ENCLIMAH 2022

ENVIRONMENT, CLIMATE CHANGE AND HEALTH CONFERENCE

HYBRID (IN-PERSON AND VIRTUAL)

OCTOBER 12 and 13, 2022

INSTITUTE FOR ENVIRONMENT AND SANITATION STUDIES (IESS)
UNIVERSITY OF GHANA, LEGON

IN COLLABORATION WITH

RAIN & C2R-CD Coastal Community Resilience to Climate and Diarrhoea

PROJECTS

BOOK OF ABSTRACTS

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INTRODUCTION

The environment faces myriads of challenges including rapid loss of forest cover, reduced availability and quality of drinking water, species extinction and loss of biodiversity, to mention few. Globally, 3.2 billion people are affected by land degradation, and it is estimated that 95% of the Earth's land area could become degraded by 2050 (GEF, 2022). Many assessments of global environmental change have painted a consistent negative picture of the state of the global environment and of the impact of human activities. Climate change in particular is identified as a critical global challenge whose impacts are already evident. In the midst of global environmental challenges, global crisis of chronic diseases and failure of public health to stem the rise in highly preventable risk factors have left populations vulnerable to acute health emergencies such as COVID-19. In today's tightly connected world, a disease threat anywhere is a disease threat everywhere. There is therefore the need to sync efforts and share information if humanity is to survive and overcome the various daunting global challenges.

The "Environment, Climate Change and Health (ENCLIMAH) Conference" therefore seeks to bring together researchers, academics, policymakers, private sector and civil society groups to discuss and share ideas, research findings and innovative models on relevant issues of development on the thematic areas of the conference as outlined below. Poster sessions would be held in parallel. A plenary session will climax the event. The 2-day conference will also feature a panel discussion on "The Climate-Sanitation-Health Nexus: Policy Implications". Day 1 of the conference will take a hybrid form (In-person and virtually on ZOOM). Day two of the conference will be held entirely on zoom. Key themes covered include the following:

- Water resources research and management
- Waste management and the circular economy
- Sanitation, health systems and climate resilience
- Climate change and Environment
- GIS techniques and applications

University of Ghana

The University of Ghana (UG) was founded in 1948 as the University College of the Gold Coast. The current student population stands at about 60,000. See more on UG at https://www.ug.edu.gh/.

Conference Highlights

- Over 35 oral and poster presentations covering the general conference topics
- Keynote addresses and statements by Policymakers and University Leaders
- Panel discussion with accomplished academics and experts
- A plenary highlighting key presentations and the way forward
- Selected papers from the conference will be published in a special issue of West African Journal of Applied Ecology (WAJAE)

There would be a special symposium by the Coastal Community Resilience to Climate and Diarrhoea (C2R-CD) project on Day 1 (Wednesday, October 12, 2022, at 12:00 noon) to share findings with stakeholders and discuss district-level actions necessary for coastal community resilience to climate change and diarrhoea.

The C2R-CD is transdisciplinary research aimed at building resilience to climate change and improving diarrhoeal management in coastal communities in Ghana. The partnerships for the project are made up of the Academia (the University of Ghana, IESS leading with other units, Aarhus University, Denmark), Civil Society Groups (Peoples Dialogue on Human Settlements), and Government Agencies (the Ghana Environmental Protection Agency, Municipal assemblies of study communities).

Acknowledgements

We are highly indebted to the following for their diverse contribution to the success of the conference:

- Prof. Kwasi Appeaning Addo, Director of the Institute for Environment and Sanitation Studies (IESS) for his inspiration and leadership.
- All reviewers of abstracts and manuscripts for the conference.
- All participants for their contribution to the conference.
- All session Chairs for the able manner they chaired the sessions.
- Mr. Prosper Adiku, Ms. Cecelia Datsa, Mrs. Millicent Acheampong and Ms. Blessing Lanyo for IT support, preparing background material, and for assisting in the conference planning.
- The Coastal Community Resilience to Climate and Diarrhoea (C2RCD) project for funding support.
- The “RAIN Project-Sustainable Technologies and services for adaptation to climate change in flood and drought endangered Settlements in Ghana”, for financial support.

We take this opportunity to welcome all of you to our HYBRID conference. May you enjoy the conference on our beautiful campus and also virtually on ZOOM.

Dr. Samuel S. Koranteng
Dr. Daniel Nukpezah
Dr. Adelina Mensah
Dr. Philip-Neri Jayson-Quashigah

Accra, October 6, 2022

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SESSION 1

Water Resources; Ecosystem Services

Session Chairs

Dr. Daniel Nukpezah &

Dr. Benedicta Fosu-Mensah

Predictors of Stakeholders' Willingness to Participate in Payment for Ecosystem Services among Urban Water Users in Accra, Ghana

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Abstract

Ecosystem services are the benefits that people receive from nature. They play an important role in the socioeconomic well-being of local communities. Climate change, urbanization, population increase, and land degradation all contribute to severe ecosystem degradation. More stakeholder participation in ecosystem conservation is becoming increasingly important. Although payment for ecosystem services is well-known in many parts of the world, its use and adoption in developing countries is still restricted. The purpose of this study was to explore how socioeconomic characteristics influenced stakeholders' willingness to participate in payment of ecosystem service for long-term water supply in places where water supply instability is already a major developmental concern. We surveyed 400 downstream water users of the Densu basin in the city of Accra, Ghana. Our result show that only 39.3% of the total respondent surveyed were willing to pay for ecosystem services with majority not willing. A chi-square test further revealed that respondents' age, education, kind of work, and income levels were all significant factors of their willingness to participate in the payment for ecosystem services at 0.05 significant level. Respondents' willingness to pay for ecosystem services was prioritized on the availability and quality of urban water supply, as well as ensuring efficient resource management. The majority's hesitancy was however fuelled by a lack of trust in the management of such funds, a high cost of living, and a lack of alternative sources of income. This necessitates increasing the credibility of resource management institutions and ensuring a broader range of stakeholders' engagement in the development of inclusive community co-management initiatives that can contribute to a win-win situation for ecosystems and improved community living standards.

