The 3rd Meru University of Science and Technology

International Conference

On

# SCIENCE IN THE SERVICE OF CLIMATE ACTION

Meru, 26th to 28th June 2024

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| **ORGANIZED BY:** | Meru University of Science and Technology |
| **IN CONJUCTION WITH:** | National Research Fund (NRF), PanAfrican Climate Justice Alliance (PACJA), Co-operative Bank, Three Steers Hotel, Alba Hotel Institute of Engineers of Kenya (IEK) and The African Journal of Science, Technology and Social Sciences (AJSTSS) |
| **KEYNOTE SPEAKER:** | Dr. Beatrice Muganda Inyangala<br>Principal Secretary, State Department for Higher Education and Research |
| **VENUE:** | Meru University of Science and Technology, Main Campus |

# CONFERENCE PROCEEDINGS

# 3rd Meru University of Science and Technology International Conference (MUSTIC 2024) Conference Proceedings

**Editors:** Zacharia Chiliswa, Amos Omamo and Ruth N. Gibendi

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# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

## VICE CHANCELLOR'S SPEECH

Ladies and gentlemen,

It is my utmost pleasure and honor to welcome you all to the beautiful city of Meru, Kenya, as we gather here today for the Third International Conference of Meru University of Science and Technology (MUSTIC 2024). Under the theme "Science in the Service of Climate Action," this conference provides a crucial platform for intellectual exchange, collaboration, and exploration of innovative ideas that will shape our future. I extend my warmest welcome to our distinguished guests and delegates from around the world. Your presence here today reflects the shared commitment to forging a brighter future for all.

Over the course of this conference, we will delve into significant sub-themes that capture the breadth and depth of the challenges we face. From agriculture, food security, safety, and bio-security to business, economy, and society, we will explore the intricate interplay between human well-being and environmental sustainability. Climate change, with its pressing demands for adaptation, mitigation, and resilience, will take center stage as we seek innovative solutions for a sustainable planet.

At Meru University of Science and Technology, we are proud to demonstrate our commitment to combating climate change through active participation in key initiatives. Currently, our students are taking part in the two-week long Nairobi Summer School at Chuka University, organized by the Pan African Climate Justice Alliance (PACJA). This involvement not only enriches their knowledge and skills in climate action but also underscores our dedication to fostering a generation of leaders and innovators who are equipped to tackle the pressing environmental challenges of our time. Our Sanitation Research Institute is a beacon of innovation, converting waste into usable products and contributing to a circular economy. Moreover, our commitment to environmental stewardship is evident in our University's forest cover, which stands at 14%, significantly above the national average of 10%. These initiatives reflect our dedication to creating a sustainable future through science and technology.

To our dear partners, National Research Fund (NRF), Pan African Climate Justice Alliance (PACJA), Cooperative Bank, Kenya Commercial Bank, Three Steers Hotel, Alba Hotel, Institution of Engineers of Kenya (IEK) and African Journal of Science and Social Sciences (AJSTSS), we could not have done this without you. I take this opportunity on behalf of the MUST family to say, Thank You. We offer our deepest gratitude for the immense support accorded to us. Your contribution is the backing we require to maintain a firm foundation anchoring our researchers and innovators as they come up with the solutions we need. Thank you for investing in a better tomorrow and believing in our vision to be a center of Excellence in Research and Innovation. Be rest assured that your contribution has been put to good use. MUSTIC is bigger than all of us and we want to ensure that it serves the world even after us. That is the impact we are striving for.

This is also the right time to remind members of the Meru University community the importance of research in the University. Given the fourth industrial revolution which is technology based, research has been made easier and more accessible. It is now easier to connect to researchers from

all over the world with the increasing presence of all nations on the world wide web making the world a global village. There are now more efforts towards making research findings easily accessible through open access platforms. This is a great time to be alive as knowledge of all types in all disciplines is available at the click of a button on your computer.

I would like to therefore urge us to embrace the research agenda. It is our duty to give our students the best guidance so that they become great researchers. We can take a leaf from the global trend where members of the academia enhance the capabilities of their learners through leading by example. For intellect should be seen in everything that we do, including how we guide our students in the usual courses and in research.

Moreover, I am pleased to share that this conference is not only an intellectual endeavor but also an opportunity for edu-tourism. Meru University of Science and Technology, nestled in the picturesque landscapes of Meru, offers a unique blend of academic excellence and natural beauty. We encourage all participants to explore the wonders of our region, immerse themselves in the rich cultural heritage, and forge new connections that will endure beyond this conference.

