated regional monitoring, enhanced wastewater treatment, and sediment-targeted risk management to protect Lake Victoria's ecological integrity.

Keywords: Emerging contaminants, Sediments, Spatial distribution, Sources, Ecological-risk assessment, Lake Victoria

1.2 Biodiverse non-timber forest products for climate resilient livelihoods in refugee-hosting northern Uganda

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Abstract

Non-timber forest products (NTFPs) are biodiverse resources that support food, healthcare, and income across the Global South, yet their role in humanitarian landscapes and climate-resilient economies remains underexplored. This study compares NTFP knowledge, reported use, and market sale among refugees and hosts within and around Uganda's Imvepi Refugee Settlement. Goals were to explore NTFP knowledge retention, livelihood functions, and sustainable market opportunities. Participatory transect walks were completed with 240 refugees and hosts in forests and woodlands surrounding Imvepi, with participants identifying edible, medicinal, and fiber NTFPs used and sold. Participants collectively identified 66 edible, 95 medicinal, and 29 fiber NTFPs, including trees, herbs, mushrooms, and insects. Hosts identified more edible and fiber NTFPs than refugees, whereas medicinal knowledge was slightly higher among refugees. Negative binomial count models revealed that overall NTFP knowledge was lowest among female and younger refugees. While both groups reported selling numerous NTFPs, hosts more frequently sold high-value products like Shea nuts, white ants, and tamarind. Qualitative analysis revealed that, despite differences, NTFPs help refugees and hosts alike to fill humanitarian aid and household subsistence gaps. Furthermore, NTFP utilization can support ongoing sociocultural practice and traditional ecological knowledge maintenance. Participants voiced concern, however, regarding long-term NTFP availability due to forest degradation near settlements. Study recommendations include amplifying forest conservation interventions within and surrounding settlements, and biodiversity-focused sensitization and knowledge sharing through schooling or community mechanisms. Additionally, value-addition pathways could be explored for building sustainable and equitable refugee-host livelihood opportunities. Findings highlight NTFPs as essential to climate-resilient livelihoods in socio-ecologically marginalized displacement settings and point to humanitarian and governmental opportunities for strengthening equitable access, biodiversity sensitization and protection, and conservation-oriented market opportunities under intensifying human and environmental change.

Keywords: Biodiversity, non-timber forest products, refugees, hosts, traditional ecological knowledge

1.3 Economic significance of the Mpanga catchment on returns of investment and economic analysis

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Abstract

In Uganda, the government adopted Catchment-based Water Resources Management (CbWRM) initiatives as a flagship approach to address water security challenges. Despite this commitment, investment in catchment-based water resources management remains low due to a limited understanding of the returns on investment (ROI) from these measures. In the Mpanga catchment, a critical water source for thousands of people, several nature based solutions, such as afforestation, have become increasingly popular for addressing water security challenges and promoting sustainable development. However, the economic significance of these initiatives remains poorly understood, creating a funding gap for CbWRM. This study aims to evaluate the economic significance of the Mpanga catchment, focusing on ROI and economic analysis of nature-based solutions by assessing the economic costs and benefits of these initiatives. The pre-feasibility analysis shows that ongoing degradation particularly deforestation 70%, soil erosion 20%, and sedimentation 10% has increased water treatment costs, reduced agricultural productivity, and compromised infrastructure performance, resulting in substantial economic losses. On the contrary, investments in catchment-based water resources management and nature-based solutions such as afforestation 60%, riverbank restoration 15%, and soil conservation 10% and others 15% generate measurable economic returns of carbon benefit with the cost ratio of 6.06.1 generating returns of investment of 506% by stabilizing water flows, reducing maintenance costs, improving yields, and protecting downstream infrastructure. The avoided costs and productivity gains exceed implementation expenses, demonstrating positive returns on investment over time. The study concludes that catchment restoration is not merely an environmental intervention but a cost-effective economic strategy that enhances resilience, safeguards public investments, and supports sustainable development.

1.4 Bridging constraints to upscale Nature-based solutions for soil erosion control: lessons from Bugobero sub-county, Manafwa District in the Mount Elgon region

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Abstract

Soil erosion remains a persistent and worsening problem in the Mount Elgon region of eastern Uganda, where it continues to degrade productive land, reduce farm yields and weaken the agricultural base required for agro-industrial development and inclusive economic growth under Uganda's tenfold growth strategy.in Bugobero sub-county, Manafwa district, erosion impacts are wide spread ,yet the nature-based solutions(Nbs) promoted to address this problem have not been adopted or sustained at a scale commensurate with erosion risk. This study examined the spatial distribution of erosion risk, household wide scale adoption of Nbs and agricultural planning under vision 2040 and NDP IV. A random cross-sectional survey of 30 farming households was conducted using stratified random sampling, supported by spatial assessment of erosion-prone areas. Descriptive statistics were used to examine erosion exposure and Nbs coverage, while chi-square tests and logistic regression assessed associations between household characteristics and adoption. House holds reported constraints were analysed using weighted ranking whereby results show that severe erosion is widespread in all the households especially on the upper slopes yet Nbs remains fragmented. Soil based Nbs measures were adopted by 72.7% of households, compared to water based Nbs which is at 27.6%, despite high erosion risk further yet Labour shortages, gendered labour roles, land tenure arrangements and maintenance costs emerged as key constraints limiting sustained adoption. These findings reveal a critical disconnect between erosion risk and the effectiveness of the wide scale adoption of the current Nbs. if unaddressed, constraints will continue to undermine agricultural productivity and agro-industrial growth. Addressing socio-economic barriers is essential to enable district authorities, extension services and national programmes to upscale Nbs as viable tools for environmental resilience and inclusive economic transformation.

2 SUB-THEME 2: INVESTMENT IN SCIENCE, TECHNOLOGY, INNOVATION AND CAPACITY BUILDING TO ENHANCE PROGRESS IN WATER AND ENVIRONMENT MANAGEMENT AND DEVELOPMENT

2.1 Eco-zones of Uganda: a hierarchical clustering and classification of Uganda's ecological heterogeneity

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Abstract

Existing environmental and ecological management frameworks in Uganda often rely on drainage divides, taxonomic patterns, or sector-specific classifications. While operationally convenient, these subdivisions do not adequately represent the high ecological heterogeneity required for broad-scale ecological analysis, conservation planning, and environmental management. The development of comprehensive ecological zonation frameworks is constrained by the scarcity of reliable, localised datasets and the absence of appropriate stratification methods that can integrate complex interactions among environmental gradients. This study develops a hierarchical eco-zonation framework based on climate, topographic, and hydrological variables to better capture large-scale ecological patterns and delineate ecological zonation across Uganda. Machine-learning techniques, primarily random forest classification and hierarchical clustering, were integrated into a systematic, reproducible workflow built entirely on open-source software and globally accessible datasets to delineate hierarchical biogeographical zones. The ecological relevance of the observed abiotic patterns was evaluated using Uganda's potential natural vegetation (PNV) as an independent reference, applying a spatially dispersed 10-fold cross-validation strategy to minimise the effects of spatial autocorrelation. At the broadest scale, five major ecoregions (EcoR) were delineated and subsequently subdivided at three nested bioregional levels. Validation results indicate a clear decline in ecological coherence with increasing spatial resolution, from 80.35% agreement at the EcoR level to 52.69% at the finest bioregional tier (BR III). The two coarsest levels (EcoR and BR I) exhibited strong ecological coherence, whereas finer subdivisions (BR II and BR III) showed weaker correspondence with PNV patterns. This scale-dependent decline highlights limitations in best-available global, regional, and national biotic datasets, particularly in data-scarce tropical regions. The findings underscore the need for locally curated or integrative high-resolution datasets to support finer-scale ecological stratification. Overall, the proposed framework offers flexible biogeographical classifications with high spatial and thematic resolution for supporting biodiversity assessment, conservation planning, ecological modelling, and environmental management in Uganda landscapes.

Keywords: Eco-zones, ecoregions, bioregions, classification, clustering, Uganda

2.2 Assessing the Feasibility of Composting as a Reduce, Reuse, Recycle (3R) Strategy in Solid Waste Management

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Abstract

The Rapid increase in Solid Waste generation in urban areas has posed significant environmental and public health challenges. This study investigated the feasibility and effectiveness of composting as a 3R strategy for managing Solid Waste in Kabale, Uganda, a municipality with a population of 68,207 people. The main objective was to assess how composting can contribute to improved waste management practices by sorting, quantifying, composting, and identifying challenges associated with organic waste handling. A mixed-methods approach was employed. Field activities involved sorting waste from five loaded tippers at disposal site to separate decomposable and non-decomposable fractions, quantifying organic waste by volume, and implementing in-vessel composting using perforated buckets. Questionnaires were administered to 385 stakeholders, including households, students, waste collectors, farmers, and municipal officials, to capture perceptions and challenges related to composting practices. The effectiveness of the compost was assessed through a controlled farming experiment using spinach, comparing compost application, inorganic fertilizer, and an untreated control. Results indicated that approximately 79.27% of total waste was organic, forming the largest component of Municipal waste stream. The composted material significantly improved crop growth, with compost-treated plots achieving a 90% germination rate, greater plant height (21.5 cm), and higher yield (2.2 kg from 10 plants) compared to chemical fertilizer and untreated control plots. Stakeholder analysis revealed major barriers to composting adoption, notably lack of awareness (82%), inadequate municipal support (77%), poor segregation (74%), limited space (70%), and lack of tools (68%). The study concluded that composting presents a feasible and effective solution for managing organic solid waste with substantial environmental and agricultural benefits. However, its implementation requires addressing technical, institutional, and community barriers. It was recommended that the Local Municipal Administration strengthen sensitization, enforce segregation at source, integrate composting into policies, support access to tools, and develop compost markets through farmer engagement and partnerships.

Keywords: Waste segregation, Organic waste, Environmental Sustainability, composting

2.3 Estimation of Soil Erosion and Sediment Delivery Ratios in Maziba Sub-Catchment, Uganda

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Abstract

The Maziba sub-catchment experiences severe soil erosion, primarily driven by agricultural activities and heavy rainfall, leading to sedimentation. This study investigates soil erosion rates and Sediment Delivery Ratios (SDRs) in the Maziba sub-catchment, southwestern Uganda. Specifically, mapping the spatial distribution of erosion rates, identifying erosion hotspots, comparing modelled hotspots with actual geographic features, and assessing sediment delivery ratios in the area. On-site measurements and laboratory analyses were used to record stream discharge and total suspended solids (TSS). Soil loss and erosion hotspots were mapped using QGIS. Discharge was measured using the float method, and TSS was determined through gravimetric analysis. These data, together with estimates from the USLE model, help evaluate erosion conditions in the sub-catchment. Annual soil loss across quantiles ranged from 92.9 ± 74.7 to 265.6 ± 261.4 (75^{th} quantile), 41.7 ± 30.3 to 120.7 ± 121.4 (50^{th} quantile), and 26.8 ± 20.9 to 63.4 ± 61.4 (25^{th} quantile). SDR values varied from 0.007 ± 0.005 to 0.035 ± 0.017 (25^{th} quantile), 0.003 ± 0.005 to 0.019 ± 0.01 (50^{th} quantile), and 0.001 ± 0.002 to 0.008 ± 0.001 (75^{th} quantile). Severely degraded watersheds, such as Mukirwa, Kakore East, and Ihanga West, experience an average soil loss of 227 t/ha/year, while highly degraded watersheds, including Ihanga, Rugyendira, Kabanyonyi, and Maziba Dam, lose approximately 82 t/ha/year. Moderately degraded watersheds lose about 26 t/ha/year. Soil erosion hotspots are primarily on hilly slopes and are influenced by human activities, with consistently high-risk sites identified across watersheds. Based on these findings, the study recommends enhancing sustainable practices, such as terracing, agroforestry, and cover cropping. These interventions require the engagement of farmers and supportive policies. Ground truthing can validate model estimates and is recommended to improve the understanding of soil erosion.