Keywords; Predictors, Payment for Ecosystem Services, Predictors, Stakeholders, Willingness

The Design and Construction of a Portable Water purification System Model Using Locally Available Materials

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Abstract

Accessibility to a constant supply of pipe-borne water in many rural areas of Africa is challenging, especially for people living with poor or no piping system. Meanwhile, requirements for clean water usage has become very relevant especially in the wake of Covid-19. Hence, teaching, learning, and understanding of water treatment is very key and requires the practicality of its operation to clearly understand the processes involved in water purification. This study explains the processes, development, design and testing of a simple, portable water purification system, and examines the effect of water purification processes on water quality. Two different sources of water (rainwater and water from the Volta River) was used in testing the performance of the portable water purification system. The designed model was based on the standard engineering design process. Sieve analysis was performed to standardize the sand media to obtain an even sand and a desired flow of water to enable effective filtration. Six (6) water quality parameters monitored during treatment were pH, Colour, Turbidity, Total Hardness, Calcium Hardness and Magnesium Hardness. The study design output is a portable 23 kg-three stage raw water purification system consisting of a raw water tank, sedimentation tank, filtration tank and a final water tank on a 0.5 m^2 platform, capable of improving raw water quality for pH, Colour, Turbidity, Total Hardness, Calcium Hardness and Magnesium Hardness within World Health Organization (WHO) and Ghana Standard Authority (GSA) thresholds. The model is therefore recommended for teaching, learning and rural household water purification.

Keywords: Model, Covid-19, design, construction, water quality

Uncontrolled Landfills and Ground Water Quality: The Case of Nsumia Waste Disposal Facility

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Abstract

The Insumia Waste Facility is an active dumpsite located in the Ga West Municipality of the Greater Accra region which receives waste from various parts of Accra as well as the Nsawam enclave. Residents in the surrounding communities have complained about the waste facility affecting the quality of their potable groundwater sources which they suspect are responsible for some of their health challenges. Questionnaires were therefore administered to solicit their opinion on the dumpsite and its activities. Samples of groundwater were collected around the dumpsite over a period of six months and Physico-chemical quality, bacteriological quality and heavy metal content of the groundwater in the area analysed in order to determine the quality indices of the groundwater. Levels of NO_3-N, EC, BOD, Fe, Ni, Cd and Pb exceeded WHO permissible limits for drinking water. The water samples from both hand-dug wells and boreholes recorded a very high-Water Quality Index of 801 and 475.76 respectively, which are indicative of water unsafe for drinking. High levels of Pb in the water sources (hand-dug well =1.0 mg/L; Borehole = 0.06 mg/L) were essentially responsible for the high WQIs. Furthermore, the bacteriological quality of hand-dug well did not meet the WHO standards. It was inferred that leachate infiltration into groundwater was responsible for the contamination of groundwater sources. The perception of the community members that the waste dump is responsible for the pollution of their groundwater sources and by extension, some of the water-related illnesses and skin diseases resulting from use of these waters cannot therefore be overlooked and require further investigations.

Keywords: Water quality index, Groundwater, Heavy metals, Solid waste, Insumia

Assessment of Water Purification Potential of Activated Carbon from Coconut Waste for Domestic and Commercial Use

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Improper waste management and lack of potable water remain two major problems faced by Ghana. The inefficient management of waste, typically organic waste by means of open burning and dumping in unauthorized places has left the country in a state of despair. Also, the lack of access to safe, clean and treated potable water, typically in rural areas, remains of public health concern. As such, this study sought to upcycle coconut waste into Activated Carbon (secondary product) for the purification of water for domestic and commercial use. Waste coconuts were obtained from the University of Ghana, Legon Campus, pyrolyzed, and activated whereas water samples were obtained from the effluent of the Legon Waste Water Treatment Plant, Birim River, and Oboadaka River. A mixed method was employed by gathering quantitative data from the analysis of the activated carbon produced and the quality of water samples, pre- and post-treatment with the activated carbon made. Qualitative data was also collected from focus group discussions organized, analyzed and inferences made. Results obtained reflects the efficiency of activated carbon for treating polluted water and the subsequent uses to which the water can be put.

Keywords: Waste management, Activated Carbon, Upcycle, Water Quality

Strengthening Climate Change resilience in Ghana by combining numeric and water management models

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Temperatures in Ghana will rise in the future significantly whilst changes in precipitation patterns seem uncertain with a moderate decrease following latest climate projections. In retrospect, however, heavy rainfall events and associated surface runoff increasingly led to high socio-economic damage, and a continuing trend in the future seems likely. The RAIN project combines a drought and flood early warning system with an organisational water management for Nabogu and Sakumono. By integrating simulated flood and dry spells into water management, climate change related vulnerabilities can be detected and reduced. Remote sensing techniques, GIS applications, different numeric and water management models were used to simulate long-term evolutions of the local boundary conditions under climate change aspects in order to evaluate their influences in correlation with urbanisation and uncontrolled settlements. The analyses revealed a trend towards increasingly prolonged droughts which will put pressure on ecosystems. The increase in heavy rainfall events will lead to more devastating floods, which in turn will result in greater socioeconomic damage due to the settlements in flood-prone areas. Strategies are developed for sustainable management and use of water resources as ponds, wetlands and rivers in the catchments of Sakumo River and Nabogu River. The risks identified in this process are used for the development management strategies.

Keywords: Climate change impact and adaptation; Water resources research and management; Land use and Land degradation; Environmental pollution and control; GIS techniques and applications

Assessing the pollution risk of potential harmful elements in surface water. A case study of the Matjhabeng Mining area, South Africa

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Gold mine tailings contaminants may be a significant source of pollution to surface water. Physical water quality properties, potential harmful elements (PHEs), and pollution risk indices were assessed to determine the level of pollution of surface water bodies, the source, pathway, and the receptors of such pollution in the Matjhabeng Mining case study area. Principal Component Analysis (PCA) was applied to determine if the PHEs were from a similar source in the environment. The results revealed that surface water in the Matjhabeng Mining area was highly polluted, as evident by the low levels of DO in the water, high pH, EC, and turbidity levels. Concentrations of Cu, As, Co, Fe, and Zn were above the limits for surface water protection at some of the sampling sites. The Single factor pollution index and the Nemerow integrated pollution index results confirmed moderate pollution by arsenic, with exceptionally high pollution levels for Se. Such pollution of surface water poses a risk to the aquatic organism and the local community. The PCA results accounted for 94.5% of the total variance with eigenvalues greater than 1. The presence of Co, Cu, Ni, Zn in PC1 and Pb, Cr, Fe in PC2 strongly suggest a common anthropogenic origin. The third PC consisted of Se, while the fourth was comprised of As and Mg. The results revealed that several contaminants found in surface water could have originated from gold mine tailings. Nature-based solutions, including constructed wetlands are required to mitigate surface water pollution in the area.