In conclusion, I extend my deepest gratitude to all the organizers, sponsors, and partners who have worked tirelessly to make this event a reality. Your unwavering commitment to research, innovation, and sustainable development is an inspiration to us all.

May this conference be a catalyst for transformative ideas, fruitful collaborations, and lasting impact as we seek solutions to the climate agenda. Together, let us embark on this journey of exploration, innovation, and progress in the post-COVID era.

Thank you, and I wish you all a successful and enriching conference ahead.
God bless you all.

**Prof. Romanus Odhiambo, Ph.D.**
Vice Chancellor
Meru University of Science and Technology

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| 8. Caroline Karani<br>Elizabeth Kamolo | **Nursing:** Harnessing Nursing and Health Systems to mitigate the effects of climate change. |

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# THE 3rd MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

# CONFERENCE ON SCIENCE IN THE SERVICE OF CLIMATE ACTION

*Meru, Kenya*
*26th to 28th June 2024*

VENUE: MAIN CAMPUS, NCHIRU

**Conference Sub-themes**

**Agriculture:** Sustainable Agro-ecological practices for climate resilience

**Business and Economics:** Sustainable Entrepreneurship in Business & Economics for climate resilience; Carbon Credit Markets: Business Strategies for Climate positive impact.

**Computing and Informatics:** Leveraging Computing and informatics Technologies for Climate adaptation and resilience

**Education:** The role of social science and/ or educational institutions in climate change mitigation; Training for skills and competencies to mitigate climate change in education systems.

**Engineering:** Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

**Health Sciences:** Climate Change and Public Health; Response and Impact of environmental changes on Health.

**Nursing:** Harnessing Nursing and Health Systems to mitigate the effects of climate change.

**Pure and Applied Sciences:** Climate change prediction for nature-based innovations on biological conservation and resource management; Climate smart technologies and innovations on infrastructure development and land-use practices; Climate change resilient human activities and development

# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

## CHIEF GUEST'S ADDRESS

**Dr. Beatrice Muganda Inyangala, Ph.D**
Principal Secretary, State Department for Higher Education and Research
MINISTRY OF EDUCATION



Good morning and welcome to the MUSTIC2024 Conference, hosted by the Meru University of Science and Technology. It is an immense honour to join you today as the chief guest for this prestigious event. Our theme, "Science in the Service of Climate Action," is not just timely but crucial as we navigate the complexities of our rapidly changing world.

Climate change is undoubtedly one of the most pressing challenges of our time. It transcends borders and disciplines, requiring a united and multi-faceted approach. This conference, with its diverse sub-themes spanning Agriculture, Business, Computing, Education, Engineering, Health, and more, exemplifies the comprehensive effort needed to address climate change.
Here in Kenya, the government is acutely aware of the vital role that research and higher education play in addressing climate change. Our universities and research institutions are at the forefront of developing innovative solutions and fostering the next generation of leaders equipped to tackle these challenges.

Agriculture and Food Sciences are at the forefront of this battle. Sustainable agro-ecological practices are essential for building climate resilience. Our farmers, equipped with scientific knowledge, can turn the tide against the adverse effects of climate change, ensuring food security for future generations. The Ministry of Education, in collaboration with agricultural institutes, is committed to integrating climate-smart agriculture into our curriculum and research initiatives.
In the realm of Business and Economics, sustainable entrepreneurship and carbon credit markets offer innovative strategies for a climate-positive impact. Businesses must evolve, adopting models that not only drive profit but also contribute to the health of our planet. The Kenyan government is actively supporting green business practices through incentives and policy frameworks aimed at promoting sustainable economic growth.

Computing and Informatics technologies provide powerful tools for climate adaptation and resilience. From predictive models to real-time data analysis, these technologies enable us to respond swiftly and effectively to climate-related challenges. Our universities are developing cutting-edge programs to harness these technologies, ensuring our students are at the forefront of digital innovation in climate science.

Education plays a pivotal role in climate change mitigation. Our educational institutions must focus on training individuals with the skills and competencies needed to address climate issues. Social sciences offer insights into behavioural changes necessary for a sustainable future. The Ministry of Education is dedicated to embedding climate education across all levels of learning, ensuring every student understands their role in combating climate change.

