WATER INSTITUTE

THIRD INTERNATIONAL MAJI SCIENTIFIC CONFERENCE

BOOK OF ABSTRACTS

Mlimani City, Dar es Salaam

31 January - 2 February 2024

BOOK OF ABSTRACTS

Table of Content

SUB-THEME ONE: WATER RESOURCE MANAGEMENT (WRM)

Niche Dimensions of Predatory Fish in two Estuaries with Different Degrees of Anthropogenic Disturbances: Case of Wami and Pangani Rivers

Theresia J. Lyasenga*[1,2], Prosper L. Mfilinge[3], Daniel A. Shilla[3], John A.M. Mahugija[1].

[1]Chemistry Department, University of Dar es Salaam, P. O. Box 35061, Dar es Salaam, Tanzania.

[2]Ministry of Water (MoW)–Ubungo Maji, P. O. Box 9153, Dar es Salaam, Tanzania.

[3]School of Aquatic Sciences and Fisheries Technology, University of Dar es Salaam, P.O. Box 35064, Dar es Salaam, Tanzania.

Email: teddylyasenga@gmail.com

Abstract

The study aimed at comparing the diet, carbon and nitrogen isotope ratios and Layman community metrics of predatory fish between two estuaries with different degrees of anthropogenic disturbances. The Layman community metrics were estimated following the Bayesian approach. It was revealed that the diets of the predators Arius africanus, Epinephelus coioides, Sillago sihama and Pomadasys argenteus and their isotopic values were significantly different between Wami and Pangani estuaries (PERMANOVA, Pseudo-F $\geq$ 3.1, p = 0.05). Comparison of isotopic niche width at the estuary level showed that isotopic niche of Wami estuary was slightly narrower (3.90–6.94 at 95% CI) than that of Pangani (5.70–9.69 at 95% CI). Comparison of the nitrogen isotope ratios and range of species suggest shifts in the trophic position of the species in Wami relative to that of Pangani. Furthermore, the Layman metric indices of trophic diversity and redundancy of Wami estuary were substantially smaller than that of Pangani estuary. Thus, despite the protection of Wami estuary, extent of disturbances upstream is potentially high enough to induce ecological changes at the base of the food web downstream. Then, the ecological

redundancy and ecosystem complexity of Wami estuary is possibly compromised to that of Pangani estuary.

Keywords: Anthropogenic activities, ecological redundancy, Layman community metrics, Niche flexibility, Pangani and Wami estuaries.

Application of Business Continuity Model for Sustainable Water Management System in Rural Areas

Eligi Respigi Shayo
eligishayo@gmail.com

Eligi Respigi Shayo, a dedicated Water Engineer, has spent six years innovating sustainable solutions for water supply and sanitation. With a background in Water Resources Engineering and a Master's degree in Engineering Management, he has led numerous and demonstrated a unique ability in large-scale projects, from designing to advanced successful water supply systems.

Abstract

Despite the fact that the business continuity model (BCM) is crucial for ensuring organizational survival, few studies have looked at how BCM affects organizational performance in the water sector. The rural water supply system is facing numerous challenges that hinder the performance of the water organization, such as poor water quality and infrastructure, operation and maintenance facilities, affordability, and water scarcity due to drought. Therefore, this research gives empirical evidence on the application of the BCM in managing water supply in rural areas in the Lindi region. The application of BCM helps to establish factors of organizational performance as well as the challenges facing the water supply in rural areas. A survey was conducted, whereby 101 valid questionnaires were obtained from the rural water supply and sanitation agency (RUWASA). The correlation analysis technique has been employed to perform the analysis with the help of Partial Least Squares-Structural Equation modelling (PLS-SEM). This analysis technique determined the relationships between the dependent variables, which are performance indicators such as water production, service coverage, unaccounted water, and quality of

service as measures of operational performance, and the observed variables, which are the BCM factors. The results revealed that BCM factors significantly and positively influence rural water supply performance as management commitment (β=0.807), the financial requirement (β=0.767), organization skills (β=0.807), technology selection (β=0.883) but the social-cultural effect was not statistically significant with (β= -0.225). The study revealed financial resources for maintenance, the inability to monitor water schemes, operation and maintenance procedures, and a lack of well-trained staff as major challenges. According to the study, RUWASA was aware of the challenges impeding the performance and sustainability of water supply schemes in their community. The findings suggest that water treatment at water sources, the quality of procured fittings, and the maintenance of water equipment such as water pumps be monitored regularly to ensure effective performance and sustainability of the water supply scheme.

Impacts of Bottom Valley Cultivation on Water Resources Management under the Changing Climate in Little Ruaha River Sub-Catchment, Tanzania

Neema Aloyce Mwamoto
Faculty of Science and Education, University of Iringa,
Email: nmwamoto@gmail.com

Neema Aloyce Mwamoto is an Assistant Lecture and a chairperson of Academic Staff Association at University of Iringa. She has wide research experience in the areas of Inclusive Education, Climate Change Adaptation, Water Resourse Management, Innovative Strategies for Resilient Food System as well as indignous knowledge and environmental conservation. Her responsibilities among others include; curriculum development, facilitating professional trainings, supervision and community out reach.

Abstract

Climate change poses a significant challenge to global agriculture, impacting long-term climate patterns and consequently affecting water resources management. While bottom valley cultivation (Vinyungu) demonstrates considerable potential in ensuring year-round food production and poverty alleviation, it has also contributed to water scarcity issues. This study employed a mixed approach, including a questionnaire survey, key informant interviews, interpolation of climate data, and documentary review, to comprehensively assess the impact of bottom valley cultivation in the Lupalama sub-catchment. Qualitative data was analyzed through content and trend analysis, while quantitative data were analyzed using SPSS. The study's findings reveal that bottom valley

cultivation in the Lupalama sub-catchment significantly affects water resources management by reducing river depth, impeding water flow, contributing to water pollution, and causing siltation. In response to these challenges, the study recommends potential adaptation strategies, such as promoting water conservation practices and developing climate-resilient infrastructure. The study emphasizes the importance of integrated water resource management and advocates for collaborative efforts among stakeholders. The study concludes by underlining the necessity of adopting sustainable agricultural practices and implementing effective land-use planning to ensure the sustainability of water resources in the region.

Health condition of Lukosi River catchment using selected physico-chemical parameters as indicators of water quality

Ahmad A. Nyagongo[1], Vedasto G. Ndibalema[1], Makarius C.S. Lalika[2,3]
[1]Department of Wildlife Management, College of Forestry Wildlife and Tourism, Sokoine University of Agriculture, P.O. Box 3073 Morogoro, Tanzania
[2]Department of Geography and Environmental Studies, College of Natural and Applied Sciences, Sokoine University of Agriculture, P.O. Box 3038 Morogoro, Tanzania
[3]UNESCO Chair on Ecohydrology and Transboundary Water Management, Sokoine University of Agriculture, P.O. Box 3038 Morogoro, Tanzania
Email: ahmadnyagongo@gmail.com

My name is **Ahmad A Nyagongo,** a wildlife conservationist pursuing a Master's of science in Wildlife Management and Conservation at Sokoine University of Agriculture, and I hold a Bachelor of science in Biology from University of Dodoma. I have experience in ecological data analysis, wildlife research, laboratory activities and GIS.

.

Abstract

This study focused on evaluating the health status of the Lukosi River, a vital tributary to the Great Ruaha River, by examining various water parameters. Three distinct sampling sites along the Lukosi River were chosen, and water samples were collected using the American Public Health Association (APHA) technique. On-site assessments included pH, temperature, total dissolved solids (TDS), electrical conductivity (EC), dissolved oxygen (DO), and turbidity. Laboratory analyses were conducted for parameters such as total hardness, biochemical oxygen

demand (BOD), nitrite (NO2), copper (Cu), calcium (Ca), manganese (Mn), chloride (Cl), fluoride (F), sulfate (SO4), magnesium (Mg), zinc (Zn), iron (Fe) and ammonia (NH3). One sample t test was used to analyze the results. Results indicated that some of the parameters, such as DO, Turbidity and BOD fall beyond the allowable limits set by TBS and WHO for water quality. Additionally, elements such as NH_3, NO_3^-, Fe^{2+} and Cu^{2+}, were found to be higher than the standard values set by WHO. These findings indicate that water of the Lukosi River is polluted and necessitates continuous monitoring of its quality along with the implementation of protective measures to reduce pollution levels so as to meet those set in the aforementioned standards.

Keywords: Health condition, Lukosi River catchment, Physico-chemical parameters, Water quality indicator.

Evaluating the Performance of Low-Impact Development Practices in Mitigating Runoff Floods in the Kinyerezi River Sub-Catchments in Dar es Salaam, Tanzania

Livingstone Swilla[1,2,*], Zacharia Katambara[2] and Mwajuma Lingwanda[2]
[1]Department of Water Supply and Irrigation Engineering, Water Institute, P. O. Box 35059, Dar es Salaam, Tanzania
[2]Department of Civil Engineering, College of Engineering and Technology, Mbeya University of Science and Technology, P.O. Box 131, Mbeya, Tanzania
*Corresponding author: swilla59@yahoo.com

Livingstone Swilla holds a Bachelor's and a Master's degree in Civil Engineering from the Peoples' Friendship University of Russia, specializing in Rivers and Underground Hydraulic Structures. He is currently a PhD candidate at Mbeya University of Science and Technology (MUST) in Tanzania and a registered professional engineer with the Engineers Registration Board.

Abstract

The eleventh United Nations Sustainable Development Goals aims to reduce water-related disasters in cities by 2030 however, the achievement of this target has been interfered by the current land use and land cover changes through the rapid urbanization that is associated with the increase in peak runoff and flood disaster risks. The Dar es Salaam city experiences frequent floods along the Msimbazi River likely due to urbanization. The Low Impact Development (LID) practices which includes bio-retention (BR) ponds, rain barrels (RB) and rain gardens (RG) has the potential to reduce peak flows and reduce the flood levels. This study aims to evaluate

the performance of LIDs in mitigating the peak flows in the Kinyerezi River, a tributary of Msimbazi River. The RB sizes for public schools were evaluated and the BR and RG of 4000 m^2 sizes each were deployed into the sub-catchments. The Msimbazi River Digital Elevation Model and historical river flows data formed the calibration and verification data sets of EPA SWMM model. The results indicated that LIDs could not attenuate the peak runoff of 130.6 m^3/s, however for 105.6 m^3/s the combination of BR, RB and RG reduced it by 19.8%. The total surface runoff volume was reduced by 3.5% and increased the runoff infiltration by 139.8% while the RB insignificantly decreased the runoff infiltration by 0.0002%. The combination of the three LIDs showed the best effectiveness in mitigating runoff floods. The study proposed the use of RB, RG and BR during city planning.