Keywords- gold mine tailings; pollution risk; potential harmful elements; nemerow integrated pollution index; single factor pollution index

Floating treatment wetlands as a nature-based solution addressing water quality challenges in water infrastructure - a case study in South Africa

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Water availability is not the largest threat to a reliable water supply in South Africa; rather, it is the pollution of available water sources. The advancement of eco-technology or nature-based solutions can help solve various planetary health related issues associated with anthropogenic impacts and contribute significantly to maintaining ecosystem health by addressing problems with water quality, community support and development and biodiversity. Floating treatment wetlands are a type of artificial constructed wetland treatment system that can be applied as a powerful tool in water infrastructure to restore habitat and biodiversity, treat contaminated water, create bio-intelligent landscapes, re-instate ecosystem services and address pollution. Four floating wetlands, ranging in size from 10 to 30 square meters, were designed, constructed and deployed on several dams in the Johannesburg area, South Africa. More than 200 indigenous species with known phytotechnological qualities were planted in the floating treatment wetlands. The study was supported by selected greenhouse trials to investigate the phytoremediation properties of various plants. The study's findings pointed to a number of important variables that influence the overall effectiveness and diffusion of floating treatment wetlands as a nature-based solution addressing water quality challenges in water infrastructure.

Keywords: Floating treatment wetlands; water quality; water infrastructure, phytoremediation; nature-based solutions; ecosystem services

Biochar filter reduces surface water contamination in Ghana: A field study

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In this study, biochar (BC) was evaluated as a filter material for treating surface water contaminated with wastewater to produce safer irrigation water. Different BC were investigated in laboratory column tests for more than 8 weeks. Based on the results, the most suitable BC was selected and tested in a two-stage BC filtration pilot plant (BCFP) during a two-month field study in Ghana. The BC were evaluated for their efficiency in removing turbidity and pathogenic indicator bacteria such as *E. coli*. Laboratory tests with diluted wastewater showed that among BC prepared from cocoa shells, maize cobs, and maize straw, the highest mean removal rate of 2.7 log-units for *E. coli* was achieved by BC prepared from maize cobs. The BCFP, consisting of a coarse filter of 4-8 mm maize cobs BC and a fine filter of 1-4 mm maize cobs BC, was operated with water from the Onyasia River spiked with wastewater to approximate the concentration of pathogens during dry season. The BCFP assessment showed that a 90% reduction in turbidity was achieved (mean effluent turbidity 2.5 NTU). *E. coli* was found in the influent with an average concentration of 5.4E+04 CFU/100 mL, which was reduced to an average effluent concentration of 3.1E+03 CFU/100mL, complying with WHO monitoring levels for leaf crops and drip irrigation for high-growing crops. The average elimination of *E. coli* was 1.5 log-units, demonstrating significant retention during this field study. These results indicate that BC is a potential filter material to treat contaminated water for irrigation.

Keywords: polluted surface water, biochar filter, pathogens, irrigation water, field study

SESSION 2

Waste management and the Circular Economy

Session Chairs

Dr. Opoku Pabi &

Dr. Benjamin Ofori

Modeling the Amount of Waste Generated by Households in the Greater Accra Region using Artificial Neural Network

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Abstract

Waste can be defined as solids or liquids unwanted by members of the society and meant to be disposed. In developing countries such as Ghana, the management of waste is the responsibility of the Metropolitan Authorities. These authorities do not seem to have effective management of the waste situation and therefore it is not unusual to see waste clog the drains and litter the streets of the capital city, Accra. The impact of the waste on the environment along with their associated health related problems cannot be overemphasized. The Joint Monitoring Programme report in 2015 ranked Ghana as the seventh dirtiest country in the world. The lack of effective waste management planning is evident in the large amount of waste, dumped in open areas and gutters that remains uncollected. In planning for solid waste management, reliable data concerning waste generation, influencing factors on waste generation and a reliable forecast of waste quantities are required. This study used two Artificial Neural Network algorithms, namely Levenberg-Marqardt and the Bayesian Regularization algorithms to develop a model to critically assess the factors that influence solid waste generation in some selected districts of the Greater Accra Region. The study found the Bayesian regularization algorithm to be the most suitable and house size, districts, employment category, dominant religion and house type were found to be the top five important input variables required for forecasting household waste. It is recommended that efforts of government and its stakeholders be targeted to reduce the amount of waste generated through recycling.

Keywords: Artificial neural Network, Waste Generation, Households, Algorithms

Solid Waste Collection and Disposal Methods: The case of a Sub-urban Community in Koforidua, Ghana

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Abstract

Solid waste management has been a major concern for many developing cities due to rapid population growth and infrastructural development, resulting in increased waste generation and higher demand for waste management resources and solutions. The study was aimed at assessing household solid waste disposal options and practices and also assessing the mode and frequency of solid waste collection and disposal. The research gathered data from preliminary field investigations, questionnaire surveys and structured interviews. The key findings established factors such as logistical constraints on the part of the Assembly, inadequate funds for the Assembly to effectively function, inadequate human resource base for the Assembly to function, inaccessible road networks within some parts of the community, attitudinal problem by residents of the community and lack of education and awareness regarding solid waste management. The research recommended the adequate supply of logistics, regular collection of waste, concerted and collective effort among stakeholders to sustainably deal with the problem and support from Government and other private and corporate institutions.

Keywords: sanitation, waste collection, waste disposal, sub-urban, sustainable

Industrial Ecology Practice among Selected Enterprises in the Agro-Food Value Chain in Ghana

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Abstract

Industrial food waste is detrimental to the environment, people and profits. To mitigate this, studies recommend enhancing the practice of Industrial Ecology (IE), where material and energy flows are circulated within and among industries to minimise waste. However, IE studies and adoption in Africa is low, and in Ghana, largely undocumented with few focusing on a single firm. This research employs the mixed method approach, applying input-output and material flow analyses to investigate by-product reuse and interdependency within and among enterprises, and model an Eco-Industrial Network (EIN) for enterprises along the agro-food value chain in Ghana using Stan2web, a material flow analysis tool. It determined that, although 88% of enterprises have knowledge on interdependencies, only 78.86% practised it at firm level, while 53.89% practised it across enterprises. The noticeable synergy was between food and non-alcoholic beverage industries, and the waste management industry, for the manufacture of compost. Overall, only 7.7% of respondents have identified useful by-products from others, partly attributable to concerns among consumers over waste by-product reuse especially for the production of edibles. However, 25% and 78.8% indicated their willingness to pay for useful by-products and enhance interdependency, respectively, underscoring opportunities to deepen by-product exchanges. The study modelled an EIN, mapping synergies among enterprises. The synergies revealed that establishing a waste water treatment and steam and/or biogas plants would be essential to transitioning towards circularity, in addition to incentives from regulators. This study contributes to literature by noting IE in Ghana and opportunities to enhance interdependencies.