Keywords: *Soil erosion, sediment delivery ratio (SDR), Maziba Sub-catchment, erosion hotspots, sustainable land management.*

2.4 Adaptation of AI- driven and agentic based technologies to strengthen environmental governance systems

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Abstract

The adoption of new and digital technologies, particularly Artificial Intelligence (AI) and Agentic AI, presents a strategic investment opportunity to enhance water and environment management and development in Uganda, where climate variability, water scarcity, and environmental degradation increasingly threaten livelihoods and economic growth. This study introduces the integration of science, technology, innovation, and capacity building as a critical investment approach for strengthening Uganda's water and environmental governance systems. The significance of the research lies in its potential to demonstrate how AI-driven and agent-based technologies can improve data analysis, forecasting, monitoring, and adaptive decision-making in water resource management, irrigation, and environmental protection. The study employed a qualitative and analytical methodology, drawing on a review of relevant policy documents, project reports, and scientific literature, complemented by selected case experiences and stakeholder consultations involving water sector institutions, local governments, and community-level actors. The results indicate that the application of AI technologies enhances real-time monitoring, climate risk prediction, and operational efficiency, while Agentic AI supports autonomous system coordination, early warning, and optimized water allocation under changing climatic conditions. Capacity-building initiatives were found to be essential in enabling technical staff and institutions to effectively adopt, operate, and scale these technologies. However, challenges related to limited digital infrastructure, technical skills gaps, and high initial investment costs were identified. In conclusion, the study affirms that targeted investment in AI, Agentic AI, and capacity building can significantly accelerate progress in water and environment management and development in Uganda. It recommends strengthening digital infrastructure, expanding skills development programs, promoting multi-stakeholder partnerships, and aligning national policies and financing mechanisms to support the sustainable scaling of AI-enabled solutions for climate resilience and water security.

2.5 Willingness to Pay Water-User Fee and Associated Factors Among Household Heads in Mayuge District

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Abstract

On a global scale, access to safe water has improved considerably; however, the sustainability of water supply systems implemented by governments and development partners remains a major concern, often leading to system breakdowns, unreliable supply, and increased risk of waterborne diseases. These challenges are exacerbated by rising water demand and low community willingness to contribute to water user fees required for operation and maintenance. This study assessed household willingness to pay water user fees and associated factors in Mayuge District, Eastern Uganda, to generate evidence for strengthening sustainable water service delivery. A cross-sectional study design employing mixed quantitative and qualitative methods was used, including a contingent valuation approach. A total of 396 household heads were recruited using a semi-structured questionnaire, complemented by key informant interviews and in-depth interviews. Data were analyzed using STATA version 14, applying descriptive statistics and multivariate logistic regression to identify factors associated with WTP. Ethical approval was obtained from the Makerere University School of Public Health Institutional Review Board, and confidentiality was maintained throughout the study. The median age of respondents was 42 years, with the majority being female (59.3%), Muslim (35.6%), and residing in male-headed households (83.8%). Boreholes were the main water source for 75.8% of households, and 59.3% of respondents expressed willingness to pay water user fees. Among those willing, 43.8% preferred paying UGX 500–1,000 per month for borehole services, while 32.8% were willing to pay less than UGX 50 per jerrycan for piped water systems. Multivariate analysis revealed that gender, household headship, education level, and year-round functionality of the water source were significantly associated with willingness to pay. The findings highlight the importance of gender-responsive and education-driven water policies, alongside improving water source reliability, to enhance fee compliance and promote long-term sustainability of rural water services.

2.6 Interactive Radio Capturing Community Perspectives on Climate-related Migration in Uganda

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Abstract

Communities' perspectives are crucial but often missing in water, environment, and development practice and policy. In 2025, Farm Radio used On-Air Dialogues (OADs) to consult communities of Buganda, Lango and Teso on climate-related migration, droughts and floods. OADs is an interactive radio program designed to consult rural communities on topics of significant importance to them. We worked with 3 radio stations targeting three ecological zones (Wetland, Savanna woodland and Savanna grassland) to create radio episodes of an OAD program aired on a weekly basis. OAD integrates a mobile-phone based polling system called Uliza for audience polling, communication, and exchange of information between communities and their radio station quickly and easily. We aired four episodes receiving a variety of participants. Each episode posed a series of questions to listeners. A total of 888 (573 men, 315 women, 649 youth) respondents participated in the OAD polls across the regions leading to 6,615 interactions. The abstract is developed using results from the first two episodes. 67% of the 169 participants of episode one acknowledged that people move either to rural (42.01%) communities or towns and cities (25.44%). Droughts and water scarcity (38.3%) were cited as main drivers of migration followed by floods (25.6%). A significant proportion of older men and women complained of not having enough timely and reliable information on floods and drought. The biggest impacts resulting from climate-induced migration are pressure on natural resources (especially land, water, pasture) and increasing conflict in communities. There is a need to support mobility as an adaptation strategy, managed locally through inter-community dialogue and resource management clearly articulated in the national and local adaptation plans. Interactive radio is a practical and accessible early warning system that can support timely adaptation to climate change, especially for rural communities.

Key words: Interactive radio, Climate migration, On-air dialogues

2.7 Integrating WASH Interventions across Healthcare Facilities: Evidence from Northern and Eastern Uganda

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Abstract

The Sexual Health and Reproductive Education (SHARE) Project is a five-year initiative (2022–2026) funded by the Government of Canada and implemented by a consortium led by WaterAid Uganda to strengthen Water, Sanitation, and Hygiene (WASH) in healthcare facilities in rural Uganda, particularly in the Buyende and Adjumani districts. Recognizing that inadequate WASH contributes to healthcare-associated infections and undermines sexual and reproductive health and rights (SRHR), especially for adolescents and young women, the project adopted a systems-strengthening approach that combined infrastructure rehabilitation with capacity building. Interventions included upgrading water supply systems, constructing gender-segregated sanitation facilities, and establishing safe, color-coded healthcare waste management systems. Using the WHO Water, Sanitation and Hygiene Facilities Improvement Tool (WASH FIT), 160 health workers were trained in WASH and infection prevention and control, resulting in cost-effective WASH improvement plans across 66 health facilities. Facility-based WASH/IPC committees were established to support sustainability, along with training and supply of PPE, menstrual hygiene management, and waste handling. These improvements were deliberately integrated into maternal health, antenatal care, and maternity services to encourage facility-based service utilization. The project resulted in improved WASH services, and cleaner, safer healthcare environments, reduced infection risks, and increased service uptake, with some facilities reporting more than a twofold increase in antenatal attendance. Continuous Medical Education (CME) on WASH FIT and IPC was integrated into institutionalized mentorship for health workers, support staff, and community volunteers (i.e., community health workers). Overall, the SHARE Project demonstrates that integrating WASH improvements into SRHR programming can significantly enhance the quality of care, service utilization, and long-term health system resilience in underserved settings.

2.8 Efficient Energy Utilization Strategies for Off-grid Aquaponics Systems for smallholder farmers in Uganda

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Abstract

Increasing pressure on Uganda's water and environment, coupled with shrinking agricultural land from urbanization and industrialization, is undermining the sustainability of conventional food production systems. Aquaponics offers a water-efficient alternative by integrating fish and plant production; however, the energy intensity and uncertain performance of solar-powered aquaponics systems remain poorly characterized, constraining evidence-based adoption and long-term viability of aquaponics in Uganda. This study assessed the power consumption of small-scale aquaponics systems and evaluated their financial feasibility for smallholder farmers. PVsyst software was used to simulate and size solar energy requirements based on measured loads from pumps, aerators, and lights, combined with site irradiation data. The optimal configuration was selected by key performance indicators including performance ratio, solar fraction and least system losses; and the system's financial viability was analyzed using net annual profit, payback period, return on investment (ROI), and net present value (NPV). The simulation resulted in a 2.4-kilowatt peak PV system meeting 10.62 kWh daily consumption, met with six 400 Wp and four 48-V lithium-ion batteries. The system annual useful energy production was at 3,562 kWh with a performance ratio of 70.3%, solar fraction of 95.4%, and missing energy was at ~5% per year. In addition, the financial evaluation showed that the system pays over $1,500 per year after deducting all expenses. This project can payback its investment in ~4.5 years with a 21.3% ROI per year. After 10 years discounting at 10% rate, the NPV stood at $2,200. In conclusion, an off-grid solar-powered aquaponics system is a profitable investment for medium-scale operations with over $5,000 investment. In times of low solar irradiance, load shifting needs to be done to minimize battery usage and prioritize usage in aquaponics. Also, the batteries need to be replaced after 10-15 years.

2.9 Digitisation of Water Service Connection Assessment Process in Uganda

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Abstract

Water Service Connection Assessment is a critical operational interface in Uganda's Rural Water Supply Systems, traditionally managed using paper-based methods. At the same time, digital solutions are increasingly being adopted in the WASH sector to enhance efficiency and transparency and to bridge gaps in the water service connection process. These conventional approaches were constrained by slow processing times, labour-intensive workflows, transcription errors, and limited spatial accuracy, particularly in large-scale water supply systems. The methodology involved adopting the mWater digital platform for service connection assessment, integrating geo-referenced, real-time data collection, automated validation, and immediate report generation within the existing Ten-Step Service Connection Implementation Framework. Key results demonstrated significant gains in efficiency, accuracy, and productivity: field teams assessed 4,404 households in Nyamugasani Water Supply System within 49 working days, exceeding the target of 3,000 households, and achieving a dramatic increase in productivity after the introduction of the digital platform. The findings indicate that digitisation eliminated manual data entry, reduced errors, improved data accuracy and completeness through GPS geo-referencing, and enabled faster reporting and real-time decision-making via automated dashboards. Key recommendations include continued investment in technology, capacity building, and data-driven approaches to ensure effective, equitable, and sustainable delivery of water services. Notwithstanding its transformative potential, digitisation may be constrained by systemic reliance on reliable electricity supply in rural areas, the need for sustained institutional and user capacity development, and the capital and recurrent costs associated with acquisition of digital hardware.