Keywords: Bio-retention ponds; Kinyerezi River Catchment; Low Impact Development (LID); Rain barrel; Rain-garden

The Use of Air to Water Technology to Tap into Atmospheric Moisture as a Source To Overcome Water Stress

Pitio Binamungu Ndyeshumba
Rainmaker, P. O. Box 67352, Dar es Salaam, Tanzania.
Telephone: +255754348697 Email: ndyeshumba@yahoo.com

Pitio B. Ndyeshumba is a graduate of University of Dar es Salaam and Twenty University, the Netherlands. He is a Research Scientist in the sectors of water, environment and gender. A soil scientist with vast experience in soil survey, land evaluation, planning, integrated water resources management and land resources inventory. He is a renowned consultant and a trainer in water sanitation and hygiene subsector.

Abstract

Due to high demand, the globe is experiencing very high fresh water consumption leading to dwindling of available fresh water. Overexploitation of fresh water has consequently depleted ground water leading to salt intrusion and adding pressure to open water sources, the situation which is exacerbated by climate change. Apparently, global water stress is becoming critical, whereby 800 mil people do not have access to potable water. The use of fossil fuels to power water supply aggravates carbon emission, whilst produced water is lost through leakages. With the compelling situation it is imperative to tap into atmospheric moisture as a substantial source of fresh water, much as the total water in the air is sufficient to cover over 3 times total global fresh water use. Rainmaker has unveiled Air to water technology that uses a modular system to extract atmospheric water vapor by cooling air to dew point whereby waste heat is utilized to power the system, at ambient condition of 15ºCelcius and ≥20% Relative Humidity. Air to water is

conceived as a natural fit system for remote area, including places with fresh water source stress and prolonged drought areas. It can also serve as a disaster relief package for high influx of refugees, polluted and degraded low quality water. A to W uses renewable energy which reduces CO_2 emission and it does not use chemicals, all of which render the technology sustainable. The system is suitable for community water supply, irrigation and commercial water bottling. It has opportunities for customization to meet demand, optimize capacity utilization, through upsizing and creating several units' farm. Air to water system is also versatile since it adds new water source to water supply solutions and mitigate water demand challenges.

Keywords: Carbon emission, humidity, renewable energy

Mapping and Assessing the Current Status of Water Sources for Effective Restoration and Conservation Practices. A strategy to Enhance Environmental flows of Mbarali river Sub catchment

Nyemo Chilagane[1*], Papilon Mkome[2], Elias Chundu[2], George Wandelage[3], Winfred Mbungu[4], Festo Silungwe[4], Japhet Kashaigili[5]

[1]Tanzania Research and Conservation Organization, P O BOX 6873, Kihimbwa Street, Morogoro,

[2]National Environment Management Council, Southern Highlands Zone, P O B OX 1562, Mbeya,

[3]Rufiji River Basin, Water User Association of MBUMTILU, P O Box 1562, Mdandu, Njombe, Tanzania.

[4]Department of Civil and Water Resource Engineering, Sokoine University of Agriculture, P O Box 3003, Morogoro.

[5]Department of Forest Resources Assessment and Management, Sokoine University of Agriculture, P O Box 3013, Morogoro

Email: nchilagane@yahoo.com

Nyemo is a co founder and Deputy Managing Director of Tanzania Research and Conservation Organization with amply expertise in ecological and hydrological modeling. Nyemo undertaken numerous water resource conservation initiatives across many regions and developed hydrological models for management of numerous river catchment including Wami-Ruvu, Pangani, Sogwe and Great Ruaha.

Abstract

Mbarali river sub-catchment is one of sub-catchment within Rufiji basin in the Southern Highland of Tanzania is an important waterway that facing ongoing degradation due to climate change, land use change and poor institutional management. Degradation and poor management of water sources within the sub-catchment have affected river flows in both quantity and quality with devastating impacts to the downstream users. Several conservation initiatives have been put in place but still the progress is slow in water sources conservation and management which hinder the implementation of environmental flow in Mbarali River for sustainability of riverine ecology and downstream users. This study presents the findings of the cross-sectional survey conducted to identify, map and assess the current status of water sources in Mbarali river sub-catchment. The overall objectives of this study are to provide a general understanding on the number of water sources and their spatial distribution in Mbarali sub-catchment, level of human induced pressure that detrimentally affect the quality of water sources and to propose conservation strategies to be taken onboard at a specific water source to ensure its sustainability. At this first phase, the study focused to identify, assess and map water sources available in MBUMTILU Water User Association (WUA). This is the biggest WUA in Mbarali river sub-catchment occupying 453 km^2 covering about 20 villages of Wanging'ombe district and having three permanent tributaries drain to

Mbarari River. Literature review, field visit and stakeholder consultation were used to accomplish this study. Results revealed that, there about 200 water sources in which 181 water sources drain to Mbarali river catchment and the remaining drain out from Mbarali river catchment to Luhuji and Halali River. From identified water sources, only 35% were found to be in good condition and the remaining 65% were degraded from anthropogenic activities. The analysis discloses that Bottom valley cultivation was found to be the leading and deadliest threat to water source, followed by Livestock grazing, agricultural encroachment and fire. Site-specific interventions including the planting of water-friendly trees, beekeeping, ban bottom valley cultivation and stop brick making adjacent to water sources were suggested to each identified water source depending on the level of degradation. The study recommends a number of tree species which are friendly to water sources with consideration of weather conditions to be planted which include *Ficus sur* (Mdzombe), *Syzigium cordatum* (Mvengi), *Asenia abysinica* (Mdobole), *Salix subserrata* (Msusuliani), and *Rauvolfia caffra* (Mvelevele).

Keywords: Conservation, Ecological Management Class, River flow, Water source.

Wetlands for Environmental Pollution Control and Poverty Alleviation Through Agricultural Activities

Irene Aurelia Tarimo
Department of Environmental Science Open University of Tanzania
Email: irene_tarimo@hotmail.com

Dr. Irene Aurelia Tarimo is a Lecturer with the background of Teaching Biology and Chemistry in Secondary Schools later on oriented in Zoology and Botany with Education at University level. In higher learning Irene embarked on Environmental Studies, Water Resources Management, Wastewater treatment and recycling with ecological modelling to be much more multipurpose.

Dr. Irene's professional role is Teaching, Research and Consultancy at the Open University of Tanzania with very big professional achievements in Organizations and National awards. She is also a quality assurance and controller, ACDE & ICDE member, while in environment and gender as well as consultancy, she works with Damax solutions and Tanzania Environmental Conservation Society (TECOSO), and a member of African Women in Unity (Womanity Africa).

Abstract

Tanzania Water Sector through Water Quality services division has put great efforts to ensure people are supplied with clean and safe drinking water. Little effort is done to investigate the efficiency of existing water treatment systems in the country. Supply of water of unknown quality to

the community can lead to spread of water borne diseases/epidemics. Therefore, this study will contribute implications for water supply agencies, policy and decision makers to take corrective measures. It evaluated the efficiency of the treatment plant and the quality of drinking water from Lower-Ruvu treatment plant which feeds water to households in Coast Region and Dar es Salaam regions. The Lower Ruvu Water Treatment Plant (LRWTP) is located in Bagamoyo District, Coast Region about 75 km North of Dar es Salaam City. Ten grab samples samples, two (02) from water treatment plant and eight (08) from different distribution points were collected during dry season of August - September, 2023 and sent to Central Water Quality Laboratory for analysis. The results revealed that eight sites: John residence, Mapinga, Boko, Kerege resort, Zinga sokoni, Kiromo Bunju, Ukuni petrol station and Bunju "B" had low level concentration of residual chlorine compared to recommended level set for drinking water (0.2 - 0.5 mg/L) WHO (2021) and Tanzanian standards for drinking water (TZS 789:2018) with a mean concentration of 0.09 mg/L. At the treatment plant which was at Sanzare levels of residual chlorine met the standard set (1.0 - 2.0 mg/L). Also the eight sites had presence of coliform bacteria E coli, Faecal coliforms and Total coliforms bacteria. The recommended level for coliforms bacteria in drinking water set is (WHO; 0 CFU/100ml) and (0 CFU/100ml TZS 789:2018) respectively. However, two sampling sites the Treatment plant and nearby distribution point Sanzare were free from coliforms bacteria

contamination. It is recommended that, chlorination should be done frequently at the booster stations to check any bacterial growth. The booster station for LRWTP should be placed near the treatment plant as now is located at Ardhi University. Regular monitoring of residual chlorine in distribution systems should be carried out to ensure residual chlorine of (0.2–0.5 mg/l) is available at the point of use. Frequent assessment of water quality should be carried out at different points in the distribution systems. Checking and repair broken lines must be observed from scheduled time to reduce introduction of contaminants in distribution lines.

Keywords: Water treatment, bacterial growth, chlorination

Integrated Water Resource Management for Water Services and Hygiene (IWRM4WASH) and Ensure Climate Resilience In Wami/Ruvu Basin.

Janette Worm (World Waternet),
Miriam M. Esanju & Paschal Qutaw (WRBWB 2023)
Email: janette.worm@waternet.nl

Abstract

The effects of climate change in Tanzania are strongly felt with changes in rainfall patterns and intensity, which lead to too much or too little water, affecting water needs for Water, Sanitation, and Hygiene (WASH) and food security, livelihoods, economic development and increasing the risk and vulnerability to disasters. In the Wami/Ruvu Basin Water Board (WRBWB) water availability has become an increasing problem and many major water bodies (rivers and dams) have shown extreme drops in water levels. In year 2021/2022 and 2022/2023 the Mindu Dam a key water source for Morogoro Municipality (75%) experienced minimum water levels since its constructions. This had directly impacted the WASH services, economic activities and the livelihood of the community based on agriculture activities to industrial development. With the understanding of the intrinsic relation between water resources, climate resilience and healthy ecosystems, strengthening the collaboration between basin board and water utilities on Integrated Water Resource Management (IWRM) issues is paramount. To this end Wami/Ruvu Basin Water Board WRBWB and MORUWASA (Morogoro Urban Water Supply and Sanitation) agreed to work together to protect the Mindu Dam Catchment Area (MDCA) for sustainable water supply. Through this collaboration the water utility and basin board work together to accelerate IWRM4WASH

in the basin that feeds the Mindu Dam and mobilized resources for catchment conservation. To conserve water and prevent soil erosion and subsequent siltation of the Mindu dam reforestation and agroforestry has been identified as a key nature-based solution. Sustainable IWRM is key to make the WASH sector climate resilient and ensure water provision and hygiene.

Agroforestry as a Nature-Based Solution in Mindu Dam Catchment Area.

Miriam Esanju, Emmanuel Komba (WRBWB),
Renée Zijlstra & Roos van Haeff (FarmTree 2023)
Email: esanjumiriam82@gmail.com

Miriam Esanju is working as Civil and water engineer and a project coordinator of water resource management projects within Wami/Ruvu Basin Water Board (WRBWB) Tanzania. She has experience in Integrated Water Resource Management, project coordination and management. She has also worked on Fecal sludge and abattoir waste Management. She has degrees in Civil and water Resource Engineering (BSc, University of Dar es Salaam) and Integrated Water Resources Management (MSc, UDSM.