Keywords: Industrial food waste, Input-Output Analysis, Material Flow Analysis, Modelling, Eco-Industrial Networks (EIN).

Towards Industrial Ecology: An Assessment of Environmental Practices within the Plastic Industry in Accra, Ghana

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Abstract

Industrialisation over the years has come with it some dire consequences on the environment, including global warming, and deforestation which require immediate action to tackle. However, long-established management objectives of industries have concentrated on economic benefits; viewing environmental and social issues as having less significant benefits. Amplified environmental awareness over the last few decades has resulted in the development of policies and pushed industrial businesses to address environmental concerns, leading to the development of concepts such as industrial ecology. Mimicking nature, industrial ecology seeks to close the loop by reducing waste and using waste as a resource. The plastic industry is one whose effects on the environment cannot be overemphasized. The study, therefore, assesses corporate environmental practices implemented by plastic-producing enterprises in Accra, Ghana that align with industrial ecology principles. Employing methodological triangulation, data obtained from 18 plastic-producing enterprises within the Accra and Tema metropolis in Ghana was analysed quantitatively and supported with qualitative data. The study found that enterprises engage in environmental practices such as material and energy efficiency, adoption of sustainable technology and environmental management systems (EMS), and use of recycled materials. The study also found that, 5 enterprises representing 27.8% had identified by-products of other industries that can be useful to them, 4 of which were willing to pay for such by-products for production. To a large extent, industrial ecology principles of roundput, locality and diversity were found to be imitated in plastic-producing enterprises in Accra, Ghana.

Keywords: Industrial Ecology, Recycling, Roundput, Environmental Practices, Plastic

Cleaning From the Bottom Up: Formalizing the Informal Waste Workers in Ga-East Municipality, Accra, Ghana

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Abstract

Informal waste workers play an important role in solid waste management in cities especially in developing countries. However, their contributions to city wide waste management and environmental sustainability in general are unrecognized. The LIRA project on Cleaning from the bottom up: integrated stakeholder engagement, sought to facilitate the regularization of the activities of the informal waste collectors (IWC) within the Ga-East municipality, Accra. A transdisciplinary research method was employed to collect data at the stakeholders' level, using purposive sampling technique. Selected key stakeholders from the Municipal Assemblies, Borla Taxi Associations, CSOs, market women were involved in the study. Non-scientific skills employed for this engagement included skills for community engagement, conflict resolution, team building and tools such as the mass media and social media platforms were used to solicit public views on the subject and for dissemination of project information. The study findings revealed a strong support from all stakeholders for formalizing the informal waste collectors in the municipality. Out of 376 questionnaires administered, (59%) patronized the services of the informal with collectors and of which 60% ranked their works as good. Out of those who patronize the services, 80% support their legalization on the reason of having their activities monitored, identification and tax purposes and the fact that their services are crucial. Issues raised from expert interviews and focus group discussions bordered on availability of waste dump sites, training, and monitoring of activities of IWC, identification and provision of security for IWC and contracting IWC by municipal assembly for hard-to-reach areas of the municipality. The project activities led to the regularization of the IWC as a co-operative, the first within the Ga-East municipality. It is recommended that the Municipal Assembly considers the needs of IWCs and factor them into their Municipal Environmental Sanitation Strategy and Action Plan (MESSAP).

Keywords: Informal, waste workers, Ga-East Municipality, Formalizing, Borla Taxi

Assessing the Effectiveness of Concession Waste Collection and Private Sector Involvement in Waste Management from a Developing and Developed Nation Perspective

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Abstract

Developing nations, like Ghana, face developmental challenges when it comes to the collection and disposal of solid waste. The private sector's involvement has become necessary in a concerted attempt to address this situation for the purpose of improving the waste management service delivery. However, it is important to note that the management of solid waste has not improved. In developing nations, the problem of inefficiency in the approaches adopted by the government and private sector continuously bloats the costs involved in managing solid waste, increase in sanitation related health problems and the inability of individuals to develop a culture of handling and disposing of waste properly. On the other hand, governments of developed nations have been able to partner private sectors and are delivering efficient, and reliable waste collection and disposal services. The study examines the approaches to waste collection in both a developing and developed country contexts where lessons are drawn from the latter. A mixed method is used in collecting data in the Ga East Municipal Assembly, Ghana, and only qualitative method (expert interviews) in Tubingen, Germany. The results of the study revealed differences in the modalities to private sector involvement in waste collection and disposal services and shed light on activities that yield effectiveness and efficiency in service delivery. Also, Standard modes of operations, acknowledged performance indicators and approved monitoring and evaluation techniques have been suggested to aid in future research and decision making in waste management across the world.

Keywords: Waste management, Private sector, Public-private partnership, Concession, Effective waste collection

Implementing Household-level Waste Segregation in Ghana: Lessons from a Developed Country

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Abstract

Waste management is considered a global challenge in recent times due to increasing urban growth and modernization. Waste is being championed as a resource, allowing for recycling and energy recovery. This requires the preservation of waste materials from contamination as much as possible through waste segregation at the source, especially at the household level.

The health and economic consequences associated with poor waste management are intensifying especially in developing countries. The inability to practice waste segregation among households hinders sustainable waste management. Developed countries, however, record high rates of recycling and energy recovery to save these materials from being wasted. The study examines the waste segregation situation in the developing and developed country contexts to draw lessons for the former. A mixed method was employed in collating data in Kpone Katamanso Municipal Assembly, Ghana, and Rottenburg, Germany. Key informant interviews and questionnaire surveys were held for staff at the Environmental Sanitation Unit and residents of both communities under study respectively. In addition, the regulatory framework underpinning waste management in both areas was reviewed. The results of the study among other things exposed loopholes in the regulatory framework and provided suggestions for improvement where needed. This study has enriched the literature on the implementation of household-level waste segregation and provided insights for developing countries especially, to implement and promote waste segregation and improve waste management.