In Engineering and Architecture, the development of sustainable infrastructure and sanitation systems is critical. Innovative designs and technologies can create urban environments that are resilient to climate impacts. Our engineering schools are leading research into sustainable construction practices and green technologies, contributing to the development of climate-resilient cities.

Health Sciences highlight the intersection of climate change and public health. Understanding the impact of environmental changes on health allows us to develop responsive strategies that protect and promote community well-being. Kenyan health institutions are conducting vital research on climate-related health risks and developing interventions to safeguard public health.
Pure and Applied Sciences contribute to climate change prediction and the development of nature-based innovations. These scientific endeavours are crucial for managing biological conservation and resource management, ensuring that our natural world can withstand and adapt to climate changes. Our universities are pioneering research in this field, advancing our understanding and capacity to mitigate climate impacts.

Finally, in Nursing, we recognize the significant role that health systems play in mitigating the effects of climate change. Nurses are often on the front lines, addressing health issues exacerbated by environmental changes and advocating for sustainable practices within healthcare. The Ministry of Health, in collaboration with educational institutions, is strengthening nursing programs to include climate health resilience.

As we embark on this journey over the next few days, I encourage you all to engage in meaningful discussions, share your research, and collaborate on innovative solutions. Let us harness the power of science and education to drive climate action and build a resilient future for all.

Thank you, and I wish you a productive and inspiring conference.

# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

## CHAIRMAN OF COUNCIL'S ADDRESS

**Prof. JAMES IRERI KANYA, Ph.D**



Good morning and a warm welcome to the MUSTIC2024 Conference. It is my privilege to address you as the Head of the Council of Meru University of Science and Technology. Our theme, "Science in the Service of Climate Action," underscores the critical role that scientific inquiry and innovation play in addressing one of the most urgent challenges of our time.

At Meru University, we are dedicated to being a beacon of academic excellence, providing transformative education that empowers students to make a global impact. This conference aligns perfectly with our goals, integrating scientific research and education into practical solutions for climate resilience. Climate change impacts every aspect of our lives, and this conference brings together experts from diverse fields to explore comprehensive solutions. Our sub-themes reflect this interdisciplinary approach, mirroring our strategic initiatives aimed at fostering a holistic response to climate challenges.

We strive to be a catalyst for ground-breaking research and innovation. In Agriculture and Food Sciences, we focus on sustainable agro-ecological practices essential for food security and climate resilience. Our strategic plan supports research in climate-smart agriculture, equipping our community with tools to combat climate-related challenges. Business and Economics explore sustainable entrepreneurship and carbon credit markets to drive climate-positive business strategies. This shift prioritizes environmental stewardship alongside economic growth, preparing students to lead in a green economy.

As a bridge between academia and industry, we leverage computing and informatics technologies to adapt to and mitigate climate impacts. Our strategic plan includes cutting-edge programs in computing, ensuring our graduates lead in technological solutions for climate resilience.

To nurture an environment where every student thrives, we emphasize education's role in climate change mitigation. Training individuals with necessary skills and understanding social sciences influences behavioural changes, developing leaders equipped to tackle climate issues. Our strategic initiatives integrate climate education across all disciplines, fostering environmentally conscious leaders. Engineering and Architecture offer sustainable solutions for infrastructure and urban environments. Our strategic plan encourages research in eco-friendly building technologies.

Health Sciences, including Nursing, examine the link between climate change and public health. Addressing health impacts of environmental changes requires a proactive approach. Nurses, at the forefront of healthcare delivery, advocate for sustainable practices and address health issues related to environmental changes. Meru University invests in health sciences research and nursing programs that incorporate climate health, preparing students to meet these challenges.

In Pure and Applied Sciences, we explore climate change prediction and nature-based innovations for effective resource management and conservation. Our strategic focus supports research in these areas, ensuring our scientific community contributes to sustainable practices.

This conference is a platform for sharing knowledge, fostering collaboration, and driving innovation. As we engage in these discussions, let us be inspired by the expertise gathered here and work towards practical solutions. Meru University's strategic plan aligns with these goals, and we are committed to leading the way in climate resilience through education and research.

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**SUBTHEME 1: • Agriculture: Sustainable Agro-ecological practices for climate resilience**

PRE-CONFERENCE PAPERS

# 1. Residual effects of land preparation method and organic amendment on soil physical property, growth and yield of collards (Brassica oleracea).