Abstract

In Morogoro, the Wami Ruvu Water Basin Board is actively engaged in the Integrated Water Resources Management for Water, Sanitation, and Hygiene (IWRM4WASH) initiative, aimed at enhancing and safeguarding water sources within the Mindu Dam Catchment Area (MDCA). Agroforestry has been identified as a nature-based solution to prevent soil erosion, harvest rainwater, conserve water, and enhance livelihoods for rural populations and farming communities living in the MDCA. Using the FarmTree Tool, a decision support tool for agroforestry systems, all relevant stakeholders were invited to design agroforestry systems suitable for the MDCA. The resulting systems include riparian agroforestry, silvo-apiculture, crop-fruit agroforestry, crop-timber agroforestry, banana agroforestry, spice agroforestry, syntropic agroforestry, and mango

agroforestry. The FarmTree Tool's projections now provide decision-makers with insights into the impacts of proposed agroforestry systems on erosion, water conservation, and livelihoods. Additionally, the required investments are clear, enabling seeking financial support through payments for ecosystem services. The next project phase involves the establishment of nurseries with relevant species, the provision of farmer training, and the set-up of a monitoring system to ensure the effective implementation and success of the proposed agroforestry systems for protecting the MDCA.

Keywords: agroforestry, erosion, IWRM, livelihoods, wate

Implication of water Policy and water utility management systems on the performance of water quality service delivery in Africa

Margaret Sima Kironde[1][2]*
[1]Mbeya University of Science and Technology, Mbeya, Tanzania
[2]Pan African University Institute of Water and Energy Sciences, Abou Bekr Belkaid University
of Tlemcen, Tlemcen, Algeria.
Email: magigesima01@gmail.com

Margaret Sima Kironde is a holder of Master's degree of Water Policy and Bachelor degree in Environmental Science and Management from Pan African University Institute of Water and Energy Sciences and Ardhi University. Currently, she works as a Tutorial Assistant in the Department of Civil engineering, at Mbeya University of Science and Technology.
.

Abstract

A well performing water utility is the one that is able to provide sustainable high-quality water and waste water services to the community. However, many African water utilities struggle to deliver service to their customers in a convenient and reliable manner. This study aimed to analyze the impact of policies and utility management systems on the water quality service delivery performance of Côte d'Ivoire and Burkina Faso water utilities. The qualitative method was adopted for data collection; non-probability sampling precisely purposive sampling was used in this study where sample were drawn from a list of experts in the field. Structured questionnaires, and discussions were used to produce primary data. Furthermore, secondary data were collected from existing documents, journals, reports and books. Data collected from

questionnaires was organized according to performance indicators, translated and analyzed using SWOT analysis method. The results demonstrated inadequacies and gaps in the utility management systems and policies causing deficiencies in water quality service delivery to the populations of respective countries. Therefore, there is a need to have a comprehensive approach that addresses the challenges and gaps so as to have sufficient, reliable, convenient, transparent, financially sustainable, responsive to citizens and
safe water services and sanitation.

SUB-THEME TWO: WATER QUALITY MANAGEMENT (WQM)

Water Quality Management in Emergency Situations through Water Safety Plan

Henry Mugassa

Emai: homugassa@gmail.com

Henry is an experienced water engineering professional with over 20 years of expertise in water supply, sanitation, and hygiene locally and internationally. He obtained his MSc in Civil Engineering specializing in water resources from Russia's Rostov on Don State Building Academy in 1995. Additionally, Henry received an FTC in Water Engineering from Tanzania's Rwegarulila Water Resources Institute in 1987. He has varied development and emergency humanitarian works spanned from Tanzania, Sri Lanka, Sudan, Ethiopia and the Democratic Republic of the Congo.

Abstract

Water Safety Plans (WSPs) are a commonly used management system that rely on active community participation and leadership to ensure a good quality and maintain the safety of water supply throughout the whole system (i.e. from the catchment to the point of end user). In Sri Lanka after the Tsunami Disaster, most of the groundwater sources which were mostly relied on by people, were contaminated with salty water from the ocean. Following this disaster most people switched to Rainwater Harvesting (RWH) as the reliable water source from drinking. Communities were supported to install this type of system which ranged from 8 to 15 m^3 in each house. Depending on the size of the plot some tanks were installed semi underground and were fixed with a hand pump. Communities were trained on the usage of a Water Safety plan approach in order to manage the quality of their water. The system was designed to ensure that the first rain is not entering into the tank until all the impurities

are flushed out before allowing the water to enter into the tank. Roof and Gutters were regularly cleaned up, all extended tree branches to rooftops were cut off. The communities were provided with the simple bacteria testing kit (H2S) in order to monitor the quality of water regularly, it requires a very simple knowledge for each family member to operate it without any problem. For the sustainability of WSP, the H2S kits were made available in the pharmacy shops with affordable price. Sanitation and hygiene practices were also promoted to the community. As a result, more than 3000 RWH systems were constructed, and the main impact was the reduction of water and sanitation related diseases in the community.

Keywords: Rainwater harvesting technology, Tsunami, WASH in Emergency, Water safety plan

Locally Available Materials for Drinking Water Treatment in Tanzania-A Critical Review

Fanuel J. Ligate[1*]
[1]Mkwawa University College of Education, University of Dar es Salaam, 2513 Iringa
Email: fanlg25@gmail.com

Abstract

This paper examined the potential, limitations, and sustainability of locally sourced materials for the remediation of drinking water. The assessed materials encompassed natural deposits (bauxite, magnesite, gypsum, and minjingu phosphate), plant-based (Moringa oleifera, coconut shells, cassava peels, rice husks, tamarind seeds), and animal-based (bone char and chitosan). The contaminant removal mechanisms of these materials were elucidated from a chemical perspective. The findings unveiled that most studies on these materials were confined to laboratory-scale investigations, none have evolved into sustainable large-scale applications. Challenges hindering the widespread implementation of such materials were identified, including limited accessibility and preparation for certain materials as well as issues related to sustainability in terms of producing enough for large-scale. For instance, bone char, extensively proven effective in fluoride removal, faces resistance from the end-users, due to concerns about treated water quality in terms of color, odor, and religious beliefs. Additionally, the bulk production of bone char poses a sustainability challenge for large-scale treatment plants. The paper recommends that the development of optimal large-scale water treatment technologies using locally available materials should consider the quantity, quality, production costs, acceptability, and sustainability.

Emphasis is placed on promoting innovative, low-cost water treatment systems, especially in rural settings.

Keywords: agricultural wastes, bone char, water treatment, sustainability, water remediation.

Organic Matter Sources and Sewage Pollution in Human-Impacted River Estuaries-Wami and Pangani: Multidimensional Approach of Fatty Acids and Stable Isotopes

[1,2] Theresia J. Lyasenga*, [3]Prosper L. Mfilinge, [3]Daniel A. Shilla, [1]John A.M. Mahugija.
[1]Chemistry Department, University of Dar es Salaam, P. O. Box 35061, Dar es Salaam, Tanzania.
[2]Ministry of Water (MoW)–Ubungo Maji, P. O. Box 9153, Dar es Salaam, Tanzania. 3School of Aquatic Sciences and Fisheries Technology, University of Dar es Salaam, P.O. Box 35064, Dar es Salaam, Tanzania.
Email: teddylyasenga@gmail.com

Abstract

The study used a complementary strategy incorporating stable isotopes and fatty acids aiming at identification of various organic matter sources and allochthonous inputs linked to sewage pollution in Wami and Pangani River estuaries. Permutational multivariate analysis of variance (PERMANOVA) revealed variations in fatty acid indicators of terrestrial-based organic matter and sewage pollution between Pomadasys argenteus and Sillago sihama (Pseudo-F 0.97, $p < 0.05$), with high amounts in Pomadasys argenteus collected from Wami. Also, high values of these markers were noted in polychaetes with large concentrations in Wami estuary. Bacterial fatty acid indicators showed considerable variations between Epinephelus coioides in the two estuaries with high concentrations in Pangani. Results also revealed significant variations in carbon and nitrogen isotope ratios (PERMANOVA, pseudo-F $\geq$ 18.5, $p = 0.001$) among the fish species. Sewage contamination was found in Wami and Pangani estuaries, as evidenced by significant concentrations of nitrogen isotope ratios, bacterial fatty acids and indicators for sewage

pollution in estuarine fish. Also, findings indicated that estuarine fish relies on different organic matters sources including both autochthonous and allochthonous. These suggest an urgent need for regular monitoring by Wami and Pangani River authorities for sustainable use of these ecologically vital and economically significant ecosystems.

Urbanisation and structure of benthic macroinvertebrates in the watercourses of the city of Yaoundé and its surroundings

Temgoua. Z. Marie Anita[1], Foto. M. Samuel [2]Atchimi. T. Bernard[1]

[1]Regional Center of Excellence on Sustainable Cities in Africa (CERViDA-DOUNEDON) université de Lomé, Togo, Lomé 01BP 1515, Togo. Email. anitatemgoua1@gmail.com

[2]Hydrobiology and Environment Laboratory (LHE), University of Yaoundé 1, Faculty of Science, Yaoundé P.O. Box 812, Cameroon

TEMGOUA ZEMO Marie Anita, a doctoral student at the Regional Center of Excellence on Sustainable Cities in Africa (CERViDA-DOUNEDON) with a specialization in urban ecology and sanitation at the University of Lomé, TOGO. Leveraging a background in hydrobiology, I employ benthic macroinvertebrates as bio-indicators of aquatic environments. I have contributed as an author to several peer-reviewed articles.

Abstract

In view of the urban sprawl in the city of Yaoundé and the surrounding area, which is leading to the pollution of hydro systems and the destruction of biodiversity, this study aims to assess the population structure of benthic macroinvertebrates along the urbanisation gradient in watercourses subject to anthropogenic activities. Satellite data was acquired on the occupation of catchment areas, physico-chemical parameters were measured using standard methods and benthic macroinvertebrates were collected using a multihabitat approach. The

physico-chemical (conductivity, orthophosphate, nitrate, temperature, pH, ammoniacal nitrogen, nitrite, TDS, and alkalinity) analyses reveal that the watercourses located in the urban environment are almost anoxic (1.5%) with an average fluctuating around $10.13 \pm 4.71\%$ and in the reference environment an oxygenation rate fluctuating around an average of $59.02 \pm 4.24\%$ and organic pollution indicators above 1mg/L in the urban environment. The structure of the benthic macroinvertebrate population is represented in the urban environment by a population dominated by the phylum of arthropods, the class of insects and the order of Diptera with the predominance of the family Chironomidae, whereas in the reference environment, the dominant order is that of Decapoda followed by Ephemeroptera. The diversity indices show a low diversity population dominated by the genus Chironominus in the urban environment and *Caridina africana* in the reference environment. Given the structure of the population due to the degradation of hydrosystems in urban areas, incorporating them into land-use planning policies would enable them to be rehabilitated and reduce the cost of treating drinking water supplies.