Keywords: Waste segregation; Recycling; Household; Developing country; Developed country

Analysing the Perception of Consumers on Upcycled Products – The Case of Chairs made from Waste Tyres

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Abstract

In recent times, plastic pollution has gained global recognition due to its effect on the environment including both terrestrial and marine ecosystems. Notable among them include waste tyres which are key environmental polluters. Every year, a billion waste tyres are generated nonetheless altering consumption patterns by purchasing upcycling products has the potential to substantially reduce emissions across national borders. Although 17 Sustainable Development Goals (SDGs) target the most pressing issues in this world, only one indicator (Goal 14.1.1) expressly addresses minimising the impact of plastics. Focusing on the hospitality industry (hotels, restaurants and beach and seafront facilities) and domestic consumers as case studies and using a mixed-method approach this research analyses the perceptions of consumers about upcycled chairs made from discarded car tyres. The Contingent Valuation Method (CVM) was adopted to examine the environmental and health risks of waste tyres while exploring and understanding the factors underpinning the willingness of consumers to patronize chairs made from waste tyres. The SWOT analysis was also employed to examine the profitability and marketing strategies of green businesses within the upcycling industry. Findings showed that purchasing power played a crucial role in influencing the willingness of consumers to purchase green products. The adoption of circular practices promotes sustainable consumption by minimizing the negative consequences brought on by excessive resource production and consumption.

Keywords: chairs, circular economy, plastic pollution, upcycling, waste tyres

SESSION 3

Sanitation, Health Systems and Climate Resilience

Session Chairs

Dr. Ted Annang &

Dr. Benjamin Botwe

Global Health: An Analysis of Vaccine Diplomacy in the Era of COVID-19

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Abstract

This paper analyses the relationship between sovereign states (bilateral) and or among states (multilateral) in pursuit of their national interest or foreign policy. One means of such inter-state relationship is through the exchange of ambassadors between and or among states. States' interests are diverse and diplomacy takes different forms such as military, economic, social, cultural, technological, and medical diplomacy among others. One of the most crucial aspects of states is to ensure their citizens and people resident in their states are healthy for strategic reasons including saving medical costs, budgetary savings, and use of resources for other purposes than medical expenditure. As a result, some states adopt preventive healthcare rather than curative. Thereby rendering and providing more preventive measures in their healthcare systems and less curative healthcare services. The world has been faced with several epidemics and pandemics centuries ago. In November 2020 a viral disease was discovered in Wuhan China which became known as the novel coronavirus disease 2019 (COVID-19). The disease was declared a global pandemic in March 2020 by the World Health Organization (WHO). One of the best ways out of this global pandemic is through vaccination with the hope of attaining herd immunity. Thus, this introduces the politics of vaccines in terms of manufacturing, and distribution, while some states have more access to vaccines, others do not have any access or little access. In this regard, this paper attempts to find out if there is nexus between vaccine diplomacy and global health security of states.

Keywords: Vaccine diplomacy, COVID-19, global health security, WHO, Ghana

Sanitation Response During the Covid-19 Pandemic

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Abstract

The Accra Metropolitan area was described as a hotspot during the covid-19 pandemic. This area has many informal settings and slums, with all the inefficient waste management facilities and sanitation challenges. Since the onset of the outbreak of Corona virus pandemic in Ghana, Environmental sanitation and hygiene has gained prominence as a prevention control strategy. Governmental efforts have been increased towards sanitation in public places. The onset of the lockdown on the 30th of March 2020 came with it, mass cleaning and fumigation of markets, provision of hand hygiene equipment and decongestion of markets to promote social distancing. On the 20thApril 2020, the lockdown was lifted to promote socio-economic stability of the county while battling the pandemic. A social survey was conducted in two public markets namely at Tema Community 1 and Dome. Market women totaling 160 were randomly selected to investigate how people responded to basic sanitation during the partial lockdown, ascertain the level of readiness of Ghana to handle sanitation issues and to describe the waste management situation in the selected markets. The findings revealed that before lockdown 76.5% of respondents did not sanitize their hands but during the partial lockdown 90.4% began to use sanitizers. Approximately 60% of respondents believe the waste management situation in the market has not changed post pandemic. Again, 15% of respondents dispose their waste at the main dumpsite at the market, with the others either selling the waste or dropping it in their own bins. The study also indicated that 98% of respondents still had access to toilet facilities during the partial lockdown as they did prior to the pandemic. These findings seem to suggest that market areas can provide sanitation services in emergency situations.

Keywords: waste management, sanitation, covid-19, emergency, disease outbreaks

Climate Change and Diarrhoea: Exploring Risks and Multilevel Adaptation Approaches

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Abstract

The impact of climate change on human health is adding further burden to the global diseases. There has been re-emergence of infections due to climate change. In Africa, these diseases are referred to as climate-sensitive diseases and include diarrhoeal illness and typhoid. Climate-related events including droughts, heat waves, floods, tropical storm, and wildfires have caused alteration to the ecosystem, disruption of food and water supply, infrastructure damage and increased human mortality. There is a consensus of climate change especially in coastal communities, however, what is not clear is how communities are adapting as far as their health and diarrhoeal diseases are concerned. A case study approach was used to investigate how residents of three coastal communities in Ghana perceive the impact of climate change on diarrhoea diseases. The study employed household questionnaire surveys, focus group discussions (FGD) and key informant interviews to obtain a comprehensive understanding of communities and households' risks and adaptation measures. The study findings demonstrate high levels of participants' knowledge and awareness on the nexus between climate change and diarrhoea prevalence and its implication on livelihood systems. Findings reveal that approximately 70% of respondents believe there is not adequate information on climate related hazards whilst a further 80% confirm they do not receive information concerning hazards that can cause diarrhoea at all. More than half of respondents (51%) admit the best medium for information dissemination is the information centre. There ought to be more, and regular climate related and diarrhoea information made available to enhance adaptation within households and community members.

Keywords: Coastal, Communities, Diarrhoea, Diseases, Resilience

Spatio-temporal Evolution of Diarrhoea in Coastal Ghana: Understanding the Evidence for Action

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Abstract

Coastal areas are nerve centres of economic activity and high populations, the area is vulnerable to anthropogenic and climatic impacts including coastal erosion and flooding with implications for community resilience. Diarrhoea-causing pathogens are affected by weather conditions; infections warmth, humid weather, and moist soils, incidence differs with respect to time and the unique conditions prevailing at the specific location. Poor WASH conditions resulting from limited infrastructure, unacceptable waste management, and open defecation further expose the populations in the area to water-borne diseases such as diarrhoea. Strategising a response for managing these risks must be informed by scientific evidence to be effective. This research focuses on evaluating the relevance of climatic variables to the onset and evolution of diarrhoea along the coast of Ghana. With a combination of statistical and social science-related methods in an integrated geospatial model, diarrhoea risk scenarios and visualisation of the spatial and temporal distribution of diarrhoea risks will be generated for the eastern coast of Ghana. This study will promote community resilience, and forms essential components of efforts aimed at achieving the SDGs targets on water-borne diseases (target 3.3); equitable sanitation and hygiene (6.2); integration of climate change measures into policy and planning (target 13.2) for effective response to climatic impacts in coastal areas. Long-term **s**cenarios of diarrhoea risk distribution will bridge diarrhoea policy and SDG target gaps, and inform decision-making for effective adaptation and management within the context of Ghana's four-pillar priorities for sustainable development.