Key words: Service connection, digitisation, rural water supply, WASH, data management, efficiency

2.10 An experiential model for training the next generation of water quality professionals in sub-Saharan Africa: Lessons from a collaborative university fellowship program

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Abstract

Reliable water quality data is necessary to address safe water challenges in sub-Saharan Africa. However, there is a gap in water quality testing capacity within the region, while young engineers and technical professionals often face unemployment due to a lack of skills desired by employers. Training programs combining theoretical instruction with experiential, hands-on learning may improve both issues. This study assessed the Africa Water Quality Testing Fellowship Program, which aims to build capacity among undergraduate university students in Ethiopia and Uganda to develop a pipeline of skilled water quality professionals. The fellowship curriculum includes six modules providing theoretical background knowledge mixed with hands-on activities, a field experience involving water quality sampling procedures and field laboratory testing, and monthly virtual seminars. Across both countries, 148 students participated in the program in three cohorts from 2022 to 2025. We assessed the program by exploring student learning and career prospects through participant surveys, as well as module quiz scores and employment tracking provided by participating universities. The program positively impacted fellows' knowledge and career prospects, with all participants feeling confident in their water quality testing skills. Further, 91% of the third cohort stated that the fellowship changed their perception of local water quality issues and 89% of all fellows reported using at least one skill gained during the program in the following year. Several also moved on to water-related employment following graduation. Fellows particularly appreciated the in-depth field experience and faculty engagement. This program offers a starting point, which can be expanded and tested further to fill the gap in water quality testing capacity. University training programs with experiential components such as this can develop the next generation of water quality professionals but should offer real-world experience and be conducted by engaged faculty mentors for them to be successful.

Keywords: Drinking water quality, engineering education, experiential learning, technical and vocational education and training, water quality monitoring

2.11 Human Waste to Energy: Advancing Environmental Conservation through Biogas Systems in Uganda

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Abstract

The country loses an estimated 92,000 hectares of forest annually, with institutional cooking identified as a significant driver, while inadequate sanitation in schools further contributes to environmental contamination and public health risks. Uganda's education sector is a major consumer of biomass energy, with over 96% of schools operating feeding programmes dependent on firewood, a practice that accelerates deforestation, increases greenhouse gas emissions, and exposes learners and staff to harmful indoor air pollution. On the other hand, livestock is responsible for 14.5 to 18% of total anthropogenic GHG emissions due to Enteric Fermentation and waste (manure management). Proper management of livestock waste can significantly reduce this share through co-digestion of livestock and human waste to generate biogas. This project implemented an integrated Human and animal Waste to Energy intervention in two primary schools in Mukono District to address these interlinked challenges through climate-resilient sanitation and clean energy generation. The projects aimed to improve access to inclusive WASH facilities while reducing reliance on firewood by converting human co-digested with animal waste into biogas. A mixed-methods approach was employed, including baseline community and school surveys, stakeholder consultations, technical design and installment of installation of a 30 and 40 m^3 anaerobic biodigester, and post-intervention assessments. The two projects have benefited approximately 1,289 users, biogas production replaced a significant proportion of firewood use, reducing fuel costs and contributing to forest conservation, lowering carbon emissions, and improved indoor air quality. Treated waste was converted into bio-slurry for school gardens, supporting sustainable agriculture and nutrient recycling. The initiative presents a replicable framework for advancing inclusive and sustainable water, sanitation, and energy solutions in Uganda's education sector, contributing directly to the theme: "Water and Environment for an Inclusive and Prosperous Uganda."

Key words: Biogas, environmental conservation, waste-to-energy, school WASH, climate resilience, clean cooking

3 SUB-THEME 3: ENSURING ENVIRONMENTALLY SUSTAINABLE AND CLIMATE RESILIENT ECONOMIES AND COMMUNITIES

3.1 Community-Managed Water Funds in Rural Uganda: Multi-Year Evidence from Village Savings and Loan Associations.

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Abstract

Rural water services in Uganda face persistent sustainability challenges, with many handpumps failing due to limited financing for operation and maintenance, weak accountability, and low community readiness. To address these challenges, we assessed whether water funds integrated into 35 Village Savings and Loan Associations (VSLAs) in Kabarole District could be consistently accumulated for maintenance needs, and whether such savings persisted even as external facilitation declined. The sample comprised 10 Aquaya-supported pilot groups, followed over four cycles, and 25 district-led groups, followed over three cycles. Aquaya-supported VSLAs began with intensive facilitation, averaging 28 follow-up visits per group in the first cycle, which tapered to five in the second, two in the third, and one by the fourth. Despite this reduction in external support, Aquaya-led groups consistently contributed to water funds, achieving 69–80% of expected annual targets and saving an average of approximately UGX 25,000–50,000 per group per month (UGX 300,000–600,000 annually). District-led groups began with more moderate facilitation (16 visits in the first cycle, with further tapering thereafter) and demonstrated slightly lower adherence to water fund targets (51–52%), while still accumulating meaningful savings alongside strong overall VSLA financial activity. Importantly, across both cohorts, these contributions marked a shift from the prior status quo of no savings for maintenance and repairs. Most groups remain active and functional, with only two Aquaya-supported groups and three district-led groups dissolving over the observation period. Taken together, these findings show that communities can mobilize and sustain dedicated water funds even as external support is substantially reduced, providing practical evidence for more sustainable, district-led rural water financing models. Building on this evidence, the approach has been expanded into a randomized controlled trial in Kabarole District to empirically examine whether sustained community water funds translate into improved maintenance responsiveness and handpump functionality over time.

Key words: community financing; rural water; operations and maintenance; Village Savings and Loans Associations; Uganda

3.2 Assessment of Unregulated Water Users in Mbarara City.

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Abstract

The Constitution of Uganda entitles every person to safe and clean water provided by a recognized Water Authority. In support of this constitutional right, the Water Act, Cap 152, provides a legal framework for the regulation of water use through a water permit system. In accordance with this legal provision, Mbarara City is a gazetted area mandated to be served by the National Water and Sewerage Corporation (NWSC). NWSC reported presence of several unregulated water sources within Mbarara city, which poses significant risks to both the sustainability of water resource and public health. Uncontrolled abstraction from these sources can negatively affect available water quantities by placing pressure on shared groundwater resources, potentially leading to depletion and reduced reliability of supply. Furthermore, because the quality of water from these sources is not routinely monitored or regulated, there is a high risk of contamination, exposing users to waterborne diseases and other health hazards. An assessment was therefore conducted to identify, record, and verify non-regulated water sources within Mbarara City center. The findings revealed that in the sampled area, 90% of these sources lack the required No Objection Letters from NWSC and valid water abstraction permits from the Ministry of Water and Environment. Most of the identified sources were hand-dug shallow wells, which are highly susceptible to pollution. The study highlights the need for strengthened regulation, monitoring, and enforcement to protect water quantity, ensure water quality, and promote compliance with existing water management laws.

Key words: Water regulation, water permits

3.3 Heavy Metal Contamination of Sediments from Port Bell, Lake Victoria: Implications for Environmental Sustainability and Community Health

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Abstract

Lake Victoria remains one of Uganda's most valuable ecological and economic assets; however, increasing industrial effluents, urban runoff, and port activity continue to compromise its environmental health. This study assessed the concentrations, spatial distribution, and ecological risks of heavy metals (HMs) in sediments from Port Bell, an area experiencing intense industrial discharge and shoreline modification. Sediment samples (n = 9) were collected across three zones representing industrial outlets, channel inflow, and shoreline deposition. Samples were digested and analyzed for lead (Pb), copper (Cu), chromium (Cr), and cadmium (Cd) using atomic absorption spectrometry. Results showed clear contamination patterns, with concentrations following the trend Pb > Cu > Cd > Cr. Lead (40–44 mg/kg) and copper (6–7 mg/kg) occurred at the highest levels across multiple sampling points. Contamination indices demonstrated severe enrichment of cadmium, moderate contamination by lead, and minimal contamination by copper and chromium. The Potential Ecological Risk Index identified cadmium as the dominant contributor to ecological risk, indicating considerable potential harm to benthic organisms. While human health risk assessment found no significant non-carcinogenic dermal exposure risk during dredging, the elevated ecological risk, especially from Cd, raises long-term concerns for food webs, fish bioaccumulation, and shoreline community health. Multivariate analysis linked Cd and Cr enrichment to anthropogenic inputs, including industrial waste discharge, fuel combustion residues, domestic wastewater, and leachates from batteries and consumer plastics. These findings emphasize the urgent need for strengthened regulatory enforcement, improved industrial wastewater treatment, routine sediment monitoring, and community-based pollution surveillance. By addressing sediment contamination drivers, Uganda can enhance the resilience of Lake Victoria's ecosystems and safeguard the livelihoods and economies that depend on this critical freshwater resource.

Key words: *Heavy metals; Lake Victoria; Sediment contamination; Ecological risk; Water quality*

3.4 Influence of Psychosocial Work Environment on Job Satisfaction among Forestry Extension employees in Uganda

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Abstract

Lake Uganda relies on District Forestry Officers (DFOs) to implement forest conservation, climate resilience and environmental governance programs, yet there is limited empirical evidence on how their psychosocial work environment shapes job satisfaction and motivation. This lack of evidence represents a critical gap because dissatisfied workforces can undermine service delivery, enforcement, and progress toward national restoration targets. The objective of this study was to examine which dimensions of the psychosocial work environment are associated with job satisfaction among forestry extension employees. An analytical cross-sectional mixed-methods design was used, involving a national census survey of 111 DFOs complemented by five regional focus group discussions. Psychosocial conditions were measured using an adapted Copenhagen Psychosocial Questionnaire and job satisfaction was assessed using a validated scale. Quantitative data were analyzed using descriptive statistics, reliability testing, and multivariable regression, while qualitative used to explain the identified trends in quantitative data. Results showed moderate overall job satisfaction (mean 3.27 on a five-point scale). Workplace stability emerged as the only psychosocial factor independently associated with job satisfaction ($\beta \approx 0.28$, $p < 0.01$), whereas leadership, work organization, wellness, and personality were not statistically significant. Focus group narratives reinforced these findings, highlighting uncertainty in facilitation, logistical support, limited authority, and blocked career progression as persistent stressors that erode morale over time. Demographic characteristics such as age, gender, posting region, and tenure did not substantially alter these relationships. The findings indicate that institutional resource security rather than individual attributes remains the key driver of job satisfaction in forestry extension. Prioritizing predictable facilitation, realistic promotion pathways, and adequate operational tools can strengthen workforce stability, improve environmental service delivery, and enhance the effectiveness of Uganda's forest restoration and climate commitments. These investments would reduce turnover, build institutional memory, and ensure that frontline officers remain motivated to perform their duties.

Keywords: Psychosocial environment, Job satisfaction, Conservation of Resources (COR) theory, forestry extension, workplace stability.