Keywords: Benthic macroinvertebrates, degradation, hydrosystems, structure

Divulging the association between physicochemical and heavy metal characteristics of dumpsite leachate and groundwater around Pugu Kinyamwezi dumpsite, Dar es Salaam

Gift I. Marandu[1], Kassim R. Mussa[1], Offoro N. Kimambo[1], and Amina Hamad[1]
[1] Department of Geography and Environmental Studies, College of Natural and Applied Science, Sokoine University of Agriculture, Morogoro, Tanzania.
Email: giftmarandu98@gmail.com

Abstract

This study aims to assess possible impact of leachate percolation on groundwater quality considering spatial and seasonal analysis, using a case of Pugu-Kinyamwezi dumpsite. Leachate and groundwater samples were analyzed in situ for physicochemical parameters and for heavy metal analysis at the Ardhi University, Tanzania during the dry and wet seasons. Concentrations of various physicochemical (pH, TDS, EC) and heavy metals (Pb, Cr, Cd and Cu) were determined in leachate and groundwater samples and are reported. To uncover the relationships between observations and variables, and among the variable, the results were subjected to descriptive and inferential analysis. The concentrations of the heavy metals were higher during the wet season over the dry season and were above the permissible guidelines for TBS and WHO in the majority of groundwater. Physicochemical and heavy metal parameters showed a significant decrease with distance implying that pollution decrease with increasing distance. The principal component analysis (PCA) revealed that the dumpsite is the source of pollution into the groundwater. The presence of contaminants in groundwater, especially in close proximity to landfill site, poses a warning to its quality, making the associated

groundwater unsuitable for reliable domestic water supply and drinking purposes.

The Effects of Anthropogenic Activities on Urban River Water Quality: The Case of the Kumba River, Southwest Region of Cameroon

Niba M.L Fonteh[1]; Besende D. Njumba[2]
[1]Head of the Department of Geography higher teachers training college-Bambili, The University of Bamenda, Cameroon (mfonteh@yahoo.com) Tel. +237 679200196
[2]Department of Geography and Planning, The University of Bamenda, Cameroon. Tel. +237 672503178
*Corresponding author: susanmasale@gmail.com

Abstract

This study investigates the relationship between urban land use in the Kumba metropolis and the water quality of the Kumba River. Water samples were collected and analyzed for physical, chemical, and bacteriological parameters such as temperature, dissolved oxygen, total dissolved solids, total suspended solids, electrical conductivity, odor, color, turbidity, pH, Biochemical Oxygen Demand, Chemical Oxygen Demand, ammonia, phosphorus, chlorine, nitrates, nitrites, and heavy metals such as copper, phosphate, iron, zinc, calcium, magnesium, and fecal coliforms. Samples were collected from five points in February 2023 (dry season) and April 2023 (rainy season). data were analyzed using descriptive and inferential statistics. results showed p-values were <0.05 at a 95% confidence level, indicating pollution of the Kumba River due to urban land use activities with areas heavily reliant on the river for urban activities exhibiting significantly poorer water quality compared to areas with limited dependence. The study concludes that urban expansion from 2007-2023 has contributed significantly to the degradation of physicochemical and microbial properties of the Kumba river. Thus, addressing urban problems like poor discharge of domestic

sewage/effluents, improving on the urban wastes management system, reducing the conversion of forests to agricultural lands and reducing agrochemical usage are vital for mitigating these effects.

Assessment of Water Quality and Community Perception on Cave Water at Shehia of Mangapwani in Unguja- Zanzibar: The Case of Mangapwani Historical Caves

Leopord Sibomana Leonard* and Sarah Nuhu Sallanya
Department of Environmental Science and Management, School of Engineering and Environmental Studies, Ardhi University P.O. Box 35176, Dar es Salaam
*Corresponding author: siboditz1@gmail.com

Dr. Leopord Sibomana Leonard is a PhD holder with diverse experiences drawn from multiple disciplines. He is a WASH expert with academic background of BSc in EE, MSc. ETM and PhD. ETM. He has worked with National and International Organizations in multiple projects. He has published in reputable National and International journals on water resource management. He works at Ardhi University, as a Lecturer in the School of Engineering and Environmental Studies (SEES).

Abstract

Groundwater has become a significant resource in recent decades for drinking, irrigation, and industrial purpose due to rapid population growth, industrialization and surface water degradation. The increased water demand has led to increased groundwater extraction in sensitive areas such as coastal areas, caves, where aquifers may be exposed to seawater intrusion, resulting in deteriorating quality. Thus, this study focused on the assessment of water quality and community perception regarding cave water in Mangapwani, Zanzibar. The cave comprises three springs and a pool, where springs are used for domestic purposes and the pool for recreational activities. The study employed questionnaire and interviews among residents and community leaders. Water sampling was

done using 1L plastic materials and transported to Ardhi University for laboratory analysis. Findings of this study indicated variations of water quality parameters where by EC ranged from 601 to 6415µS/cm, calcium ranged from 59mg/L to 668mg/L while sodium ranged from 147mg/L to 613mg/L. Hydro geochemistry revealed mixed type of water in spring water. The water quality index indicated the variations of water quality categorized into excellent, good, fair and poor for spring one, spring two, spring three, and the pool, respectively. This study, generally reveals the variations of water quality among water sources and hence water treatment at household level is of paramount important.

Key words: Aquifer; Hydro geochemistry; Recreational areas; Water Pollution, Water Quality Index

The potential of farm-scale rainwater harvesting for irrigation in regions with saline groundwater

Esther Laurentine Nya [1], Tulinave Burton Mwamila [2], Willis Gwenzi [3,4,*], Chicgoua Noubactep[5,6,7]

[1] Faculty of Arts, Letters and Social Sciences, University of Maroua, P.O. Box 644 Maroua, Cameroon.
[2] Water Institute, Ministry of Water, P.O. Box 35059, Dar es salaam, Tanzania.
[3] Grassland Science and Renewable Plant Resources, Faculty of Organic Agricultural Science, University of Kassel, Steinstrasse 19, D-37213 Witzenhausen, Germany; wgwenzi@yahoo.co.uk
[4] Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Max-Eyth-Alle 100, D-14469 Potsdam, Germany
[5]Department of Applied Geology, University of Göttingen, Goldschmidtstraße 3, D-37077 Göttingen, Germany
[6] Faculty of Science and Technology, Campus of Banekane, Université des Montagnes, Bangangté P.O. Box 208, Cameroon
[7] Centre for Modern Indian Studies (CeMIS), University of Göttingen, Waldweg 26, D-37073 Göttingen, Germany
Correspondence: wgwenzi@yahoo.co.uk

Abstract

Water availability is the key to sustenance of any human community. Anciently, human settlements were created where water was available or likely to be made available, even as harvested flooding water (e.g. the Nile Valley). In those times water harvesting was key to development and was managed and used in a decentralized manner (household and community scales). During the past 170 years, efforts have been made to centralize water management worldwide. Hence, water providers have progressively replaced communities and households as the primary units for provision

and management of water. This dominant approach has occurred to the extent that rainwater harvesting is regarded as "water reuse" and its role limited to non-potable uses. However, even for agricultural irrigation, the modern farmer mainly relies on pumped groundwater which is becoming increasingly saline and depleted in some regions such as arid and semi-arid environments. Considering that water is a scarce but renewable natural resource, this communication demonstrates that rainwater harvesting (RWH) should be the primary source of irrigation water everywhere. The limited availability of rainwater in space and time implies the need for site-specific design of viable water management and striking a balance between water use and water demand to ensure its transgenerational sustainability. Several RWH technologies are both technically and economically viable, supporting the large-scale deployment of these small-scale, appropriate technologies. The implementation costs are made acceptable with the use of local materials and skills. This presentation should be helpful for any practitioner in determining the locally optimal solution for RWH for irrigation, particularly in regions with saline groundwater.

Multi-pollutants Removal from Effluents by Alkali Modified Sugarcane Bagasse Fibres

Joseph W Sengasu*[1,2], Joseph Y N Philip[1] and Kessy F Kilulya[1]
[1]Department of Chemistry, University of Dar es Salaam, Dar es Salaam, Tanzania
[2]Department of Chemistry, St John's University of Tanzania, Dodoma, Tanzania
Email: joseph.wilson393@gmail.com

Abstract

Water quality worldwide has remained a problem of concern due to pollution from different sources which has so far attracted numerous researches for pollutant removal. However, majority of researches in this area report the removal of a single pollutant per method, despite the fact that industrial effluents are matrices containing multiple pollutants. As a result, the data obtained from such techniques is typically inapplicable to the majority of actual treatment processes. Thus, this study aimed at multipollutants removal from effluents by alkali modified Sugarcane Bagasse Fibres (SBF). The multipollutants analysed were crystal violet (CV), Pb(II), Cr(III), Cd(II) and Co(II). Adsorption performance was conducted in a fixed bed column adsorption method. The fibres were extracted from sugarcane bagasse by alkaline hydrogen peroxide modified by soaking them in NaOH solution. The NaOH modified fibres SBFNa, were characterized by FTIR, XRD and porosimetry. Adsorption studies using Thomas model equation showed that NaOH modified fibrebiosorbents (SBFNa) had higher adsorption percentages; CV (65.1%), Pb(II) (36.4%), Cr(III) (17.1%), Cd(II) (16.9%) and Co(II) (13.2%) than unmodified fibres (SBF); CV (57.5%), Pb(II) (28.9%),

Cr(III) (11.2), Cd(II) (10.1%) and Co (II) (9.2). All pollutants had initial concentrations of 30 ppm. These results enlighten that NaOH modified sugarcane bagasse fibres can be used in the fixed bed method for effective removal of multipollutant (organic and inorganic) from aqueous effluents.

Keywords: alkali modification, fixed bed method, multipollutant removal, sugarcane bagasse fibres, wastewater treatment

Small Community Nalgonda Based Water Defluoridation Plant

Godfrey B. Mkongo
Water Institute Research Campus Ngurdoto, Arusha, Tanzania

Godfrey Barnaba Mkongo is a retired Head of NDRS (1992 - 2018). He developed Household and community defluoridation systems. He studied FTC in Water Quality Technologies at Water Resources Institute from 1980 to1983 and joined Ministry of water. From 1985 to 1991 he was Superintendent of Water Treatment Plant at HTM project.