Keywords: Climate Change, Decision-making, Diarrhoea, Policy, Scenarios

Prevalence of Diarrhoea in Selected Coastal Communities in Ghana

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Abstract

Introduction: Diarrhoea is a preventable disease affecting children under five years disproportionately. Globally, thousands of children die from diarrhoea related diseases each year. Coastal communities bear the greatest brunt due to poor sanitary conditions. We assess the prevalence of diarrhoea in selected coastal communities along the eastern coast of Ghana.

Methods: We conducted a cross-sectional study in Mumford, Opetekwei, Anyako, Anyauni and Ateteti communities in the Central, Greater Accra and Volta region respectively. We interviewed households with children under five years on the occurrence of diarrhoea and health seeking practices. We also used a checklist to assess the sanitary conditions of the household. Frequencies and proportions were generated. We determined significant differences using at $p<0.05$. Results were presented in tables and charts.

Results: The prevalence of diarrhoea was 36.1% (250/692), most were from Mumford. All interviewed households in Mumford and Opetekwei used improved water sources whiles more than 90% in Anyako used unimproved water sources. Households with improved water sources had 90% reduced odds of having diarrhoea compared to those who used unimproved water sources. Whiles those with improved sanitation facilities had 80% reduced odds of having diarrhoea compared to those with unimproved water sources. Fully vaccinated children had 80% reduced odds of having diarrhoea compared to those who were not.

Conclusion: Though diarrhoea prevalence was high, majority of households in the communities had access to improved water sources and sanitation facilities. We recommend in-depth analysis of water use and other factors that might be responsible for the high diarrhoea incidence observed.

Keywords: Diarrhoea, prevalence, water source, sanitation facility, households

Assessment of Water Supply, Environmental Sanitation and Hygiene Practices among Selected Communities along the Coastal Communities of Ghana

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Abstract

Safe drinking water, sanitation, and hygiene (WASH) are fundamentals to reducing poverty, promoting equality and supporting socioeconomic development. Also, for better physical health, environmental preservation, and the protection of lives lived with decency, as well as gender equality. About 1.1 billion people lack access to safe drinking water, and 2.6 billion without adequate sanitation, the magnitude of the water and sanitation problem remains significant (UN, 2015). This study sought to analyse and measure the quality of drinking water, and to understand the epidemiology and transmission pathways of diarrhoea through water, sanitation and hygiene, along the eastern and central coastline of Ghana. Questionnaires were also administered to members in Mumford, Opetekwei and Anyako to obtain information on their attitude and perceptions on waste, hygiene and diarrhoea. The selection of sampling sites in the study areas was based on the vulnerability of the areas to flood incidents, poor waste management, improper waste disposal and poor personal hygiene in the communities. The water quality analysis was employed to provide empirical data on drinking water qualities and to understand the levels of deterioration in water quality. The parameters of which samples were taken and analysed, included Chemical, Physical and Microbiological. The collected data were entered into Excel spreadsheet and summarized using table, percentages and mean. Additionally, the Pearson correlation coefficient and t-test were used to analyze the association between various drinking water parameters and detect significant variations among biological parameters in different water storage tanks to determine the difference between before and after storing water.

Keywords: Water Supply, Environmental Sanitation, Hygiene, Coastal Communities

Erosion Dynamics along the Central Coast of Ghana: A case study of the Ekumfi and Gomoa West Districts

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Abstract

Globally, shorelines are constantly changing in response to sea level rise and other natural and anthropogenic forces. As sea levels continue to rise, coupled with intense wave action and anthropogenic activities, coastal erosion challenges increases. This poses a threat to the sustainability of livelihoods of vulnerable coastal dwellers and coastal infrastructures. This study analyzed shoreline change rates for the low-lying Ekumfi and Gomoa west districts along the Central Coast of Ghana, which contribute significantly to the region's economy but are experiencing erosion. Historical shoreline change for the area was assessed using shoreline positions extracted from 2005 orthophoto, as well as 2016 and 2021 planet satellite images. For the 16 years period, the results show that the region is eroding at varying rates with an average erosion rate of -1.24 m/yr which dominates 87 percent of the beach whiles 10 percent of the beach is accreting. Relatively higher rates (-3.72 m/yr) are recorded along the shoreline fronting the Mumford township as a result of the construction of a new fish landing site for artisanal fisherfolks in the area. The structure is trapping sediment updrift and depriving the downdrift of sediment. The results confirm the impacts of these hard engineering structures on shorelines and recommends a review of the use of hard engineering structures along the coasts. Adopting an Integrated Coastal Management Plan will go a long way to protect the Coast of Ghana.

Keywords: Ghana, Ekumfi district; Gomoa West District; Shoreline dynamics; Coastal erosion

SESSION 4

Climate Change and Environment

Session Chairs

Dr. Jesse Ayivor &

Dr.Philip-Neri Jayson-Quashigah

Complexities of Livestock Greenhouse Gas Mitigation in Climate-smart Villages of Ghana

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Abstract

The livestock sector plays an important role in climate change representing 14.5% of human-induced Greenhouse Gas (GHG) emissions. In the face of climate change, the livestock sector must be redefined to adapt and mitigate climate change. It is more important to prioritize livestock sector climate-smart interventions due to the sector's significance in economic growth and as a source of sustainable livelihood for most people worldwide. Using farm-level data from climate-smart villages in Ghana, the study analysed Climate-Smart Agriculture (CSA) adoption on the GHG account of livestock management. The study established that CSA adoption reduced cattle enteric emissions up to (52.8 kg CO2e head-1, $P<0.05$) and emissions from cattle manure management (7.7 kg CO2e head-1, $P<0.05$). However, in several of the livestock management activities, emissions increased after CSA adoption. It was also found that farmers relied on highly fibrous ingredients including *Andropogon gayanus*, *Ficus species*, *Afzelia species and Pterocarpus evinacelus* which resulted in higher enteric fermentation emissions from cattle, goats and sheep. The study concludes that the complexity of livestock management requires targeted CSA practices such as improved livestock feeding, changing breeds of large ruminants and concentrated supplementation to reduce GHG emissions from livestock.