3.5 Impact of Heavy Metals on Antibiotic Resistance of Escherichia coli from Slum Wastewater: A Case Study of Kawempe Division, Kampala-Uganda

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Abstract

Lake Victoria remains Slum dwellers face significant infrastructure challenges which could facilitate prevalence of antibiotic resistance. This study evaluated the impact of heavy metals on antibiotic resistance patterns of *E. coli* in wastewater from slums of Bwaise II, Bwaise III, Kazo, and Makerere III in Kawempe division, Kampala. Levels of heavy metals (lead, mercury, cadmium, chromium, and arsenic) in wastewater were determined using ICP-MS. *E. coli* were isolated from wastewater using MacConkey agar and their susceptibility to 50 µl of stock antibiotics (tetracycline, amoxicillin, ceftriaxone at 30 µg/ml, and ciprofloxacin at 5 µg/ml) determined. The potential of heavy metals to induce antibiotic resistance in *E. coli* was determined by culturing susceptible isolates in 200 µl of Luria-Bertina broth containing stock antibiotics (10 µl), or stock antibiotics (10 µl) and stock heavy metals (10 µl). Detectable levels of heavy metals were reported in wastewater from Bwaise II, Kazo and Makerere III only. Lead, cadmium and arsenic, mercury and chromium, were highest in Bwaise II, Kazo, and Makerere III, respectively. The occurrence of *E. coli* resistant to at least an antibiotic was 72.8% (169 of 232) and resistance to tetracycline, ceftriaxone, amoxicillin, and ciprofloxacin were 34.1%, 28.9%, 35.3%, and 34.5%, respectively. Study findings further revealed a positive correlation (R^2 = 0.371–0.985) between the presence of heavy metals in wastewater and antibiotic resistance patterns of *E. coli*. Also, heavy metals; lead (77.41 µg/ml), mercury (1.44 µg/ml), and cadmium (10.21 µg/ml) significantly ($p < 0.05$) induced antibiotic resistance in susceptible *E. coli*. Findings highlight the role of heavy metals in prevalence of antibiotic-resistant bacteria. To achieve Uganda's 10-fold growth strategy, good health is key. Therefore, there is a need for proper disposal of wastes that contribute to the build-up of heavy metals towards maintain efficacy of antibiotics commonly used in treatment of infections.

Key words: Antibiotic resistance, *Escherichia coli*, Heavy metals, Slums, Wastewater

3.6 Anthropogenic and Natural Factors impacting Microbiological and Physicochemical Surface Water Quality along an urban tropical wetland

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Abstract

Monitoring microbial water quality is essential for understanding pollution dynamics and their implications for public health, especially in developing countries. This study assessed seasonal variations in physicochemical conditions and microbiological indicators along the Lubigi wetland, a riverine tropical system receiving stormwater and wastewater from Kampala's urban infrastructure. For 17 months, water samples were collected from six sites during dry and wet seasons and analyzed using specific microbiological assay tests for *Escherichia coli*, faecal coliforms, heterotrophic plate counts (HPC), *Enterococcus*, and *Salmonella* species. Results showed that nitrogen compounds, *E. coli*, faecal coliforms, *Enterococcus*, and *Salmonella* were predominantly associated with stormwater runoff, while phosphorus, organic matter, and HPC were linked to wastewater effluent. The wetland exhibited high contamination year-round, characterised by high values of turbidity and salinity. Seasonal trends revealed that *E. coli* concentrations declined significantly along the wetland during the dry season, while *Enterococcus* decreased by 58.6% during the wet season. *Salmonella* exhibited the highest reduction (50.2%) in the dry season. However, faecal coliforms and HPC showed low reductions (<20%), persisting at high levels across both seasons. Overall, pollutant inputs from the Nsooba channel and Lubigi sewage treatment plant exceeded the wetland's natural treatment capacity, resulting in sustained microbiological contamination and significant risks to downstream water quality and public health. Effective pollution control strategies must focus on preventing contamination at the sources rather than relying on natural attenuation. This study points to the public health risks and informs wetland management about improvements in urban water infrastructure.

Keywords: storm water, wastewater, seasons, wetland, microbiological indicators

3.7 Role of transboundary cooperation in promoting national sustainable development

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Abstract

Transboundary cooperation is a cornerstone for achieving sustainable water resources management and national development in the Nile Basin, where shared water resources are under increasing pressure from population growth, economic development, competing sectoral demands, and climate change. In line with the Nile Basin Initiative's 10-year Strategy and Agenda 2030, this paper underscores the importance of knowledge-based decision making as a foundation for optimal planning, management, and development of the Nile's water resources. Evidence-driven joint planning, supported by reliable data, shared knowledge systems, and technical analysis, enables riparian countries to enhance water use efficiency, manage trade-offs, and design resilient development interventions. Adherence to international water management principles and legal frameworks promotes equitable and reasonable utilization, supports benefit sharing, and strengthens cooperation, thereby contributing to peace and regional stability. The study highlights the need to integrate basin-wide priorities with national development strategies, while addressing water scarcity through conjunctive use of surface water and groundwater, technological innovation, and capacity development. By embedding knowledge-based approaches within cooperative frameworks, transboundary water governance in the Nile Basin can deliver win–win outcomes, improve sustainability of investments, and support the achievement of SDG 6 and broader regional development goals.

Key words: Transboundary, cooperation, water, Sustainability; knowledge; transboundary; development, climate change, investments

3.8 Impact of Extreme Runoff Events on the Water Quality and Catchment Stability of Lake Bunyonyi, South-Western Uganda

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Abstract

Lake Bunyonyi, a vital socio-economic hub and Africa's second-deepest lake, faces critical ecological threats from climate-driven siltation and deteriorating water quality. Despite its importance, empirical data to inform mitigation remains scarce. This study investigated catchment siltation drivers through field observations and reviewed National Water and Sewerage Corporation (NWSC) physicochemical data following the high-intensity runoff events of August 2025. Field assessments revealed significant organic loading and pollutant discharge near shoreline car-washing bays and accommodation facilities. These localized impacts resulted in distinct water discoloration, oily films, and foul odors, threatening key aquatic species such as crayfish. Literature review revealed a 3.8% decline in wetland coverage, with intensive hillslope farming contributing to 42.7% of the lake's sediment-related pollution. Post-event NWSC data (August 2025) confirmed critical water quality degradation: turbidity reached 32 NTU, color peaked at 130 PtCo, and dissolved oxygen (DO) declined to 1.60 mg/L, significantly exceeding potable water standards. To ensure the inclusive prosperity of the catchment, this study proposes a tiered intervention framework which is 1) Immediately: Carry out environmental inspections to stop illegal discharge and conduct community sensitization on sustainable farming, 2) Medium-term: Demarcation of shoreline buffer zones as natural silt traps and 3) Long-term: Widespread implementation of agroforestry to stabilize the steep-sloped catchment.

Keywords: Catchment degradation, Water quality, Ecosystem

3.9 Seasonal impact of water availability and quality on water infrastructure and household source selection in Ethiopia, Ghana and Uganda

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Abstract

Most sub-Saharan African countries experience distinct wet and dry seasons which impact various aspects of daily life. However, evidence is limited on the impact of seasons on water infrastructure and related household-level decision-making about water sources. The objective of this study was to quantify the impact of seasonality on water availability and quality, and on household water source selection. Following a multi-country longitudinal study (February 2022 to October 2025), we sampled 1,964 water points 7,028 times and surveyed 6,707 randomly selected households at concurrent times and locations. We defined seasons based on empirical satellite-derived daily precipitation specific to each district. We used generalized estimating equations to estimate the odds of water being a) available and b) free from contamination (*Escherichia coli* <1 CFU/100mL) in the dry season compared to the wet season. Further, we paired water used by households with sampled water points and implemented a decision model to identify drivers for water source selection. Most sampled water points had water available (86%), but more than two-thirds (65%) had *E. coli* contamination. Water availability and microbial contamination were both affected by season. In the dry season, water was less likely to be available than the wet season (OR 0.85; 95% CI 0.75-0.96) but more likely to be free from contamination (OR 1.37; 95% CI 1.22-1.54). Seasonal availability was primarily driven by shallow groundwater, while quality differences were shown for piped water, boreholes, and shallow groundwater. Household source selection was not different by season but driven most strongly by distance to water point, followed by reliability issues then water quality. While some existing water infrastructure is resilient to seasonal shortages, safeguards are needed to further protect new and existing drinking water infrastructure - even improved sources like piped water and boreholes - against seasonal changes in microbial water quality.

Keywords: drinking water infrastructure, water source availability, reliability, seasonality, precipitation, water source selection drivers

3.10 Assessing Insecurities of Water, Sanitation, Hygiene and Solid Waste Services in Healthcare Facilities

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Abstract

Access to safe water, adequate sanitation, hygiene facilities, and solid waste management (WASH–SWM) in healthcare facilities is fundamental to infection prevention, patient safety, and healthcare worker efficiency; however, in many low- and middle-income countries, WASH assessments predominantly emphasize infrastructure availability while insufficiently capturing users' experiences of accessibility, acceptability, and reliability. This study evaluated WASH insecurities and solid waste management practices using both infrastructure-based indicators and user-reported measures in ten purposively selected public and private healthcare facilities (levels II–IV) in Wobulenzi and Kakooge towns in central Uganda. A quantitative methods approach was employed between August 2024 and February 2025, involving structured Institutional WASH Insecurity Experiences (INWISE) surveys administered to 383 participants (130 healthcare staff and 253 recently discharged patients), direct facility observations using Joint Monitoring Programme (JMP) WASH service ladders, and water quality testing for pH, turbidity, residual chlorine, *Escherichia coli*, and total coliforms. Cognitive interviews were conducted to refine data collection tools, and data were analyzed using univariate, bivariate, and multivariate methods, including Spearman's correlations and logistic regression in Stata 15.0 and R 4.3.3. The JMP classification for water supply showed that 40% of the healthcare facilities met basic levels, while sanitation, hygiene, solid waste management and environmental cleaning remained severely inadequate. No facility met basic sanitation criteria and only 30% attained basic hygiene, environmental cleaning services and solid waste management at 20%. Water satisfaction showed moderate negative correlations with the JMP water ladder ($\rho = -0.399$ to -0.169, $p < 0.01$). Overall, the findings highlight critical gaps in WASH–SWM infrastructure and service reliability and demonstrate the importance of integrating user experience measures with existing infrastructure-based indicators to inform targeted investments that enhance infection control, patient safety, and resilient healthcare systems in small towns in Uganda and similar contexts.

Key words: Water, Sanitation, Hygiene, Solid Waste Management, WASH insecurities, Healthcare facilities.

3.11 Integrated assessment of climate vulnerabilities and adaptive capacities across water and waste services

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Abstract

Water supply, sanitation, and solid waste management (SWM) services are interconnected but often planned in isolation. Under climate change, these interlinkages become critical, as increased rainfall, flooding, and droughts amplify vulnerabilities across the entire water, sanitation and hygiene (WASH) and SWM service chain. However, there is limited understanding of how climate change jointly affects the vulnerability of interconnected water and waste services, and which adaptive capacities exist locally. The Swiss Federal Institute of Aquatic Science and Technology (Eawag), in collaboration with Makerere University, assessed climate-related risks to WASH and SWM infrastructure in two rapidly urbanizing small towns in central Uganda under the Water, Behavior Change and Environmental Sanitation (WABES) project. Hydrological and drainage network modelling using the Storm Water Management Model (SWMM) and the Soil and Water Assessment Tool (SWAT +) under different climate projections identified flood hotspots and climate-related service vulnerabilities. Scenarios of waste accumulation in drainage channels were modelled to assess the combined effect of increased rainfall and waste clogging on flood extent. Key informant interviews and field observations complemented the modelling to identify existing adaptive capacities. Results show that higher rainfall intensities expand flood-prone areas, with sediment and waste accumulation in drainage networks further intensifying and spatially shifting flooding. Interlinked climate-related vulnerabilities include groundwater contamination risks from pit latrines, flooded dumpsites, and water supply disruptions affecting basic access to water and sanitation. Adaptive capacities at household and community levels include source switching and rainwater harvesting, raised latrines, flood protection trenches near sanitation facilities, tree planting to reduce runoff, and periodic drain cleaning. The findings highlight systemic interdependencies of WASH and SWM services and underscore the need for integrated planning and strengthened institutional coordination to build climate-resilient services. The study informs evidence-based recommendations for town councils, such as routine drainage cleaning prior to the rainy season.