Abstract

Alum and lime (Nalgonda Technique) was introduced in water defluoridation about fifty years ago. In some cases, the application of this method is not cost-effective, mainly where the defluoridated waters are used for all domestic purposes. Since, if not consumed, high fluoride waters do not affect humans, it is recommended to restrict the use of de-fluoridated waters for cooking and drinking only to keep costs down. The use of non-defluoridated water should continue for other purposes. The installation of appropriate de-fluoridation plants is necessary to supply raw and treated water for both uses at water points in villages. This presentation discusses details of a small plant based on this method and as designed and tested by the author. The chemical dosage and filter backwashing systems of the plant are water-powered. Trial operations of the plant were capable of reducing fluoride from 20 and 10 mg/L to averages of 4 and 3 mg/L, respectively, at dosages of 600 mg/L alum and 95 mL of saturated lime solution. It is expected to achieve the recommended fluoride guidelines of 1.5 mg/L when this system is used with lower raw water fluoride concentration.

Keywords: Nalgonda system, de-fluoridation, small community

Performance of Copper Wire-Assisted Activated Carbon Electrode on Water Hardness Removal

Antoni M. Bairo*[1,2], Lilian M. Daudi[3], Joyce Elisadiki[3], Mtabazi G. Sahini[1], Said A. Vuai[1].
[1]The University of Dodoma, College of Natural and Mathematical Sciences, Department of Chemistry.
[2]Ministry of Water, Directorate of Water Quality, Manyara Water Quality Laboratory.
[3]The University of Dodoma, College of Natural and Mathematical Sciences, Department of Physics.
Email: antonibairo@gmail.com

Abstract

The need to apply electrical energy in water desalination technologies has led to great expenses for saline water treatment due to high energy consumption. In this study, Copper Wire-Assisted Activated Carbon (CWA-AC) electrodes lowered energy consumption during desalination while improving capacitive deionization (CDI) efficiency. CWA-AC electrodes were made by coating activated carbon and carbon black powder on the copper wire surface by using epoxy adhesive. The activated carbon weight and the length of the copper wire were varied to obtain the optimal CWA-AC electrodes. The optimal CWA-AC electrodes reduced the 100 ml of tap water hardness from 287.9 to 158.6 mg/L by using an energy of 17.4 mWh. While the conventional CDI electrodes reduced the hardness from 287.9 to 196.2 mg/L by using 22.6 mWh. During electrode regeneration, the CWA-AC electrode desorbed 94.2% of salt ions while the conventional electrodes desorbed 66.9% of salt ions. This implies that the CWA-AC electrodes are more effective in CDI with greater hardness removal efficiency, desorption efficiency, and minimal energy consumption than the conventional electrodes.

Colorimetric Sensing of Mercury in Aqueous Solutions using Silver Nanoparticles prepared from *Synadenium glaucescens* Root Aqueous Extract

Alinanuswe J. Mwakalesi

Department of Chemistry and Physics, College of Natural and Applied Sciences, Sokoine University of Agriculture, P.O. Box 3038, Tanzania. Corresponding author**:** *mwakalesi@sua.ac.tz*

Dr. Alinanuswe Joel Mwakalesi is a senior lecturer at the Department of Chemistry and Physics of the Sokoine University of Agriculture. He holds PhD degree in Chemistry from LA Trobe University, Australia, Master in Chemistry, and Bachelor in Chemistry from the University of Dar es Salaam (UDSM). His research interests are in the development of various polymeric membranes for water purification processes. He also conducts research on green synthesis of metallic nanoparticles for the sensing of various water contaminants. He has published a number of research articles in chemistry and related fields.

Abstract

Mercury contamination from various anthropogenic activities has been a recent global problem. Thus, developing cheap and efficient techniques for sensing mercury is significant for protecting humans and other organisms. The sensing of mercury using silver nanoparticles fabricated using phytochemicals extracted from *Synadenium glaucescens* roots (SYR) is reported. The successful synthesis of silver nanoparticles (SYR-

AgNPs) was confirmed by a strong plasmon resonance in the UV-Vis spectrum at 420 nm due to oscillations of electrons in the silver nanoparticles. The potential use of fabricated silver nanoparticles for the sensing of mercury ions from aqueous solutions was investigated. The prepared silver nanoparticles displayed a high selectivity for detecting mercury against other divalent metal ions (Hg^{2+}, Ba^{2+}, Ca^{2+}, Co^{2+}, Cu^{2+}, Fe^{2+}, Mg^{2+}, Ni^{2+}, and Pb^{2+}). The addition of mercury changed SYR-AgNPs color to colorless, and the observed change in color was proportional to mercury concentration. The application of silver nanoparticles for the sensing of mercury displayed a detection limit of 11.3 µM. Therefore, the findings in the current study indicate that the prepared SYR-AgNPs can serve as a potentially sensitive and selective readily available method for sensing mercury ions in environmental samples. The method can be useful in advancing the application of green technology for sensing heavy metals from environmental samples.

Keywords: Silver Nanoparticles, Synadenium glaucescens, Plasmon Surface Resonance, Mercury sensing.

Hydraulics of Waste Stabilization Ponds and Implication to Effluent Quality

Fides Izdori[1]

[1] Department of Water Resources Engineering, College of Engineering and Technology, University of Dar es Salaam, Dar es Salaam, Tanzania.

Email: eng.fide@yahoo.com

Dr. Fides J Izdori is a Water and sanitation expert, and lectures at the University of Dar es Salaam, Water Resources Engineering Department. She has over 13 years' experience in research and capacity building projects through lecturing, supervision and mentoring of both undergraduate and postgraduate students. Her interests are in water, sanitation and public health, including applications of Geographic Information Systems (GIS), Earth Observation (EO) and Remote Sensing (RS). She is also interested in resource recovery from wastes, promotion of cleaner production approaches and Water, Sanitation and Hygiene (WASH) interventions to Soil Transmitted Helminths (STH).

Abstract

Despite the advancements made in wastewater treatment, Waste Stabilization Ponds (WSPs) are still a robust natural and low-cost treatment technology, especially in tropical countries. Therefore, efforts should be directed toward understanding and improving the processes that

lead to water purification inside WSP. This research aims at studying the hydraulic conditions inside an operational Buguruni WSP as among the parameters influencing pollutant removal. The hydraulic characteristics inside the primary facultative pond were simulated using the hydrodynamic module Delft3D-FLOW. The wind blow conditions for Dar es Salaam; the dominant North-Eastern with an average speed of 4.25 m/s and the minor South-Western in the morning and South-East direction in the afternoon both at an average speed of 2.5 m/s were also added into the simulation to study their impact. In both scenarios, with and without wind, highest flow velocities are observed at the inlet and outlet, with the flow progressing from the inlet to the outlet due to elevation difference. Except for the scenario with the dominant wind speed, all others exhibited dead spaces at corners opposite to the inlet and outlet. Velocity profile elaborates further the effects of wind. In the pelagic area, the velocity profile without wind exhibits a typical open channel flow curvature, varying from a maximum at the top of the channel to a minimum at the channel bottom. Introduction of wind results into a layered structure with the maximum velocity at both the water surface and the pond bottom. From the whole pond perspective, wind amplifies the mean flows and increase vertical mixing, increasing chances of re-suspending settled materials. Overall, this study shows that the applicability of hydraulic models in studying WSP hydraulics and the possible impact of wind in WSP effluent quality.

Adsorption of Phenol in Wastewater on Activated Carbon from Litchi Fruit Seed and Husk: Isotherm and Kinetic Studies

Linda Bih Numfor *, Mwemezi Rwiza, Revocatus Machunda
The Nelson Mandela African Institution of Science and Technology
(NM-AIST). P. O. Box, 447 Arusha, Tanzania.
*Corresponding author: Linda Bih Numfor (numforl@nm-aist.ac.tz)

Abstract
Water is essential to life, yet industrial sectors that process textiles, make petrochemicals and refine oil release pollutants into water supplies, such as phenol. These extremely harmful, soluble in water phenolic compounds are detrimental to the ecosystem and aquatic life. In this study, an effective adsorption method using an inexpensive activated carbon from litchi fruit seed and husk was utilized for phenol decontamination in wastewater. KOH was used to activate the litchi fruit seed and husk to produce activated carbon and enhance surface area. Kinetic and isotherm equilibrium studies were used to evaluate how well the activated carbon adsorbed phenol. The adsorption rate values were interpreted by analyzing the experimental adsorption data using several isotherm models. Freundlich and Langmuir isotherm models, pseudo-second order kinetics, best fitted the experimental data. The experimental findings indicated that around 98% of the phenol was adsorbed, indicating that phenol adsorption is feasible on inexpensive activated carbon from litchi seed and husk.
Keywords: Activated carbon, adsorption, isotherm, kinetic, litchi, phenol

Machine Learning Techniques Applications in Water Quality Monitoring and Modelling: A Research Travelogue.

*Oswald P. Bomani[1] , Norbert M. Assey[2] , Salehe R. Mayange[3]
[1]Environmental Department, North Mara Goldmine Limited, Tarime, Tanzania.   Email: geobomani@gmail.com

[2]Department of Geology, University of Dodoma, Dodoma, P.O Box 259, Tanzania.
[3]Geosciences and Mining Technology, Mbeya University of Science and Technology, Mbeya, Tanzania.

Abstract

The deterioration of surface water and groundwater quality as a result of population growth and poor management of water resources has become the most serious issue in the present decade. With the swift increase in the volume of data on the aquatic environment, then machine-learning techniques have become useful tools for data analysis, forecasting, and classifications of water quality parameters and indices. Different from traditional methods applied to water-related research, machine learning techniques can efficiently solve more complicated nonlinear problems. In environmental-related research, machine-learning models have been applied in monitoring, simulation and forecasting, optimization of various water treatment methods and management systems. Furthermore, machine learning can provide solutions on how to monitor and manage saltwater intrusion into coastal aquifers, and watershed protection. In the present review, we describe different cases for both supervised, unsupervised, and ensemble models in which machine-learning algorithms have been applied to assess the water quality in different water environments, such as raw water, saline water, potable water, sewage,

surface water, and groundwater. Also, we suggest future applications of machine learning techniques to water management.

SUB-THEME THREE: WATER SUPPLY AND SANITATION MANAGEMENT (WSM)

Role Of Innovative, Large Diameter Structured Wall HDPE Pipes in Water Supply and Sanitation Management

Mr. Saravan Babu
PLASCO Limited, P.O. Box 19956 Mbozi Rd, Dar es Salaam
saravanan.babu@plasco.co.tz

Saravanan Babu is an Engineer with Master's degree holder in Quality Management, and a Bachelor's degree in Polymer Technology from India. He is working as a Plastic Pipe Testing and QMS Specialist with Plasco Ltd since 2011 and hold over 20 years of quality management and process engineering experience in plastic pipe extrusion and process industries. He is well trained in the Design and Structural evaluation of HDPE Structured wall pipes and fabricated products (Weholite).