Keywords: Emissions, Greenhouse gas, livestock, climate smart, intervention, mitigation

Cocoa Production in the midst of Local and Global Environmental Change: An institutional study of Ghana's Cocoa Sector

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Abstract

The contribution of the cocoa sector to the development of Ghana since its introduction over a century ago has been enormous, transcending social, economic and cultural spheres of life. Due to its significance, successive governments have initiated policies to boost production including the mass spraying, and distribution of fertilizers to farmers. Research institutions have also been established to scientifically study into developing new varieties that are resistant to pest and diseases and produce high yield per acreage. The aim of this work was to assess cocoa production from its earliest period in the country to the current local and global environmental conditions impacting agriculture in general. The work is a literary piece relying solely on secondary data sources like peer reviewed journals, annual budget statements, annual reports by COCOBOD, and books to generate graphs, build patterns and to draw conclusions and make recommendations. It was found that, although cocoa continue to be the major cash crop of the country, it faces a number of challenges from other land use activities particularly small-scale gold mining occurring in many areas of cocoa production and competition from other cash crops like palm oil and rubber. As global environmental challenge like climate change makes amount and duration of rainfall more unpredictable, developing drought resistant and water loving varieties could be very useful for farmers to adapt to the changing circumstances. Institutions set up to improve the cocoa value chains, have played important role in advancing the production of the crop, although due to the new challenges identified, their ingenuity would be needed now than ever if the crop is to continue to have any significance in the developmental process of the nation. It was recommended that, investment into the sector be enhanced to attract the youth and to ward off competition from other land use activities in key production areas.

Keywords*:* cocoa, institutions, climate change, small-scale mining

An analysis of Nigeria's Freshwater Fishes' Susceptibility to Climate Change

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Abstract

Freshwater fish are extremely susceptible to climate change due to anthropogenic drivers within the coastal area. The current paucity of quantitative data on status and dispersal for the majority of fish species requires the logical aptitude of the researcher combined with secondary data to estimate the present and future susceptibility of freshwater species to climate change in Cross River State, Nigeria. Baseline and climate change susceptibility levels were estimated for 50 native and 10 non-native fish species each. Compared to their non-native counterparts, native species have a higher baseline and climate change susceptibility. While all non-native species were categorized as being either less or least susceptible to extinction, more than 50% of Cross River State's native freshwater fishes were found to have critical or high baseline susceptibility to extinction. Only 10% of non-native fish were categorized as highly susceptible to climate change, compared to 85% of native ones. It was also discovered that native fishes that require water temperatures of less than 20 °C are more likely to become extinct in favour of non-native species that can survive a wider range of temperatures. Only a few non-native species would suffer from the loss of aquatic habitats brought on by the destruction of mangroves, severe sporadic droughts, and the physiologically demanding circumstances prevalent in most rivers during extreme weather events. The findings of this study could set conservation priorities in Cross River State and many other areas in Nigeria and elsewhere.

Keywords: anthropogenic drivers, climate change vulnerability, extreme weather events, native and non-native freshwater fish, resilience

Catch per Unit Effort of the Bobo Croaker (*Pseudotolithus elongatus*) in the Face of Climate Change

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Abstract

Research on the impact of climate change on fisheries has intensified in recent years, with many reports conveying low catch rates as global temperature increases. In the present study, samples of the bobo croaker (*Pseudotolithus elongatus*) were obtained from fish landings of the artisanal gill net fisheries of the Cross River estuary, Nigeria. Seasonal and annual variations in catch-per-unit effort (CPUE) of the bobo croaker were determined for 11 years (2010–2020). To estimate catch rates and simulate future catch trends, von Genuchten and Hatton's growth model was used. Results revealed that the mean monthly CPUE ranged from 5.53 kg in January to 9.40 kg in July, with the highest annual mean of 9.21 kg in 2010 and the lowest mean of 6.83 kg in 2020. Seasonal data revealed a lower mean CPUE (6.23 kg) in the dry season and a higher mean CPUE (9.24 kg) in the wet season. Furthermore, the catch rate was reduced at a rate of -5.36% per year in the dry season as against -1.53% per year in the wet season. Future projections with dry season data showed an alarming catch deficit of 0.87 kg in 2035, tending towards a collapsed fishery. These results reveal that the fishery is under pressure from overfishing, exacerbated by long-term climate change. Based on this finding, management measures are urgently needed for the conservation and recovery of this fishery. It is important to consider climate resilience with a timely response to anthropogenic drivers among the regulatory measures for this fishery.

Keywords: climate change, croaker fishery, Cross River estuary, fishery collapse, resilience

Variables of Flood Risk Dimensions among Households in Greater Accra Metropolitan Area

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Abstract

Understanding determinants of flood risk dimensions is a pre-requisite to undertake comprehensive disaster risk reduction management. The Sendai framework on Disaster Risk Reduction expect communities to understand the complex contextual socio-hydrometrological interactions and the specific variables driving flood risk for a successful flood risk management programmes. Extant studies aver that flood disasters are recurrent in Sub Saharan African countries including Ghana. Meanwhile there is paucity of studies on determinants of flood disaster risk among Sub Saharan Africa countries. This study assesses relevant variables constituting flood risk in Greater Accra Metropolitan Area (GAMA), Ghana. Questionnaires were developed from relevant variables for exposure, sensitivity, hazard and vulnerability dimensions for flood risk. Survey was conducted randomly for households in GAMA. Households were geolocated using Geographical Information System. The risk analysis was based on the risk analytical formula for the IPCC Fifth Assessment Framework. Principal Component Analysis was conducted to determine the dimensions and variable contributions for exposure, sensitivity, hazard and adaptive capacity for flood risk. Vulnerability recorded an index of 0.76 while sensitivity and adaptive capacity scored a mean values of 0.42 and 0.65 respectively. With a range of to 0.52 to 0.93, vulnerability interacted with mean exposure of 0.81 and hazard of 0.84 to account for a mean flood risk of 0.52 and a range of 0.21to 0.77. It is recommended that measures are put in place to reduce flood risk.