Key words: Water, Sanitation, Solid Waste, Climate Vulnerabilities, Stormwater Management, Adaptive Capacity

3.12 A Systematic Review of Toxic Metals Exposures through Drinking Water in East Africa

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Abstract

Lead (Pb), Arsenic (As), and Manganese (Mn) present substantial and irreversible health concerns to exposed populations. Prior evidence suggests that drinking water is an important exposure route for each of these contaminants. Lead primarily enters drinking water systems through anthropogenic means: either through lead-containing infrastructure like pipes and handpumps or through source contamination. Arsenic and Manganese are predominantly geogenic contaminants. These contaminants may produce significant public health burdens as East Africa continues to improve its drinking water infrastructure. Given the potential risk to substantial populations, we sought to understand the existing exposures of populations to Pb, As, and Mn through drinking water in East Africa. A systematic review approach is being used per PRISMA. Inclusion criteria include peer-reviewed studies published in English since 1969 reporting a toxic metal of concern in drinking water in a Low-and-Middle-Income Country (LMIC). 24,000 studies were identified from these databases, with 3,908 proceeding to data extraction. Of this set, 108 studies took place in East Africa, comprising a total of 1700 data points across Pb, As, and Mn. Evidence from this analysis suggests that across the region, 30%, 25%, and 16% of improved, urban sources have Pb, As, and Mn above their WHO guideline values. This is substantially higher than in rural settings, though there are insufficient studies to conclude significance. There seems to be an increase in geogenic contamination when swapping to an improved source in rural areas. A current limitation is the lack of nationally representative and high-fidelity water quality data for toxic metals in the region, suggesting a gap for future research. This study concludes that while more work is needed to determine the final levels of exposure, there is substantial evidence that toxic metals should be integrated into national drinking water strategies to prevent population-wide exposures.

3.13 Integrated assessment of climate vulnerabilities and adaptive capacities across water and waste services

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Abstract

Water supply, sanitation, and solid waste management (SWM) services are interconnected but often planned in isolation. Under climate change, these interlinkages become critical, as increased rainfall, flooding, and droughts amplify vulnerabilities across the entire water, sanitation and hygiene (WASH) and SWM service chain. However, there is limited understanding of how climate change jointly affects the vulnerability of interconnected water and waste services, and which adaptive capacities exist locally. The Swiss Federal Institute of Aquatic Science and Technology (Eawag), in collaboration with Makerere University, assessed climate-related risks to WASH and SWM infrastructure in two rapidly urbanizing small towns in central Uganda under the Water, Behavior Change and Environmental Sanitation (WABES) project. Hydrological and drainage network modelling using the Storm Water Management Model (SWMM) and the Soil and Water Assessment Tool (SWAT +) under different climate projections identified flood hotspots and climate-related service vulnerabilities. Scenarios of waste accumulation in drainage channels were modelled to assess the combined effect of increased rainfall and waste clogging on flood extent. Key informant interviews and field observations complemented the modelling to identify existing adaptive capacities. Results show that higher rainfall intensities expand flood-prone areas, with sediment and waste accumulation in drainage networks further intensifying and spatially shifting flooding. Interlinked climate-related vulnerabilities include groundwater contamination risks from pit latrines, flooded dumpsites, and water supply disruptions affecting basic access to water and sanitation. Adaptive capacities at household and community levels include source switching and rainwater harvesting, raised latrines, flood protection trenches near sanitation facilities, tree planting to reduce runoff, and periodic drain cleaning. The findings highlight systemic interdependencies of WASH and SWM services and underscore the need for integrated planning and strengthened institutional coordination to build climate-resilient services. The study informs evidence-based recommendations for town councils, such as routine drainage cleaning prior to the rainy season.

Key words: Water, Sanitation, Solid Waste, Climate Vulnerabilities, Stormwater Management, Adaptive Capacity

3.14 The response of macroinvertebrate communities to multiple stressors in the greater Kampala Metropolitan area, Uganda.

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Abstract

Benthic macroinvertebrates act as biological indicators of aquatic degradation due to their bottom-dwelling lifestyle and sensitivity to disturbances. Biological Monitoring (such as the use of Benthic Macroinvertebrates) has for long emerged as a cheap, easy, and reliable approach to determining the water quality in developed and some developing nations. This study investigated how macroinvertebrate communities respond to multiple stressors in the greater Kampala Metropolitan area, Uganda. This study specifically aimed to determine i) the physical chemical parameters, ii) the hydromorphological parameters and iii) the response and sensitivity of macroinvertebrates in streams of GKMPA. A total of 26 sites were sampled for physico-chemical, hydromorphological parameters, substrates, and macroinvertebrates. Physicochemical parameters reliably categorized sites into highly disturbed-DS, moderately disturbed-MD, and natural sites-NN. A Kruskal-Wallis test determined significant differences. Results showed highest phosphate concentration, temperature, EC, and BOD in DS. Nitrates, pH, and turbidity were highest in MD, while DO was highest in NN. No significant differences were shown by stream depth, width, flow velocity, and Hydro morphological Index of Diversity (HMID). Finer substrates dominated DS while coarse substrates in NN. Multiple stressors led to increased abundance of pollution-tolerant taxa such as Chironomidae red and Oligochaeta in DS, while EPT taxa declined. Taxa richness of pollution-tolerant and pollution-sensitive taxa was highest in NN. The existing African biotic indices, such as SASS, TARISS, RS, and ETHbios showed limitations onto determining the ecological integrity of streams under study compared to the new developed KASS (Kampala Scoring System). This can be attributed to missing taxa on their score sheets and regional differences for which they were developed. This justifies the urgent need for a local biotic index for Uganda's freshwater systems. Results of this study supports the ongoing SWAQ project under ministry of water and Environment upon which a national framework will be developed.

Key words: Macroinvertebrates, multiple stressors, hydromorphology, biomonitoring, biotic-index.

3.14 Restoring Hope through Trees: Community-Driven Reforestation in Ibanda District, Uganda.

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Abstract

Restoration is not only vital for environmental benefits but also drives rural development, biodiversity conservation, and climate change adaptation. In Ibanda district, located within the Mpanga catchment, 61.2 hectares of land were mapped as severely degraded due to deforestation and poor agricultural practices. This degradation has reduced water quality and quantity with increased climate change vulnerability. In response, the Ministry of Water and Environment, through the Albert Water Management Zone, with support from the Conrad N. Hilton Foundation, is implementing nature-based restoration activities in the catchment with focus on restoring the degraded landscapes while improving the livelihood through participatory community-driven tree growing. Central to this approach was strong stakeholder and community awareness. 489 community members were sensitized in Nyamarebe, Rukiri, Ishogororo and Kagongo. While 213 received hands-on training in sustainable tree growing. Over 40,000 tree seedlings were planted on 45.16 hectares, including Mahogany, Grevillea, Albizia, Musizi, Prunus Africana, and coffee, matched to farmers' preferences and ecological characteristics. Key innovations included use of Free Prior, and Informed Consent forms (FPIC) to secure voluntary land commitment and hybrid training of both indigenous knowledge and technical forestry expertise. To track restoration performance, 30m * 30m sampling plots were established on key sites. Encouraging results: Kashangura 85%, Kigunga 60%, Kibande 70% and Kiburara prison farm 80%. Tree heights ranged from 18 to 82cm, depending on the tree species and environmental conditions. Challenges such as land fragmentation and low incomes posed threat; practical solutions like agroforestry and carbon credit linkages were adopted to enhance sustainability. Overall, this initiative can yield significant ecological and socio-economic benefits while aligning to Uganda's National Forest and Tree planting Act (2003), Vision 2040 and SDG13 (Climate Action).

3.15 Social Value of the Welfare Benefits and Potential Demand for Improved Fecal Sludge Management in Urban Settlements in Uganda

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Abstract

Poor fecal sludge management (FSM) derails the achievement of SDG 6 (ensuring access to clean water and sanitation for all) in developing countries relying on on-site technologies. While cost-sharing models between sanitation providers and households offer a potential solution to funding gaps, their sustainability depends on households' willingness to pay (WTP) for improved sanitation. The study aimed to estimate WTP for improved FSM; estimate the social value of welfare benefits from improved FSM; and (ii) estimate potential uptake of improved sanitation services. Social value of welfare benefits is a policy factor to guide decisions to invest in sanitation projects. This study utilized the Contingent Valuation Method to estimate WTP, social welfare benefits, and potential service uptake in Wakiso District, Uganda. Data from 308 households were analyzed using a random effects probit model. Results indicate a mean WTP of UGX 4,200 (USD 1.17) per month. This exceeds the estimated monthly operational cost of UGX 1,130 (USD 0.31), suggesting economic viability for service delivery. However, when capital costs for infrastructure (construction of the pit latrines and FS treatment plant) are included, the total cost rises to UGX 20,300 (USD 5.64), far exceeding household WTP. The total social value of improved FSM for the district is estimated at UGX 2.13 billion (USD 591,888) per month, with projected uptake rates ranging from 6% to 58.2%. Uptake rate is largely influenced by education level, monthly charge, payment interval and awareness of poor fecal sludge management in the community. The study concludes that while households can cover operational expenses through a monthly fee, they cannot afford the full capital costs of improved latrine construction. Recommendations include government-private partnerships to expand vacuum truck fleets and treatment capacity, alongside public awareness campaigns to highlight the health risks of poor FSM and drive service demand.

Key words: Contingent Valuation, fecal sludge management, improved sanitation, social value, welfare benefits

3.16 Participatory Integrated Planning (PIP) as a pathway to climate-resilient and environmentally sustainable livelihoods in Uganda's highland ecosystems: Evidence from the INCLUDE Project in Rubanda District.