Abstract

Developing countries are working to better manage water resources amid climate change impacts like water scarcity. Even if greenhouse emissions stabilize soon, some climate change effects are unavoidable. Water issues intersect with sustainable development challenges. Plastic piping systems play an indispensable role in the water cycle for drinking water, wastewater, and stormwater. Innovative plastic pipe systems significantly contribute to quality of life and sustainable water management. Large diameter structured wall HDPE pipes have been used globally and recently deployed for major water projects in Tanzania and Kenya where innovation and value are necessities. Case studies of major piping projects in Tanzania and Kenya demonstrate distinct advantages of quality plastic pipe systems for water supply and sanitation. A 900mm diameter HDPE pipe system supplies irrigation water in Tanzania. An 1800mm

stormwater drainage system was installed under a busy Tanzanian road. 400m^3 rainwater harvesting and municipal tanks were built across Tanzania. Innovative HDPE products treat water in Kenya. Together, these projects show the versatility, innovation, and infrastructure-building potential of structured wall plastic pipes to sustainably deliver water services in East Africa for future generations.

Keywords: HDPE pipe, Water, piping systems, greenhouse emission

Removal Kinetics of *Escherichia Coli* from Faecal Sludge Treated with *Moringa oleifera* on Unplanted Sand Drying Beds.

Mmasi Benjamin Doglas[1], Kimwaga Richard [2] and Prosper Zenorina[1]
[1]Water Institute, Ministry of Water, P.O Box 35059, Dar es Salaam
Email: benjamindoglas@gmail.com
[2]Department of Water Resources Engineering, College of Engineering and Technology, University of Dar es Salaam, P. O. Box 35131, Dar es Salaam, Tanzania
*C*orresponding author: email address benjamindoglas@gmail.com

Abstract

The removal kinetics of *Escherichia coli* (E. coli) from Faecal Sludge (FS) on an unplanted sand drying bed was with *Moringa oleifera* studied. A total of 100 samples from influent and effluent of the sand bed unit were collected for mathematical model calibration, and 40 samples size for model validation. The bacterial removal mechanisms studied were field temperature, solar radiation, effect of *Moringa oleifera* conditioner and adoption, diffusion and filtration. The model results show that the *Escherichia coli* removal kinetics was most influenced by adsorption, diffusion and filtration mechanism by 64.3% of total removal followed by *Moringa oleifera c*onditioner which contributes to 34.7%. The influence of other parameters such as temperature and solar intensity was insignificant ($p=0.72$ at $\alpha=0.05$) contributing to about 0.7% and 0.3% respectively. Construction of Faecal Sludge dewatering facility need to consider the temperature, viscosity of Faecal Sludge and particle size of filter media, contact time, concentration of *Moringa oleifera* stock solution and its dilution factors for improving the efficiency of Faecal Sludge treatment plants.

Keywords: Fecal sludge, *Moringa oleifera*, dewatering

Avoiding Unnecessary Cost in Water Quality Analysis (WQA) Aspect for the Groundwater Sourced Rural Water Supply Projects

Aaron E. Swai

swaiaek@gmail.com

Aaron is a Principal Water Engineer with over 15 years' experience spanning Ministry of Water and RUWASA. Holds MSc in IWRM and BSc in Environmental Engineering from UDSM, currently pursuing PhD in Groundwater. Skilled in water supply, sanitation, resources, quality, climate change, and procurement. Teacher, boxer, and gospel enthusiast.

Abstract

Rural Water Supply and Sanitation Agency (RUWASA) has been implementing Sustainable Rural Water Supply and Sanitation Programme (SRWSSP) in its effort to attain National Development Vision (NDV) 2025. The NDV aims at achieving 85% universal access to water supply coverage in rural areas by 2025. In order to achieve the NDV, a lot of capital investment has been invested on rural water projects; from projects' planning, designing and implementation respectively. For instance, for the aforementioned period, Singida Region alone has invested > 24 Billion (TZS) on almost 90 new and rehabilitated water supply projects (RUWASA, 2023). Groundwater has been a potential and it remains as the main domestic water supply source to the region's rural communities (Musa, K et al (2020)). However, review of several reports of the said water projects has revealed there is no case-to-case WQA but rather generic consideration during well development or projects'

monitoring. For instance, heavy metals (e.g. Hg & Pb) were analyzed frequently. However, they can't prevail in the rural settings but rather on the urban. By this way, the cost of WQA has skyrocketed unnecessarily. It is now envisaged to share this field experience, to the practitioners, i.e., RUWASA and other Water Sector's Practitioners, to see on how best we can avoid this unnecessarily WQA costs on the case-to-case basis and save money for an alternative capital investment.

Keywords: Rural Water Supply and Sanitation Agency; Sustainable Rural Water Supply and Sanitation Programme; Groundwater; Water Quality Analysis; Groundwater; Case to Case.

Prioritization of Services Deliveries for Tanzania Water Utilities Improvements - Application of Micro Integration Decision (Mid) Model - Innovation

Fredius J. Magige[1], Eng. Sam Shemsanga[2]; Eng. Clement Kivegalo[1]
[1] Rural Water Supply and Sanitation Agency (RUWASA), Dodoma
[2] WEM Consultant, Morogoro
magige.joseph@ruwasa.go.tz

	Eng. Fredius Joseph Magige is professional engineer; since 2006 to to date, serving GoT at varies levels, include Assistant Administrative Secretary at Mbeya Regional Commissioner's Office and Principal Engineer at RUWASA, Iringa Office. He focus in water supply and sanitation projects, management and developments, indeed modelling and projects prioritization. From 2003 to 2005 he worked with Barrick North Mara Gold (formerly Placedom). Eng. Magige has B.Sc (2001) and M.Sc (2006) of University of Dar es Salaam

Abstract

Though water is covering 71% of earth's surface, less than 1% is available for human consumption. Inadequate and unsafe water to community causes waterborne and *estimated 502,000 annual diarrheal deaths* caused by unsafe water access in developing countries. Global community declared, *water and sanitation for all by 2030*. Tanzania has established 26 urban utilities, and about 500 rural supplies. Service providers have mandatory to supply clean, adequate and affordable water to communities. Micro Integration Decision (MID) model has developed to address worldwide decision makers' allocation challenge facing public resources, adaptation to climate change and infrastructures aging. Among

many possible descriptive submodels; non-revenue water (NRW), integrated and opted to address utility improvement priorities. It had ranked Dodoma, Vwawa-Mlowo, Musoma, DAWASA; as 1st, 2nd, 3rd, 4th respectively. Vwawa-Mlowo had high NRW and lowest breakdowns. On another hand, Dodoma, DAWASA and Mwanza were first three cities prioritized, had high populations, NRW and experienced losses of 210.1million litres per day (MLD). DAWASA had lost 152.1MLD, and 26Utilities lost 320.6MLD. Those losses had environmental degradation, waterborne consequence and revenue losses of 91.04TZS billion in year 2021/2022. Furthermore, MID proposed three main clusters; cluster-ABC, high attention cluster, cluster-DEF and concluded by cluster-G, less attention cluster.

Keywords: Water prioritization, planning, developments, decision, mid model, utilities

Use of Octacalcium phosphate with an Innovative Household-scale De-fluoridation Prototype for De-fluoridation

Mihayo Nkinda[1]*, Godfrey Mkongo[1], Giorgio Colombo[2], Simon Kajala[2], Revocatus Machunda[3], Wilson Mahene [3], Alfredo Idini[4], Franco Frau[5], Luciano Gutierrez[5], Elisabetta Dore[6], Giuseppe Nocella[6], Giorgio Ghigglieri[6],

[1]Water Institute Research Campus Ngurdoto, Arusha, Tanzania
[2]Oikos Tanzania
[3]Nelson Mandela African Institution of Science and Technology
[4]University of Cagliari, Italy
[5]University of Sassari, Italy
[6]University of Reading, United Kingdom
* **Corresponding author:** nkinda2022@gmail.com

Dr. Mihayo Sahani Nkinda, Campus Manager at WI-Research Campus Ngurdoto, was born in Simiyu Region in 1970. He earned an F.T.C. in Water Engineering in 1993 from Water Institute, followed by a B.Sc in General Science from OUT in 2004, and M.Sc. from UDSM, and a PhD in Environmental Science from NM-AIST in 2022. With over 15 years of experience spanning managerial, research, and innovation roles in the water sector, Dr. Nkinda leverages his robust educational background to drive progress across academic and practical realms. His expertise bridges critical gaps between theory and application.

Abstract

A de-fluoridation using Octacalcium phosphate (OCP) is a new technology introduced within the European Union (EU) Horizon 2020

FLOWERED project. The technology uses an effective de-fluoridation device in which octacalcium phosphate is used as an effective material for de-fluoridation. Test operation for running the flowered de-fluoridator devices (FDD) was conducted at the Water Institute Research Campus Ngurdoto - Arusha. The experiment aimed to reduce the level of phosphate and pH in water after being treated with the OCP. Initially, we used calcium hydroxide which could not reduce the phosphate and pH level to an acceptable WHO and TBS guideline. Finally, we adopted the use of calcium chloride and calcium sulfate simultaneously. The results indicated that calcium chloride and calcium sulfate may reduce the pH and phosphate levels in water treated with the OCP to an acceptable WHO and TBS guideline for drinking water. We concluded that calcium sulfate and calcium chloride were the best reagents for reducing phosphate and lowering the pH level in water when the OCP is used for de-fluoridation.
Keywords: Water de-fluoridation, OCP technology, Octacalcium phosphate

Digital Technologies for Water and Sanitation Management

Mweta Allen
BAJOM Enterprise Ltd.
mwetaallen31@gmail.com

Abstract

Soon after Independence on 9th December 1961 the Water sector took various initiatives that could provide clean, safe, affordable and sustainable water supply and sanitation services but to date sustainability of these services remains as the greatest challenge. The 2002 National Water Policy stated among reasons that could not provide sustainable water supply and sanitation services is 'lack of proper flow of information related to water supply and sanitation services from rural areas to the National level." From the year 2000, Digital Technologies were introduced in Rural Water Supply Division which currently is Rural Water Supply and Sanitation Agency (RUWASA) by establishing Rural Water Supply Database that was funded by GIZ to monitor Rural Water Supply Schemes and Management Information System (MIS) was funded by World Bank to track down the implementation of Water and Sanitation Projects. The objective of this paper is to discuss, review and harmonization these two Databases to achieve the needs of the Agency in relation to The Water Supply and Sanitation ACT NO. 5 of 2019 and its Regulations. The methodology to be used to review and harmonize will be both Qualitative and Quantitative methodologies.