**Victor Kiptoo Kemboi[1]*, Peter Masinde[1] and Eric Mworia[1]**

[1] Department of Agriculture, Meru University of Science and Technology

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Land preparation method and organic soil amendment is a potential practice for soil physical properties and source of plant nutrients for increased crop production in Kenya, but its residual effects have not been fully realized. Therefore, in this study collards (Brassica oleracea) was used to determine the residual effects of land preparation method and organic soil amendment since it requires high nitrogen for vegetative growth. The experiment was conducted at Meru University Demonstration Farm in split plot design with randomized complete block design (RCBD) land preparation being the main plot and nutrient management being the sub-plots. The experiment consisted of two land preparation method (conservational and conventional). The nutrient levels were 2.5t ha-1 BSF, 5.5t ha-1 BSF, 8.5t ha-1 BSF, 2.5t ha-1 BSF + Biochar, 5.5t ha-1 BSF + Biochar, 2.5t ha-1 BSF + Trichoderma 125g ha-1, 5.5t ha-1 BSF + Trichoderma 125g ha-1, 5t ha-1 FYM, 100kgN ha-1 DAP and control. Collards were planted on the plots where maize crop was harvested. Data collected was on collard stem diameter, chlorophyll index, plant height, number of leaves, collard yields per plant and soil moisture. Results showed that land preparation method had no significant residual effect on collard stem diameter and chlorophyll index. Organic soil amendment had a significant residual effects ($p<0.0001$) on vegetative growth and yield of collards with 8.5 t ha-1 BSF manure maintaining the highest values. Conservational land preparation method influenced soil moisture significantly ($p<0.05$). Organic soil amendment has a residual effect on collard production.

**Keywords:** *Biochar, Black soldier fly manure, Collards vegetative growth, Collards yield, Soil moisture, Trichoderma spp.*

# 2. A comparative assessment of soil biodiversity and physicochemical characteristics in conservation and conventional smallholder farms in Kenya

**Benjamin Muteti[1]*, Cynthia N. Mugo Mwenda[1] and Erastus Mwangi[2]**

[1]Department of Department of Biological Sciences, Meru University of Science and Technology

[2] Department of Physical Sciences, Meru University of Science and TechnologyTechnology

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Soil health is essential for sustainable crop production. However, distinct farming practices poses varying impacts on soil biodiversity and the physicochemical characteristics of the soil. Conflicting information exists about the effects of conservation and conventional farming practices on soil health. This study assessed soil biodiversity and physicochemical properties of soils in 20 conservation and 20 conventional smallholder farms in Meru, Tharaka Nithi, Kirinyaga, and Laikipia counties in Kenya. Soil samples from the smallholder farms was collected at 0 to 30 cm depth. Plot quadrats in combination with transect line sampling design were applied in all farms. Pitfall traps and heat extraction were used to extract earthworms, termites, and ants from the soil. Soil organisms' species richness and organisms' diversity were analyzed using Margalef's Diversity Index and Shannon's Index of Diversity, respectively. Different analytical techniques were used to determine the soil's physicochemical properties. One-way ANOVA was used to determine the significant differences between the two farming systems in the counties. The percentage of carbon, phosphorus, potassium, and pH values showed a significance difference between the conservation and conventional farms studied, while no significant difference was observed in the percentage nitrogen. A total of 5947 soil organisms were recorded in all the farms in the four counties. Out of the total soil organisms encountered 83.6% and 16.4% was recorded for conservation and conventional farms respectively. The results of soil organisms on Shannon's Index of Diversity, Shannon's Evenness Index, and Species Richness Diversity Index showed no significant differences, except for the species abundance which was significantly higher in conservation farms than conventional farms. In conclusion, conservation farms showed higher soil biodiversity and nutrient-rich soils than conventional farms. These findings imply that conservation farming methods create favorable conditions that promote the growth of soil organisms.