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Abstract

Uganda's highland ecosystems, particularly in the Kigezi region, are increasingly vulnerable to climate change, land degradation, and water stress, largely driven by population pressure, fragmented planning, and limited community ownership of natural resource management interventions. While national policies emphasize climate resilience and environmental sustainability, translating these ambitions into practical, community-led action remains a persistent challenge. This paper examines the application of Participatory Integrated Planning (PIP) as an inclusive and adaptive methodology for strengthening environmentally sustainable and climate-resilient livelihoods among smallholder livestock farmers under the Inclusive Livestock Development for Smallholder Farmers (INCLUDE) Project in Rubanda District, south-western Uganda. Using a participatory action research approach, the study draws on community planning sessions, modular PIP implementation experiences, and field observations to assess how PIP enhances farmer motivation, stewardship of land and water resources, and livelihood resilience. Findings indicate that PIP enables smallholder farmers to integrate livestock management, sustainable land use, water conservation, and household livelihood planning into a single, farmer-owned vision, resulting in improved adoption of climate-smart practices, strengthened local institutions, and increased ownership of environmental outcomes. The paper demonstrates that participatory integrated planning not only supports sustainable production and resilience at household level but also contributes to broader ecosystem protection and climate adaptation goals in fragile landscapes. The study concludes that scaling PIP within Uganda's water and environment programming can strengthen community-driven resilience, bridge policy-practice gaps, and support inclusive and sustainable economic development.

Key words: Participatory Integrated Planning; Climate resilience; Environmental sustainability; Smallholder farmers; Highland ecosystems; Uganda

3.17 Safeguarding Lives and Livelihoods in Nyamwamba: A Hybrid Ecosystem–Infrastructure Model for Enhanced Climate Resilience

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Abstract

Climate change is increasing the frequency and intensity of extreme hydrological events in many mountainous regions of Uganda. In Kasese District, the Nyamwamba River catchment has experienced recurrent flash floods and debris flows originating from the Rwenzori Mountains, leading to loss of life, destruction of infrastructure, ecosystem degradation, and disruption of local livelihoods. These impacts highlight the urgent need for integrated and sustainable flood risk management approaches. In response, a hybrid ecosystem–infrastructure model was implemented in the Nyamwamba catchment, combining engineered flood protection measures with ecosystem-based interventions. Structural measures included riverbank stabilization and desilting of river channels to improve flow conveyance during high-flow events and protect critical infrastructure. These were complemented by ecosystem-based solutions such as riverbank restoration, catchment rehabilitation, and slope stabilization aimed at restoring watershed functions and reducing upstream drivers of flood risk. By addressing both the immediate impacts and underlying causes of flooding, the integrated approach strengthens river corridor stability while restoring ecological integrity across the catchment. This contributes to reduced flood intensity, improved sediment management, and enhanced long-term sustainability of water and land resources. The Nyamwamba experience also demonstrates the importance of multi-stakeholder collaboration among government institutions, local communities, development partners, and research organizations, fostering knowledge generation, innovation, and capacity building. Lessons emerging from the catchment provide valuable insights for scaling hybrid ecosystem–infrastructure adaptation strategies to other flood-prone and climate-vulnerable landscapes in Uganda, offering a practical pathway for strengthening climate resilience, safeguarding vulnerable communities, and promoting sustainable water and environmental resource management.

Key words: Hybrid ecosystem–infrastructure adaptation; Climate resilience; Flash floods; Flood risk management; Nature-based solutions; Catchment restoration.

4 SUB-THEME 4: LEVERAGING THE POWER AND CAPACITY OF WOMEN, YOUTH AND CHILDREN IN DELIVERY OF WATER AND ENVIRONMENT SERVICES

4.1 Strengthening Women and Girls' Leadership for Inclusive and Gender-Responsive Water and Environment Governance in Uganda

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Abstract

Women and girls play a central, multifaceted, and often undervalued role in Uganda's water and environment sector. Despite evidence of women, serving as primary water managers, custodians of household WASH practices, and serving as frontline responders to climate risks, their leadership remains underrepresented in formal decision-making spaces. This study examined the transition of women and girls from essential users to influential leaders, demonstrating how strengthening their leadership can advance inclusive, resilient, and community-owned environmental governance. Using a gender-responsive and intersectional lens applied to policy analysis, community experiences, and practice-based insights, this study identified key structural barriers including gendered labour roles, restricted access to financing and information, low representation in water user committees, and sociocultural norms that limit women's agency. Evidence showed that communities where women meaningfully participated in water governance experience improved accountability, enhanced uptake of sustainable water-use practices, and increased climate resilience. Women-led innovations in water conservation, early warning communication, climate-smart agriculture, and environmental stewardship further highlighted their transformative potential in advancing local adaptation and sustainable resource management. This study recommended the need for targeted capacity building, inclusive planning, digital inclusion, and financing mechanisms that elevate women-led environmental initiatives. Empowering women and girls in decision-making may help promote gender equality and also serve as a strategic catalyst for Uganda's long-term water security, climate resilience, and sustainable development. Intentional policy reforms, increased representation, and sustained leadership investments are essential to unlocking the full potential of women and girls in the water and environment sector.

Keywords: Women and girls; Water governance; Climate resilience; Gender inclusion; Leadership; Environmental sustainability.

4.2 Gender-Responsive Governance in Water and Environment Service Delivery: Evidence from Community-Level Participation in Uganda

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Abstract

This paper examined the role of gender-responsive governance in enhancing inclusive and effective water and environment service delivery in Uganda, with particular attention to the participation of women and youth at community and sub-national levels. Despite progressive policy commitments to gender equality and inclusive development, meaningful involvement of women and young people in water and environment decision-making structures remains uneven and often symbolic. While women and youth are primary users and managers of water and environmental resources, currently, their experiences and knowledge are insufficiently integrated into planning, implementation, and monitoring processes. Using a qualitative research approach, the study obtained data and information draws from key informant interviews, focus group discussions, and document review in selected rural and Peri-urban communities, complemented by a gender and power analysis framework. The findings revealed that women's and youth participation is constrained by entrenched gender norms, limited access to information, and weak institutional accountability mechanisms, even where formal representation exists. However, the study also identified promising practices, including women-led community water committees, youth-driven environmental innovations, and partnerships with local governments that enhance voice, leadership, and service sustainability. This study argues that leveraging the power and capacity of women and youth requires moving beyond numerical representation towards transformative participation that redistributes decision-making power, resources, and technical support. It is recommended that gender-responsive institutional frameworks are strengthened, invest in capacity building for women and youth leaders, and embed participatory social research methods into water and environment governance to support inclusive and climate-resilient development in line with Uganda's national priorities.

Keywords: *Women and Youth Agency, Community-Level Participation, Uganda*

4.3 Green Growth Skills for University Students to Exploit Opportunities in the Circular Economy in Uganda

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Abstract

Youth misalignment of skills in the circular economy presents a critical barrier to achieving both global sustainability targets and inclusive economic growth. This skills mismatch is most visible among university students that are transitioning into the circular labour market. Among others, limited waste management skills by the youth contribute to this mismatch, and yet these skills remain largely untapped within the current workforce market. A descriptive cross-sectional survey was conducted targeting all active members of the 5 Eco Club Campus Chapters. A total of 268 university students across ten higher education institutions located in Central, Eastern, and Western Uganda were interviewed. Quantitative data were analyzed using descriptive statistics while qualitative responses were interpreted through a thematic approach. Results revealed that 75% lacked practical skills in waste management notably in planning and resource recycling (45%), regulatory compliance and safety (35%), and waste identification and categorization (20%). Key barriers included limited access to green opportunities (62%), lack of practical experience (45%), financial constraints (38%), and limited institutional support (29%). To address some of these gaps, a pilot public lecture on green growth skills, green jobs, and circular economy opportunities was implemented, reaching 450 students across 10 universities, engaging youth and women-led organizations. Early indications suggest increased interest in green growth skills acquisition, and renewed eco-club engagement. The study highlighted that waste management skills offer a scalable entry point for young people to exploit opportunities in the circular economy by equipping them with hands-on competencies that open pathways to green jobs and sustainable livelihoods, further strengthening their delivery of water and environment services. Future research should focus on oriented training pipelines that go beyond raising awareness.

Key words: Green growth skills, Waste management skills, Pilot intervention , Circular economy, University youth engagement, Inclusive Economic Growth

4.4 The role of women and youth in an equitable, accountable, and sustainable delivery of water and environmental services

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Abstract

Youth Meaningful participation of women, youth, and children is central to equitable, accountable, and sustainable delivery of water services. This paper examined how intentional community engagement can transform service outcomes, drawing on implementation experiences from the implementation of the Integrity Management toolkit – Small water supply systems (IMT-SWSS) complemented by empirical findings from gender inclusion studies and evidence on sexual corruption in the water sector in Uganda. Under IMT-SWSS, community-based approaches demonstrated that empowering women and youth as decision-makers rather than beneficiaries strengthened transparency, improved responsiveness of service providers, and enhances the sustainability of water and environmental interventions. Women's leadership in water user structures has been associated with improved operation and maintenance, fairer allocation of resources, and increased social accountability. Youth engagement has proven critical in advancing digital reporting, environmental stewardship, and intergenerational knowledge transfer, while structured inclusion of children has strengthened environmental awareness, and long-term behavior change. However, findings from gender inclusion and integrity studies reveal persistent structural barriers that undermine these gains. Power asymmetries, weak grievance mechanisms, and socio-cultural norms continue to marginalize women, youth, and children from meaningful participation. Most critically, there was evidence of sexual exploitation, in exchange for water services that disproportionately affected women and girls. Leveraging the full capacity of women, youth, and children requires moving beyond participation rhetoric towards integrity-centered, gender-transformative programming. This includes safeguarding mechanisms, explicit anti-sextortion measures, community-led accountability, and institutional reforms that embed gender and child protection within water and environmental governance.

Key words: Sextortion, gender, integrity risks, cultural norms

4.5 TAF Assessment of the Divya Washing Machine Technology in Kampala, Wakiso and Mayuge Districts, Uganda

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Abstract

Access to adequate sanitation and hygiene is critical for public health, and an important but often overlooked component is the ability to keep clothes clean. In many low-income communities in Uganda, laundry remains a major challenge, disproportionately affecting women and girls and increasing the risk of bacterial contamination, skin infections and other hygiene-related health problems. The Divya Washing Machine (DWM), an off-grid, hand-cranked and portable washing technology, was assessed using the Technology Applicability Framework (TAF) to determine its applicability, scalability and sustainability in Kampala, Wakiso and Mayuge districts. Manual washing places a heavy physical burden on women and children and consumes large amounts of water and time, and the DWM was introduced to reduce drudgery, lower water and detergent use and improve the wellbeing of vulnerable and low-income groups. The assessment followed the TAF approach based on perspectives of three stakeholder groups, namely users, promoters, and regulators. It was guided by six sustainability dimensions i.e., social, economic, technological, environmental, skills and know-how, and legal and institutional using eighteen indicators. Twelve (12) out of sixteen (16) machines distributed in Uganda were assessed in schools, a community health centre for children with disabilities, women groups and households. Results show positive user reception, reduced washing burden and shorter washing time, with the machine using about 30 litres of water per cycle, reducing water use by approximately 50 percent and operating without electricity. Moderate challenges were identified, including lack of user contribution to operation and maintenance, high unit cost (USD 300–400) for individual households, limited in-country spare parts, weak ownership arrangements and gaps in institutional and legal alignment. The assessment concludes that the DWM is an appropriate and socially acceptable off-grid laundry technology for vulnerable communities in Uganda. However, improved sustainability and scalability will require local production or partnerships, strengthened spare-parts supply chains, clearer institutional arrangements, and design improvements to enhance durability and inclusivity.