Keywords: RUWASA, Sanitation, Digital solutions

Addressing Tanzania's Sanitation Challenges Through Inclusive and Integrated Citywide Approaches

Oscar Mbekenga
mbekso@yahoo.com

Oscar Mbekenga is a professional training in decentralized wastewater and faecal sludge management. I have attended and, on several occasions, I have personally organized short courses, seminars and workshops on wastewater and Faecal sludge Management. I have been involved in several projects in the planning, designing and implementing safely managed sanitation programs. I am currently working as a Managing Director for Obsen Civil and Environmental Engineering Company Limited and a consultant in Decentralised Wastewater and Faecal Sludge Management

Abstract

The magnitude of sanitation challenges in Tanzania is enormous ranging from technical, social, environmental to financial perspective. All the aforementioned areas are not adequately addressed regardless of having in place comprehensive national water and sanitation policies. The said inadequacies collectively contribute to the sanitation challenges in Tanzania. To effectively address the challenges, it is imperative to concentrate from the nucleus of the big cities/towns embracing their respective peri-urban areas where the challenges are more vivid to a less challenging rural setting. Well assessed and streamlined technical, social, environmental and financial approaches with emphasis on citywide inclusive sanitation planning tool is inevitable. This presentation therefore intends to highlight in a snapshot how Inclusive financial mechanisms, inclusive gender equality and social-cultural inclusion coupled with

inclusive low cost-effective technologies work together in their unison to attain a thorough water supply and Sanitation Management component along the sanitation value chain in urban and peri-urban communities of Tanzania.

Keywords: Sanitation, gender equality, management

Navigating the Water-Energy-Food Nexus: Challenges in Water Resources for Agricultural Production in Rungwe, Tanzania

Brown Gwambene
Faculty of Science and Education, University of Iringa P.O Box 200
Iringa, Tanzania
Email: gwambene@gmail.com

Dr. Brown Gwambene is a Lecturer and researcher in Geography, Environment, and natural resources management at the University of Iringa. He has broad research experience and published articles in peer-reviewed journals and book chapters in areas ranging from Natural Resources Management, Ecology, Water Resources, Environment, Rural Development and Livelihoods, Climate Change Adaptation, Forest, Coastal and Marine Resources, and Agriculture System and Production.

Abstract

This study investigates the dynamics among water, energy, and food resources in the Rungwe District, heightening the critical nexus of environmental changes. It highlights challenges in water access, resource sustainability, agricultural production, and ecological changes, analyzing their collective impact on water availability, water for agricultural production, and distribution equity. The Water-Agriculture (WA) nexus in Rungwe is significantly influenced by environmental shifts and resource sustainability, contributing to water scarcity and a decline in production. Utilizing the WEF nexus index, key informant interviews, questionnaire surveys, and climate data interpolation, the methodology concentrates on

the three agroecological zones. The findings highlight water and agricultural production alterations (87%) and a decline in water and crop production. Increased water management challenges emanating from climate change, shortage of infrastructure, inadequate compliance, enforcement, and data utilization necessitate a multidimensional approach. The study emphasized the need for irrigation (62%), rainwater harvesting (36%), and upgraded and construction of infrastructure (67%). The study recommends bolstering water infrastructure, improving land management practices, protecting water sources, improving water storage and rainwater technology, enhancing compliance, fostering behavioral change, prioritizing data management, and alleviating conflicting sectorial actions to achieve sustainable resource management. The study contributes to improving water, energy, and food nexus resilience, promoting sustainable agricultural practices, supporting the well-being of local communities, and contributing to the ongoing environmental and farming challenges discussions.

Capacity Building for Sustainable Water Resources Management- Lesson from Lake Nyasa - BWB

Masaka Y. Maganga

masaka.maganga@tetratech.com

Eng. Masaka Yusufu Maganga is a registered professional Engineer with over 25 years' experience in the water sector. Eng. Maganga has vast knowledge in capacity building to Water Institutions including Water Boards Basins in collaboration with public and private partners in the water sector across the East African Countries (Kenya, Uganda, and Tanzania). Currently, Eng. Maganga is a Water Resource Management Team Lead for USAID/MUM project, responsible for leading a team of experts working on Technical Assistance with a focus to improve water resources management in the three Basins of Rufiji River, Lake Nyasa and Rukwa BWBs.

Abstract

The implementation of Water Resources Management capacity building plan remains insufficient in many cases. In addition to an inadequate institutional basis for governance and participation, it is often the lack of necessary competences, which lead to unsustainable activities. Existing knowledge concerning on capacity areas and associated gaps must be continuously passed on, adapted, and extended to capacity building development. This involves both the people who use the water as well as the organizations and companies supplying it. In the end, the determining factors are the surrounding social conditions. Therefore, improvements in water resources management can only succeed as part of a multi-level campaign. In this respect, the capacities of individuals, institutions, and

society to appraise, revise and implement the available options are of vital importance. The process of extending existing competence, strengthening skills, learning from experience, generating new knowledge, and then identifying and addressing water-related problems can only be tackled in a comprehensive manner. The generic term for all these facets is Capacity Development. Capacity Development plays a key role in target/problem-oriented findings and the sustainable implementation of the capacity building results. Accompanying targeted, customized Capacity Development plan, ensure that:- local authorities and stakeholders receive all needed information, knowhow and training for decision making processes with regard to the meaningful deployment of the developed technologies and management tools; local capacity increases receiving further trainings in operation and maintenance of facilities or further training on academic level with regard to sustainability beyond project ends and local population is properly taken into account to enhance public awareness and change behavior with a view to future essential skills and abilities. Lake Nyasa is one of the three Basin Water Basins (BWBs) under the USAID/MUM's five years project facilitating the Government of Tanzania to expand and sustain the provision of water and sanitation services by increasing access to sustainable water services, increasing access to finance for water, sanitation, and hygiene, strengthening the market for the sanitation products and services and strengthening basin water boards and water user associations (WUAs) for the stewardship of water resources. The focus of the project is to strengthen the capacity of Basin Water Boards (BWBs) and Water User Associations (WUAs) to adopt and implement a catchment-based approach that protects and guarantees availability to clean and safe drinking-water sources for both rural and small-town communities. The catchment-based approach underscores emphasis by USAID that water resources management interventions contribute directly to the sustainability of water supply schemes supported in the MUM districts in Rufiji, Lake Rukwa, Nyasa, and Tanganyika Basins. This paper shares USAID/MUM experiences on the successive application of sustainable capacity building in creating

momentum and holistic changes for improved water resources management in the Lake Nyasa Basin.

Proposed CBWSOS Monitoring and Assessment Modality - Lessons from Ongoing Monitoring and Assessment Of UWSAs

Issa Y. Osena

issaosena@yahoo.com

	Eng. Issa Osena, is a Tanzanian Civil Engineer, with over 30 years' experience in Rural and Urban Water Supply and Sanitation Systems in Tanzania. He is registered by the Engineers Registration Board of Tanzania -ERB(T) as Independent Consulting Engineer and is a Senior Member of the Institution of Engineers Tanzania (IET).

Abstract

In the mid1990s, the Government of the United Republic of Tanzania through the Ministry responsible with Water introduced Urban Water Supply Departments and latter Urban Water Supply and Sanitation Authorities (UWSAs) and implemented vigorous and systematic monitoring and assessment of the UWSAs. As the UWSAs struggled to adhere to and meet the set guidelines and targets, there have been much improvement of the UWSAs in terms of water production and demand curbing, network expansion and service coverage, service billing and revenue collection, water quality management and overall service provision. In comparison, the situation is still not so appealing in the rural water supply schemes managed

by Community Based Water Supply Organizations (CBWSOs). This paper puts forward a feasible CBWSOs Monitoring and Assessment Modality, being a simplified form of the Annual Assessments of UWSAs by Energy and Water Utilities Regulatory Authority (EWURA). The Modality will provide a quick guided glimpse to the performance of all CBWSOs, and handy periodic data for further situational analysis and

determination of appropriate improvement measures by the Rural Water Supply and Sanitation Agency (RUWASA). The performance ranking, as in the case of the UWSAs, will stimulate strife for better performance among the CBWSOs MoW and RUWASA are hereby recommended to implement the proposed modality as a positive contribution towards attainment of the national water and sanitation service provision goals.

Factors Affecting the Performance of The Community-Based Water Supply Organisations (CBWSOS) In Katavi Region, Tanzania

Peter Raymond Ngunula
The Open University of Tanzania
Email: ngunula@yahoo.com or **peter.ngunula@ruwasa.go.tz**

	Eng. Peter R. Ngunula, is registered engineer working under RUWASA as a Regional Manager for Katavi. He hold a BSc in Civil and Water Engineering from the University of Dar es Salaam, postgraduate studies from UNESCO-IHE, Institute for Water Education, in the Netherlands, 2011 and Master of Business Administration at the Open University of Tanzania, 2023.

Abstract

This study assessed the factors affecting the Performance of Community-Based Water Supply Organizations (CBWSOs) in managing water supply schemes in Katavi rural areas. An inductive approach and exploratory design were employed in this study. The study population comprised 48 respondents, comprising the region's management team and supervisory board members of selected CBWSOs. Data was collected through one-on-one In-depth interviews, field observation and literature reviews. The findings revealed firstly, financial management was identified as a critical aspect, emphasizing the importance of community participation in the collection of funds. Secondly, Regular infrastructure maintenance is essential for water supply reliability. Thirdly Positive political influence involves securing funding and resources, creating a supportive regulatory environment, promoting community engagement, and advocating for the

interests of CBWSOs. In contrast, negative political influence hinders decision-making processes and neglects the responsibilities of supporting and overseeing CBWSOs. Lastly, community awareness was identified as a significant factor. Community participation in the collection of funds fosters financial sustainability, a sense of ownership, responsible resource utilization, and transparency. Based on these findings, some of the recommendations and policy implications proposed include supporting financial sustainability, establishing a regulatory framework for infrastructure maintenance, minimizing negative political interference, promoting community awareness and participation, providing capacity building and implementing a monitoring and evaluation framework.

POSTERS

Assessment of the Suitability of Groundwater in Kigamboni, Tanzania for Domestic and Irrigation Purpose Using Multivariate and Water Quality Index Analyses.

Magori Jackson Nyangi[1.]
Department of Water Resources, Water Institute, P.O Box 35059, Dar es Salaam, Tanzania
magoojack@gmail.com

Abstract

Groundwater is a critical water source supporting over 2.5 billion people globally and accounting for 43% of water used for irrigation worldwide. In this study, the suitability of groundwater quality in Kigamboni, Dar es Salaam, Tanzania for drinking and irrigation purposes was assessed. Groundwater samples were collected from 25 boreholes and analyzed for physical chemical, and bacteriological parameters. Water quality index (WQI), sodium adsorption ratio (SAR), percentage of sodium (Na %), magnesium hazard (MH) and permeability index (PI) were used to evaluate groundwater suitability for drinking and irrigation purposes. Also, Pearson correlation coefficient, Piper diagram, Multivariate analysis was used to assess the groundwater quality. Results indicated that groundwater in the study area is characterized by concentration of cations in the order of $Na^+ > Ca^{2+} > Mg^{2+} > K^+$ and anions $Cl^- > CO_3^{2-} > HCO_3^- > SO_4^{2-}$. Groundwater in the study area is predominantly characterized by Na–K–Cl water type signifying influence of seawater intrusion. Furthermore, 44% and 12% of the groundwater samples were considered unsafe for drinking and irrigation purposes, respectively. This study recommends that groundwater in the study area can be used for drinking purposes with minimal treatment at household level and be used for irrigation purposes to support plant growth.