Keywords: flood risk, hazard, vulnerability, sensitivity, adaptive capacity

Climate Change Archaeology of/in Ghana: Possibilities and Prospect

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Abstract

Because the relationship between man and the environment lies at the core of research in the past and present, it can offer crucial lessons for today's climate change research and discourse. Archaeological practice has several practical implications for climate scientists regarding the impact of man on the environment and how the environment has shaped past and present social and political organization. A good engagement between climate scientists and archaeologists will afford an integrated approach to natural and cultural heritage in Ghana, which is needed for sustainable development. This paper draws on some archaeological examples to make a sensitization call to Ghanaian climate scientists to consider active engagement with archaeology for sustainable environmental conservation and climate change discourse and practice.

Keywords: climate change, sustainable conservation, archaeological practice, sustainable development, environment

Land Reclamation Gap in Small-scale Gold Mining Areas and its Consequences on Safety and Land uses; the Case of Atiwa West.

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Abstract

Since its legalisation in the late 1980's, artisanal small-scale gold mining (ASGM) activities and their impact have permeated almost every facet of both the natural and human systems that existed beforehand. The most conspicuous environmental imprint of the activity has been landscape alteration and the seeming lack of action to remediate it. Meanwhile, the destruction of land affect the wellbeing of local people. The aim of this paper is to examine the impact of land reclamation gap on future land uses and implication on safety of locals in ASGM communities. In all, thirty gold mining sites spread across Atiwa West District were observed for the study. Qualitative data using interviews and focus group discussions (FGDs) were collected in three communities with relatively long history of ASGM; Abomosu, Awenare and Pameng. The data acquired was triangulated with Landsat 8/Landsat 7/ETM+ multi-temporal imagery data obtained spanning three decades (1990-2000. 2000-2010, 2010-2021). The results show that over 70% of the sites visited were not reclaimed, while some of the reclaimed lands were dotted with water-filled pits limiting future land uses. The imagery shows a generally depleted primary forest and a robust land-use/land-cover change from forest to agriculture to the current land use of ASGM interspersed with steadily growing towns and villages over the period. It was concluded that, in the face of such rapid ecological and social change, land reclamation needs to be key component of ASGM activities to make land available for other activities long after the gold has been exhausted. It was recommended that, institutional collaboration be enhanced to bring disciplinary action including revocation of license, and/or prosecution of operators who fail to do proper reclamation.

Keywords: land, reclamation, land use, ecosystems

Comprehensive Assessment and Spatial Distribution of Heavy Metals in Gold-mining Communities in Ghana

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Abstract

Heavy metal exposure to humans has significantly increased due to its wide-ranging sources in the occupational and domestic environment, and thereby increasing its investigative interest in the scientific community. Heavy metal poisoning could result from contaminated drinking water or intake through the food chain (ingestion), high ambient air concentrations (inhalation) and absorption by the skin (dermal contact). Persistent exposure to some heavy metals can results in gradual degeneration of physical, neurological and muscular functions, which can increase the risk of multiple sclerosis, Parkinson's disease, Alzheimer's disease, muscular dystrophy and cancer. Technological advancement, an overall increase in population and high demand for mineral elements are some of the factors that have given rise to ecological exposure to heavy metals. Small scale illegal mining has risen, in addition to the legal small- and large-scale mining, even though the government has made several attempts to ban the illegal mining activities in the country. Available literature on heavy metals contamination at mining communities in Ghana is limited in terms of location and the array of heavy metals determined. The study therefore focused on a comprehensive analysis and spatial interpolation of heavy metals in soils from seventy mining communities in Ghana using Energy Dispersive X-ray Fluorescence (EDXRF) and ArcGIS respectively. Twenty-one (21) heavy metals were obtained from the multi-elemental analysis across the study area. Maps indicating the hotspot of various heavy metals contamination were produced.

Keywords: Mining communities, Heavy metals, spatial distribution, Ghana, Comprehensive

Exposure of the Ghanaian Population to Potentially High Levels of Aflatoxins through the Consumption of Maize and Groundnuts

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Abstract

Aflatoxins are highly carcinogenic mycotoxins and important natural contaminants of a wide range of crops, particularly maize and groundnuts. The widespread contamination of aflatoxins in major staples poses substantial public health risks. Notwithstanding the widespread exposure, research data and public knowledge on aflatoxins in the population remains low. Food crop analysis for aflatoxins is primarily restricted to export commodities, leaving millions exposed to potentially considerable levels of toxins. In this study, we report a comprehensive analysis of aflatoxin content (AFB1, AFB2, AFG1, AFG2) in 303 samples comprising 165 samples of maize and 138 samples of groundnuts from markets, homes and storage centres in 8 regions across Ghana. The extraction of aflatoxins was done using a methanol/water mixture, cleaned up using an immunoaffinity column and analyzed using HPLC. Aflatoxins were present in 81% of maize samples, ranging from 0.20 to 1129.7 µg/kg. In groundnut samples, aflatoxins were present in 74% of samples, with concentrations from 0.20 to 1242.9 µg/kg. Aflatoxin B1 occurred in the highest concentrations in both crops and was present in 49% of maize and 25% of groundnut samples at concentrations that exceeded the Ghanaian standard of 10 µg/kg. Our study suggests potentially significant exposure of the population to aflatoxins, with some of the country's highest concentrations and prevalence rates ever reported.

Keywords: Aflatoxins, mycotoxin, Maize, Groundnut, carcinogen

Managed Aquifer Recharge (MAR) in mitigation of climate change while limiting environmental impacts

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There is a growing need for water security by a growing population. Climate variability and climate change has a negative impact on water security. Groundwater has greater resilience during droughts and provides more efficient storage than dams. MAR are used worldwide to increase groundwater storage and water supply. The processes between the infiltration point or injection site and the site where abstraction takes place is not well known. Little is known about the potential impact of MAR on the environment. The MARSA project will investigate both these questions. Column experiments will be carried out in the laboratory to determine the level of natural attenuation that takes place during infiltration. Source water of different qualities would be used for the experiments, providing the range of water qualities that may be used for MAR, without contaminating the natural groundwater system. Alternative sources of water for the MAR process may include storm water, treated effluent and untreated surface water. The experiment should also provide an indication about pretreatment requirements. The experiment will be repeated in a test site at the Langebaan Road Aquifer Unit on the West Coast of South Africa. Monitoring of wetlands in the study area are carried out, to ensure that we have sufficient baseline data. This will provide us with reference data against which the potential impacts of the in-situ experiment can be measured. The lessons learned from this protect will be implemented in policy around MAR projects and implemented in other MAR projects.

Keywords: Managed Aquifer Recharge (MAR); coastal aquifer; wetlands; water supply security; climate change.

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