Keywords: Divya Washing Machine, Technology Applicability Framework, off-grid technology, vulnerable communities

4.6 Strengthening Climate-Resilient Integrated Water Resources Management to Close WASH Inequality Gaps and Avoid the Rising Cost of Inaction in Uganda

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Abstract

Uganda continues to face deepening WASH inequalities that undermine progress toward SDG 6, particularly for women, youth, and children, despite decades of sector investment and policy reform. While access to improved water has expanded, major disparities persist in safely managed services, gendered time burdens, and WASH conditions in schools and health care facilities, challenges increasingly intensified by climate-related shocks such as droughts, floods, and prolonged dry spells. This study addresses the gap in climate-resilient, equity-centered Integrated Water Resources Management (IWRM) by examining how weak institutional coordination, limited climate-proofing, and underfinanced pro-poor models constrain Uganda's adaptive capacity. Using evidence from 16 districts across diverse ecological zones, the analysis integrates hydrological and climate-risk mapping with social vulnerability metrics (gender, disability, wealth quintiles), alongside economic modelling of Uganda's estimated annual USD 177 million WASH-related losses. Methods further include valuation of gendered time burdens, health impact modelling, and review of participatory governance structures to understand how climate risks exacerbate inequality hotspots. Findings highlight that prioritizing climate-exposed and socioeconomically marginalized populations can significantly strengthen drought and flood resilience, reduce disease burden, and improve productivity, especially for women and adolescent girls. The study further demonstrates that climate-smart WASH technologies, such as solarized water schemes, flood-resilient sanitation, and strengthened water-quality surveillance, combined with equity-weighted financing mechanisms, generate substantial economic and social returns. Embedding climate adaptation and cost-of-inaction analysis into IWRM planning enhances policy coherence across Uganda's Health National Adaptation Plan, NDP IV, and regional frameworks. The paper concludes that inclusive, climate-resilient IWRM systems are essential for safeguarding vulnerable communities, reducing long-term national expenditure, and positioning Uganda as a regional model for achieving "Water and Environment for an Inclusive and Prosperous Uganda."

4.7 Assessing Multidimensional WASH Inequalities in Uganda: Impacts, Drivers, and Pathways to Equity

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Abstract

Uganda continues to face persistent and deeply entrenched inequalities in access to Water, Sanitation and Hygiene (WASH) services, despite progress toward Sustainable Development Goal 6, with disparities disproportionately affecting women, girls, persons with disabilities, and low-income households. These inequalities remain pronounced across households, schools, and healthcare facilities (HCFs), undermining health, dignity, and inclusive development, particularly in rural and underserved regions. This study quantified the extent and drivers of WASH inequalities using a mixed-methods design across 16 districts in four regions, combining quantitative household surveys (n=438), institutional assessments in 32 schools and 32 HCFs, secondary analysis of UDHS 2022 data, and qualitative evidence from 31 key informant interviews, 28 focus group discussions, and policy reviews, supported by systems analysis of infrastructure functionality, governance, and financing. Findings reveal stark geographic and socioeconomic gaps: rural households were 6.4 times less likely to treat drinking water than urban households, Northern Uganda recorded the lowest HCF water access (50% versus 100% in the Central region), and only 35% of rural schools met basic toilet cleanliness standards compared to 85% in urban areas. Wealth-related inequities were substantial, with the richest quintile having 3.2 times higher access to hand washing facilities than the poorest, alongside severe institutional deficits including pupil-to-latrine ratios of up to 1:176 in rural schools and limited disability-friendly sanitation in over 30% of HCFs. The study underscores the urgent need for equity-focused governance reforms, climate-resilient infrastructure investments, inclusive facility design, and targeted systems-strengthening interventions, including application of the newly developed Hygiene Vulnerability Index to guide prioritization of the most marginalized populations.

4.8 Strengthening Community and Women's Participation and Accountability in Community Water Services through Integrity Management Approaches in Uganda

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Abstract

Communities, and Civil Society Organizations are central to the use, management and sustainability of community water supply systems in Uganda, yet weak governance, low accountability and integrity risks continue to undermine their meaningful participation and equitable access to services. This paper presents experiences from the implementation of the Integrity Management Toolbox for Small Water Supply Systems (IMT-SWSS) in Lira, Kabarole and Bunyangabu districts, under the Water and Sanitation Integrity Programme led by UWASNET and the Water Integrity Network. The intervention is significant in demonstrating how integrity-focused approaches can empower communities—particularly women—by strengthening transparency, accountability and participation in local water service delivery. A participatory action-learning methodology was applied through three district-level workshops engaging Water User Committees, water boards, district water and community development officers, and community representatives. Using tools such as integrity risk mapping, scheme mapping, stakeholder analysis and action planning, participants identified governance and service delivery risks and developed locally owned solutions. Findings show that key integrity risks included weak financial management, limited transparency in tariff setting, inactive committee members, low trust between users and committees, and unequal access to water, particularly for households located far from supply points. The process increased women's and community members' confidence to participate in decision-making, improved understanding of roles and responsibilities, and resulted in concrete action plans such as establishment of bank accounts, regular community meetings, transparent billing systems, codes of conduct and customer feedback mechanisms. The paper concludes that integrity management approaches are a practical entry point for strengthening women's participation, safeguarding vulnerable users, and improving accountability and sustainability of community water services, and recommends institutionalizing integrity tools within district WASH governance frameworks to support inclusive and people-centred service delivery.

Key Words: Community water service delivery, Integrity and accountability, Transparency, Accountability and Participation (TAP), Integrity Management Toolbox (IMT)

4.9 Sexual Corruption in Access to Water and Sanitation Services: Implications for Women's Safety and Participation in WASH Service Delivery in Uganda

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Abstract

Sexual corruption, also known as sextortion, is a hidden but widespread barrier to safe and equitable access to water, sanitation and hygiene (WASH) services, disproportionately affecting women and girls who bear primary responsibility for water collection and use of shared sanitation facilities. This study examines sexual corruption in access to WASH services in Lira, Kabarole and Bunyangabu districts and analyses its implications for women's safety, dignity and participation in WASH service delivery and governance. Sexual corruption thrives in contexts where women and girls depend on communal services controlled by gatekeepers, undermining their agency and excluding them from meaningful engagement in water and environment decision-making. Using a mixed-methods approach, the study combined a standardized household survey of 1,200 women across rural, peri-urban and urban water-stressed communities with nine focus group discussions and fourteen key informant interviews involving water sector professionals, health workers and local government officials. Results show that 16.7% of surveyed women experienced sexual corruption at public water points, communal bathing areas or shared latrines, with substantially higher prevalence in Bunyangabu and Lira districts. Poverty, water insecurity, long distances to facilities and weak oversight of communal services were the strongest predictors of risk, while women with private household connections reported no incidents. The findings demonstrate that sexual corruption is a structural governance failure rather than an individual vulnerability, eroding women's trust in WASH institutions and limiting their ability to participate safely in service management structures. The study concludes that eliminating sexual corruption is essential to leveraging the full potential of women and girls in WASH service delivery and calls for explicit legal recognition of sexual corruption, gender-responsive and safe-by-design infrastructure, formalised service oversight, and survivor-centred reporting mechanisms to ensure inclusive, accountable and dignified water and sanitation services.

Key Words: Sexual corruption (sextortion), Gender and governance, Safe and inclusive service delivery, Accountability and integrity in WASH, Women's participation and leadership

4.10 Youth as Stakeholders in Inclusive and Climate-Resilient Water and Environmental Governance: The NWSC School Water and Sanitation Clubs Experience

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Abstract

The School Water and Sanitation (SWAS) Clubs implemented by the National Water and Sewerage Corporation (NWSC) represent an inclusive stakeholder engagement and capacity-building approach that positions children and youth as active contributors to sustainable water, sanitation, and environmental governance in Uganda. Established to instill lifelong values of hygiene, water conservation, and environmental stewardship, SWAS aligns with Uganda's Tenfold Growth Strategy by nurturing future human capital essential for climate-resilient economies and communities. Using a participatory, school-based outreach and experiential learning approach, SWAS integrates demonstrations, games, environmental action projects, career guidance, and mentorship to translate water and environment policy into practical, community-level action. In 2025, the programme expanded its scope to include tree planting, community clean-ups, rainwater harvesting initiatives, and partnerships that link science, innovation, and environmental responsibility with real-world application. Results indicate that over 2,000 students have benefitted from structured career awareness and water-sector exposure, with SWAS Clubs in several Ugandan schools initiating student-led hygiene campaigns, environmental advocacy, and conservation projects that extend influence to households and surrounding communities. Participation of youth in national and regional platforms, including sector exhibitions and conferences, has amplified children's voices in water and sanitation discourse while strengthening institutional accountability. The SWAS experience demonstrates that early investment in youth capacity, values, and innovation is critical to achieving inclusive growth, sustainable environmental management, and climate resilience, offering a scalable model for integrating children and youth into water and environment service delivery frameworks in Uganda and beyond.

Key words: Youth Engagement, Water and Sanitation, Environmental Stewardship, Climate Resilience, Inclusive Growth, NWSC

4.11 Empowering Youth-Led Rainwater Harvesting Initiatives for Vulnerable Households in Kamwenge District, Uganda

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Abstract

Piped water system access is considered the highest service level, providing a safe, sustainable water supply to communities in Uganda. The Water for People's Everyone Forever model established that vulnerable households in Kamwenge district, Uganda, had no access to piped water systems. This study aimed to build community resilience to water scarcities through youth-led rainwater harvesting initiatives. Vulnerable households within the communities were identified using a structured assessment tool. Four youth and women groups (each five members) with some masonry experience were identified and technically trained. Eight best-trained youth from the training were further co-opted into the construction teams. A total of 42 rainwater harvesting jars were constructed across five sub-counties in the district. The trained youth groups increased the community's technical capacity to support the sustainable operation and maintenance of the constructed jars. Moreover, it created an alternative form of employment for the previously unemployed youths in the district. Therefore, engagement of the youth in solving water scarcity is a promising solution to the sustainable maintenance of water infrastructure in communities.

Key words: youth-led initiatives; water infrastructure; sustainability.

4.12 Community-driven micro-catchment restoration for climate resilience around Kabuyanda irrigation scheme, Isingiro district

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Abstract

Catchment degradation is the longterm decline in land and ecosystem condition within a river catchment due to human activities, reducing water regulation, increasing erosion and sedimentation. To address this and ensure long-term sustainability of the catchment, the Government of Uganda, with support from the World Bank, implemented Irrigation for Climate Resilience Project (ICRP) to expand irrigation services, strengthen agricultural productivity, and establish sustainable farmer-based management systems. This was achieved through soil and water conservation (SWC) measures in Kabuyanda micro-catchments including 15,374 meters (38.44ha) of infiltration trenches stabilized with Napier grasses to intercept surface runoff and improve infiltration capacity. About 21.9ha of bench terraces were established on steep slopes to reduce slope length and breakdown runoff, and 210 percolation pits positioned in flow accumulation zones to capture excess runoffs. The preliminary results from observations showed reduced surface runoffs, soil erosion, and improved vegetation growth hance, realization better micro-catchments management. Preliminary observations provide valuable evidence in support of implementing SWC measures to mitigate catchment degradation, enhance water regulation, soil production and sustainable management services.