Assessment on the Potential use of *Pisum sativum* pods (pea pods) as a Natural Coagulant in the Treatment of Polluted Surface Water

Leopord Sibomana Leonard and Regina Winston Kapina
School of Engineering and Environmental Studies (SEES), Department of Environmental Science and Management, Ardhi University, P.O. Box 35176, Dar es Salaam, Tanzania.
Corresponding author: siboditz1@gmail.com

Abstract

Conventional drinking water treatments systems are unsuitable at household level due to high cost associated with chemicals and environmental concerns. Thus, this study aimed at assessing the potential use of *Pisum sativum* pods as a natural coagulant in treating polluted surface water. Water samples was collected from Kizinga river, transported in 20 jerrican to Ardhi University for analysis. Initial analysis indicated that water samples had turbidity of 475 NTU and elevated concentrations of iron, ammonia, fecal coliform and total coliform above Tanzania drinking and WHO standards. Pea pods was characterized using XRF and contained 8.49% proteins and 33.38% carbohydrates. The coagulation-flocculation process was done by using a jar tester model PHPPS AND BIRD 700 and the turbidity of water was varied from 150NTU, 300NTU and 500NTU so as to assess the performance of the pea pods in different turbidity levels. The optimum dosage for maximum turbidity removal was established after 12 hours settling time using 5mls of pea pods at 1% stock solution. achieving 97.3% removal efficiency and performed better in neutral to alkaline than in acidic conditions (pH of 7 to 9) though there were no significance differences in removal efficiency at various pH values as the P-value was 0.059. The use of pea pods

indicated a promising application in treating drinking water with high turbidity and hence can be adopted by households in treating drinking water.

Dietary Compositions of Four Estuarine Fish Species in The Wami and Pangani Rivers

Theresia J. Lyasenga*[1], Prosper L. Mfilinge[2], Daniel A. Shilla[3], John A.M. Mahugija[1].

[1]Chemistry Department, University of Dar es Salaam, P. O. Box 35061, Dar es Salaam, Tanzania.

[2]Ministry of Water (MoW)–Ubungo Maji, P. O. Box 9153, Dar es Salaam, Tanzania.

[3]School of Aquatic Sciences and Fisheries Technology, University of Dar es Salaam, P.O. Box 35064, Dar es Salaam, Tanzania.

Email: teddylyasenga@gmail.com

Abstract

The study aimed at the assessment of diet compositions of the four estuarine fish species; Arius africanus, Epinephelus coioides, Pomadasys argenteus and Silago sihama in the Wami and Pangani River estuaries by using stomach content method. The results showed that the diet compositions in the two river estuaries in terms of volumetric proportions of the food items were varied, with Pangani having a high percentage vacuity index (%VI). Permutational multivariate analysis of variance (PERMANOVA) revealed significant interspecific variations in diets throughout the fish species (Pseudo-F = 21.007; p = 0.001) and among the river estuaries (pseudo-F = 4.14; p = 0.002). These variations correlate with the results of similarity of percentage (SIMPER). Therefore, it is critical for estuarine fish species to have distinct feeding habits in order to reduce resource competition and support the coexistence of various fish species in their respective trophic niches. Additionally, a change in diet along with growth are expected to provide species with a variety of resources, increasing the likelihood of maintaining large populations for sustainability in the fisheries industry. Consequently, responsible

authorities should consider improving conservation techniques of these crucial feeding grounds.

Estimation of groundwater recharge variability using a GIS-based Distributed Water Balance WetSpass Model in Makutupora Basin, Tanzania

*Clarance P. Kisiki[1], Tenalem Ayenew[2], Ibrahimu C. Mjemah[3]

[1*]Water Institute, P.O. Box 35059, Dar es Salaam, Tanzania Email: clara1113@yahoo.com

[2]School of Earth Sciences, College of Natural and Computational Sciences, Addis Ababa University P.O. Box 1176, Ethiopia.

[3]Department of Geography and Environmental Studies, Sokoine University of Agriculture, P.O. Box 3038, Morogoro, Tanzania

Abstract

This study aims to apply the WetSpass model to estimate the seasonal (dry and wet) and annual groundwater recharge for the Makutupora basin. Data required for this study were biophysical (topography, land use, soil, slope, and depth to the groundwater) and long-term hydro-meteorological data (2000-2020). Data were obtained through field visits and disk transfer from institutions and websites. Hydro-meteorological data were prepared for dry and wet seasons. Raster maps were prepared in ArcMap 10.4 using the Inverse Distance Weighting (IDW) interpolation method followed by resampling into a 200×200 m grid size, thereafter converted from raster to ASCII format suitable to input in the WetSpass model. The findings indicated that more recharge was dominating in the wet season ranging between 0-120 mm/year with a mean value of 24.65 mm (99%) while less recharge occurs in the dry season ranging between 0 to 4.35 mm/year with a mean value of 0.24 mm/year (1%) and annually recharge ranges between 0 to 120.88 mm/year with a mean value of 24.88mm. Mean annual precipitation for twenty (20) years records was 694 mm/year out of which recharge accounted for 3.6%, surface runoff 33.9% and evapotranspiration 62.5%. The groundwater table receives total average

volumetric recharge of 37.3 million m^3 annually from precipitation in the entire basin area. The results of this study are useful in sustainable management plans, it may also be used as a benchmark for water supply authorities, policymakers and researchers to set a proper protection measures and pumping policies.

Keywords: Groundwater recharge, Makutupora basin, Water balance, WetSpass model, Tanzania

Factors Affecting Irish Potatoes Production during Short-rainy Season among Small-holder Farmers in Tanga Region

Ng'wiza M. Madundo & Siamarie Lyaro*
Email: hildamadundo@gmail.com

Irish potato is the largest non-cereal food produced worldwide by small-holder farmers. This paper seeks to analyse factors affecting Irish potatoes produced during short-rainy season by small-holder farmers in Tanga region, Tanzania. The paper applied data obtained from the National Sample Census of Agriculture for the 2019/2020 agricultural year. Findings showed that quantity harvested correlated positively with area planted, seed cost, and planting cost but correlated negatively with quantity of fertilizer used. Furthermore, results showed that seed cost, and quantity of fertilizer used were significant factors affected output of Irish potatoes produced. Lastly, production of Irish potatoes demonstrated increasing returns to scale, thus output increases in a greater proportion compared to increase in inputs. Generally, findings highlight the need for small-holder farmers to develop strategies for increasing productivity of Irish potatoes to at least 6.0 tons/hectare, which is the national average, in order to improve their return on investment.

Keywords: Production, Correlation, Multiple regression

The Role of Water Resources Management in Ensuring the Food Security in Tanzania

Joseph J. Nakomolwa

josephnakomolwa@gmail.com

Abstract

Water resources management play vital role in enhancing the presence of food security in the country**.** By conservation of water resources like springs, rivers etc. it helps the farmers to practice irrigation activities especially in schemes and hence this contributes to large production of various crops and hence ensure food security. Objectives of water management is to ensure all members of ecosystem in the environment have sustainability and hence reduce the water stress. Also, good practices of water management protect the biodervisity which have the important chain in the food context. Different Approaches could be used to transfer technologies in the relation to water management for food or crop production, among them is education Approach through mass media on importance of water sources conservation. Another approach is dissemination of rain water harvesting technology especially to farmers so as farmers get to know the detailed knowledge on this system hence increase the production of food throughout the year especially during dry season. Good transboundary management of water sources around the country helps to reduce unnecessary conflict among farmers within the country and neighborhood country and hence this management helps to increase food production since there is good transboundary management. Findings of the water resources management in the relation to the food security shows that the use of precision agriculture in which water management is practiced can help farmers to get enough food throughout the year. It is concluded water resources management play great role in

ensuring food security of the country since it help farmers to practice agricultural activity in all seasons.

Keywords: Transboundary, irrigation, crop production

Analysis Of Spatial Distribution Physiochemical Parameters to Evaluate the Drinking Water Quality Around Large Scale Mine in Tanzania

Musiba M. Musiba[1]* and Mwemezi J. Rwiza[2],
[1]Department of Water Resources Management, Water Institute, P.O. Box 35059 Dar Es Salaam, Tanzania
[2]School of Materials, Energy, Water and Environmental Sciences (MEWES), The Nelson Mandela African Institution of Science and Technology (NM-AIST), P.O. Box447 Arusha, Tanzania
*Corresponding author. E-mail: musiba.musiba@waterinstitute.ac.tz

Abstract

The study used the hydro-chemical characteristics and water isotopic signatures to understand the distribution and sources of water quality deterioration around the mining area. The chemical and isotopic signatures of water resources were used to understand the origin, flow pattern, and residence times of water resources. Samples located downstream, western side of the mine tailings dam were slightly acidic with pH as low as 4.6 and enriched with stable isotopes. Samples with elevated concentrations of Na^+, Cl^-, SO_4^{2-} and NO_3^- could not be isotopically linked with the local geochemistry. Thus, revealing that evaporation process and anthropogenic effects controlled the observed water chemistry and water quality deterioration. The low pH values could be associated with mining activities around the areas. The isotopic results indicated the water vulnerability to one recent contamination that could be attributed to near-surface anthropogenic activities mainly mining. The water quality deteriorated spatially along the water flow path downstream and pollutants-carrying water flow from eastern to the western side of the study area. The study concludes that groundwater recharge from recent local precipitation may have an impact on the sources studied. The use of shallow dug out wells should be minimized and proper boreholes siting should be emphasized.

Keywords: Anthropogenic activities, Isotopic signature of water, Mining sites, Water quality deterioration

Rural Water Clustering: The Case for Community-Based Water Supply Organisations in Tanzania

Tulinave B. Mwamila

Water Institute, Ministry of Water, P.O. Box 35059, Dar es Salaam, Tanzania

mtulinave@gmail.com / tulinave.mwamila@waterinstitute.ac.tz

Abstract

In Tanzania sustainability challenges in the water sector has led to recent sectoral reforms including enactment of the Water Supply and Sanitation Act No. 5 (URT 2019), which have included transformation of Community Owned Water Supply Organisations (COWSOs) to Community Based Water Supply Organisations (CBWSOs) and clustering recommendation for commercial viability improvement of Water Supply and Sanitation Authorities (WSSAs) and CBWSOs (MoW, 2019). Thus, given the government's decision to move towards a clustering approach, we now need to understand how best to do to implement clustering to attract professional service providers, consolidate diverse communities and systems, and improve efficiency and reach across Tanzania. This study aimed at establishing factors leading up to successful clustering.

Keywords: Rural water supply services, Community Management Models, Clustering.

Water Institute,
P. o. **Box 35059,**
Dar es Salaam
TeL: 0735900907