Key words: Micro-catchment, runoffs, soil and water conservation, soil erosion

4.13 Embedding Environmental, Social and Governance (ESG) Principles in Public Water Utilities: The NWSC Experience in Advancing Inclusive and Climate-Resilient Development in Uganda.

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Abstract

Environmental, Social and Governance (ESG) principles; environmental stewardship, social inclusion, and accountable governance are increasingly central to sustainable water and environment management in Uganda. The National Water and Sewerage Corporation (NWSC) provides a practical public-sector case of ESG integration that supports Uganda's Tenfold Growth Strategy while strengthening climate resilience and inclusive service delivery. Using a qualitative institutional practice and policy analysis approach, this abstract examines how NWSC embeds environmental principles through water source protection, environmental compliance, resource efficiency, and climate-resilient infrastructure planning; social principles through occupational health and safety systems, gender and youth inclusion, human capital development, community engagement, and equitable access to services; and governance principles through ethical leadership, transparency, performance management, compliance, and stakeholder accountability. Results demonstrate that ESG-aligned practices contribute to improved operational sustainability, workforce productivity, stakeholder trust, and long-term environmental protection. The experience shows that ESG is not a private-sector construct but a scalable public utility governance framework that aligns science, innovation, and capacity building with national development priorities. The abstract concludes that mainstreaming ESG principles in water and environment institutions is essential for building environmentally sustainable, socially inclusive, and climate-resilient economies and communities in Uganda.

Key words: Environmental, Social and Governance (ESG), Water Governance, Climate Resilience, Inclusive Growth, Capacity Building, Public Utilities

4.14 Changing Rainfall Regimes Across the Lake Edward Basin (1981–2024): Evidence of Nonstationary Wet-Dry Extremes

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Abstract

Rainfall variability in tropical lake basins strongly governs water availability, ecosystem stability, and climate risk, yet its long-term evolution remains an open question. In the Lake Edward Basin, hydroclimatic assessments have largely relied on trend-based indicators, implicitly assuming stationary rainfall behavior. Here, we examine whether wet-dry conditions have evolved gradually or through regime-like transitions by analyzing rainfall variability from 1981 to 2024 across 26 districts within the basin. Using multi-scale standardized precipitation indices (SPI), non-parametric trend analysis, and change-point detection, we identify prevalent district-specific non-stationarity in basin-wide rainfall regimes. Wet-dry variability was quantified using the SPI-3 (3 months) and SPI-12 (12-month) accumulation scales to capture short-term climatic variability and longer-term hydroclimatic regimes. Trend and change-point analyses were applied to the SPI time series, with monotonic trends evaluated using the Mann-Kendall test and Sen's slope, uncertainty quantified via Kendall-based confidence intervals, and abrupt shifts in standardized wet-dry regimes detected using the Pettitt test. Mann–Kendall results show that the majority of districts experienced significant wetting or drying trends, with Sen's slope magnitudes ranging from approximately −0.01 to +0.01 yr^{-1} at SPI-3 and increasing to −0.02 to +0.02 yr^{-1} at SPI-12. Only a small subset of districts remained trend-stable, indicating limited stationarity. The amplification of trend strength at SPI-12 highlights a basin-wide shift toward persistent hydroclimatic regimes beyond short-term climatic fluctuations. Change-point detection reveals scale-dependent regime shifts across the basin. At the SPI-3 scale, over 50% of the districts transitioned to wetter regimes, predominantly during the mid-1990s (1993–1996), while drying shifts were rare and isolated. At the SPI-12 scale, 76.9% of districts exhibit sustained wetting shifts with 19.2% shifting towards drier conditions, with secondary transitions emerging around 2010–2011, highlighting long-term persistence in hydroclimatic change. Rainfall in Lake Edward Basin exhibits nonstationary, regime-like patterns with short-term variability and long-term shifts, informing drought and wetness risk.

4.15 Integrated Circular Bio-Economy Demonstration

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Abstract

This abstract presents practical experiences from an integrated piggery, Black Soldier Fly (BSF), and waste-to-resource demonstration model designed to promote environmentally sustainable and climate-resilient agricultural production. Rapid expansion of livestock production and poor organic waste management in Uganda has contributed to environmental pollution, high feed costs, soil degradation, and increased reliance on synthetic fertilizers. The integrated system was implemented as a practice-based pilot where pig waste and organic farm residues were managed through biogas and bio-septic systems, while additional organic waste streams were converted through BSF farming. Pig manure was used to generate biogas for cooking and lighting, and the resulting slurry was applied as organic fertilizer to improve soil fertility. Organic waste substrates were fed to BSF larvae to produce a protein-rich, low-cost feed ingredient for pigs, while BSF frass was utilized as an organic soil amendment for crop production. Information was gathered through routine farm records, field observations, and experiential learning. Observed outcomes included improved waste management and farm hygiene, reduced environmental pollution, availability of renewable energy, lowered livestock feed costs, improved soil condition, and enhanced overall farm productivity. The integrated model demonstrated efficient nutrient recycling, reduced dependence on external inputs, and suitability for smallholder and youth-led enterprises. The experience highlights the potential of circular bio-economy approaches to simultaneously address waste management, renewable energy access, sustainable feed production, and soil health restoration. In conclusion scaling integrated piggery–BSF–biogas-Bio septic systems can support inclusive, climate-resilient rural economies and should be promoted through policy support, capacity building, and climate-smart agriculture programs.

4.16 Assessing the Role of Youth in Strengthening Uganda's NDC Monitoring and Reporting Framework

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Abstract

Youth engagement is widely acknowledged as essential for effective climate governance under the Paris Agreement, yet their integration into monitoring and reporting systems remains inadequately developed. This study examines the current extent and perceived effectiveness of youth participation in Uganda's Nationally Determined Contribution (NDC) monitoring framework. Data was collected from 233 youth aged 16-35 through focus group discussions and surveys across five regions, complemented by content analysis of national climate policy documents. Findings indicate a significant paradox: while youth exhibit strong willingness to participate, their awareness of NDCs and related monitoring processes remains critically low, with engagement often relegated to tokenistic consultation rather than substantive roles. Key barriers identified include pervasive information and technical capacity gaps, acute resource constraints, societal adultism, and weak institutional linkages that marginalize youth voices, particularly those of young women and rural communities. Despite these challenges, the study uncovers a robust potential for youth-led contributions through community-based data collection, digital innovation in monitoring, civic advocacy, and local awareness campaigns. The study concludes with targeted recommendations: formalizing designated youth roles within the Climate Change Department's monitoring structures; co-developing simplified, youth-friendly monitoring and reporting tools; implementing sustained capacity-building and mentorship programs; and ensuring equitable youth access to climate finance and digital resources. Finally, the study proposes a practical model to embed youth participation within national and global monitoring process. By transitioning youth from peripheral consultees to empowered co-creators in climate and water resource accountability, Uganda can harness their innovation and grassroots presence to build more inclusive, transparent, and effective environmental service delivery systems, for a prosperous and resilient future.

Key words: NDCs, Youth inclusive policies, Participatory climate monitoring, Climate change mitigation, Uganda

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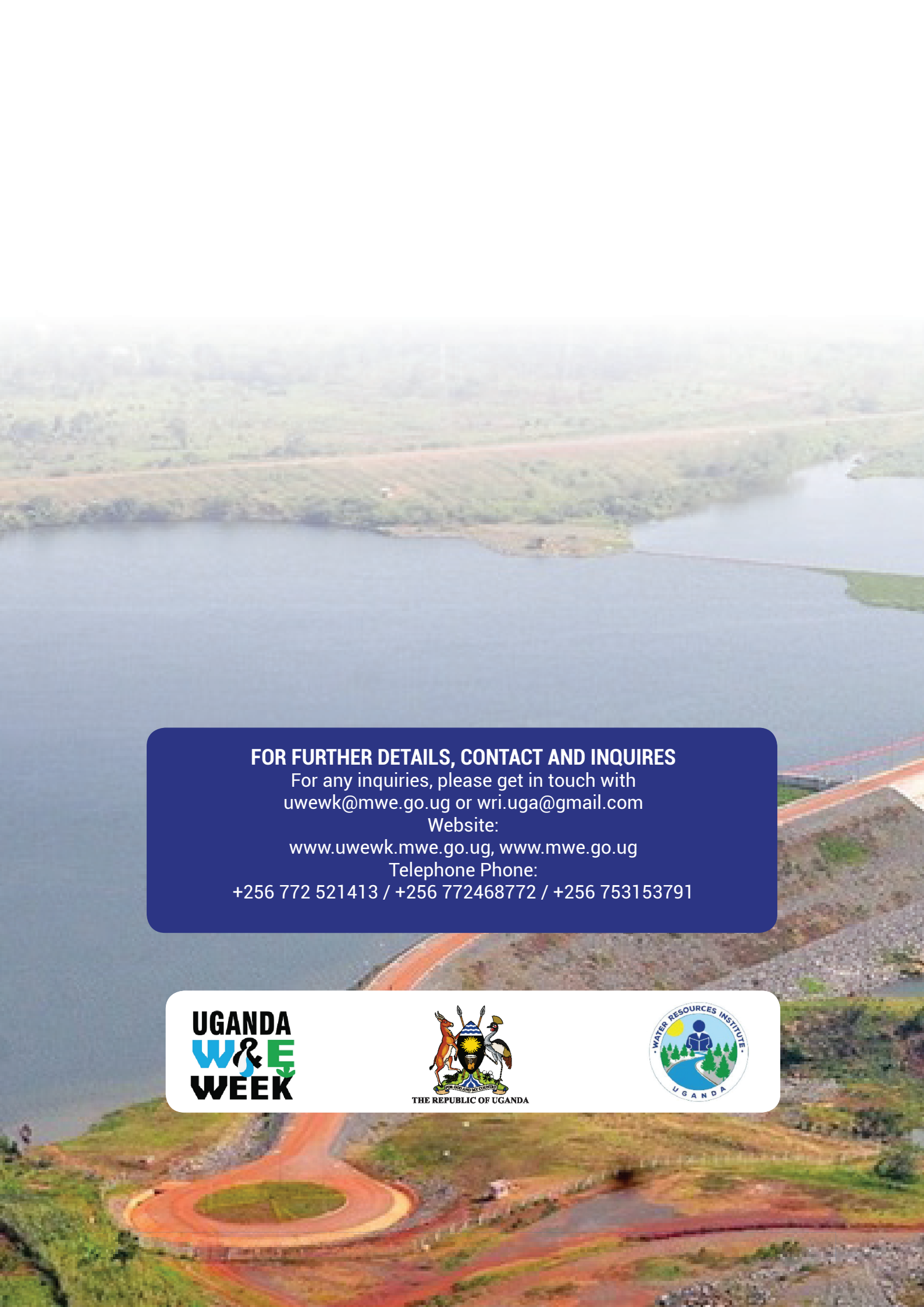

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