**Keywords:** *Soil biodiversity, conservation farming, conventional farming, physico-chemical properties, smallholder farms*

# 3. Evaluation of finger millet root exudates on egg hatch of root-knot nematodes (*Meloidogyne incognita* and *Meloidogyne javanica*)

**Jedidah Waweru[1]*, Cecilia Wanjau[1], Gitonga Nkanata[1], Peter Masinde[1]**
[1]Department of Agriculture, Meru University of Science and Technology
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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Finger millet (Eleusine coracana) is the most important millet crop in East Africa. It is an annual tufted cereal crop that that is commonly cultivated in arid and semi-arid regions in Kenya. It is considered superior to other staple cereal crops due to its unique nutrition profile, mainly the high levels of calcium, iron, dietary fibre, polyphenols, amino acids and gluten free-status. It matures in 75–160 days, has the ability to yield considerably with minimal inputs and can be stored for long periods without spoiling hence a famine reserve crop. Finger millet. Cultivation of finger millet is faced by several constraints including plant-parasitic nematodes (PPNs). Root-knot nematodes (RKN)are the most economically important PPNs that can infect almost all vascular plants. They are obligate, sedentary PPNs that extract nutrients from the cytoplasm of root cells and cause characteristic galls affecting uptake of water and nutrients. In this study, we evaluated the effect of root exudates from 27 finger millet genotypes on egg hatch of two RKN at three different plant ages and two different concentrations. Finger millet seeds were planted in pots in a screenhouse. Their exudates were collected at 14, 21 and 28 days from planting date. The ability of root exudates to induce egg hatch of Meloidogyne javanica and Meloidogyne incognita was evaluated in the laboratory at 100% and 50% concentration. Our results indicate that exudates from the P-224 and IE2872 finger millet genotypes induced the highest M.incognita and M.javanica egg hatch respectively. On the other hand, GBK genotypes 000451,043254,043145,036800,043258,008301,000494 had the lowest induction of M.incognita and M.javanica egg hatch. The results also indicated that 100% concentration had a higher influence on egg hatch compared to 50% concentration of the root exudates. Furthermore, younger plants (14 days old) induced more egg hatch compared to older plants (28 days old) These findings can be used as a base to develop effective nematode management strategies for finger millet when the plants are still young.

***Keywords***:- *Plant defence, reference crop, Root Knot Nematodes, genotype, concentration, root exudate.*

# 4. Ready-to-Drink (RTD) Pearl Millet Porridge: Comparison of physico-chemical and nutritional profile between controlled and conventionally fermented porridges

**Faith Chepngeno[1], Mio Kudo[2], Alfred Mariga[1], Kenneth Mbae[1], Joshua Arimi[1]***

[1] Department of Food Science, Meru University of Science and Technology

[2]Department of Agricultural Economics, Utsunomiya University

Corresponding author email: jarimi@must.ac.ke

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

The pearl millet is a major crop in the semi-Arid areas of Africa, especially in the Sahelian where food and nutrition insecurity is a constant threat. It is nutritionally superior in fat, fibre and minerals compared to other major cereals such as wheat, maize, sorghum and rice. Despite its important role in food security, it is under-utilized. The pearl millet is mainly used traditionally for the preparation of thin porridge. However, there is no ready-to-drink packaged and fermented pearl millet thin porridge in the market. In addition, traditional fermentation of cereal beverages is mainly by spontaneous or by back slopping. The arising product lacks consistency in quality. Further, porridges tend to undergo syneresis after storage. In addition, the porridges sold in Kenyan market are mainly presented in traditional guards, re-used cooking oil jerricans and re-used water bottles. This study aimed to determine the effect of fermentation (both conventional and controlled) on the physico-chemical and nutritional composition and to package the ready-to-drink porridge. The pearl millet was wet-milled, inoculated with the selected starter cultures and allowed to ferment at 30oC for 24 hours. Another batch of millet grains was wet-milled using a quern mill, left to ferment naturally at room temperature, and then cooked into thin porridge. The physicochemical properties (pH and TTA) were monitored hourly during controlled fermentation (0-10th, 23rd, and 24th hour). The study found that the pH of controlled fermented porridge decreased from 6.92 to 4.34, while its titratable acidity increased from 0.07 to 0.223%. The moisture, fat, and ash content of the controlled-fermented porridge were 91.62, 0.15, and 0.43% respectively. In comparison, traditionally milled porridge had moisture and ash contents of 87.5 and 0.47%, while industrially milled porridge had 88.85% moisture and 0.51% ash. In conclusion, the quality, physico-chemical and nutritional quality of controlled and conventionally fermented porridge are comparable.

***Keywords**: Pearl millet, controlled fermented porridge, spontaneous fermentation.*

# 5. Processing and physicochemical characterization of camel milk butter

**Jared Gisore Mbeche[1,2], Alfred Mugambi Mariga[1], and Joshua Mbaabu Arimi[1,2*]**

[1] Department of Food Science, Meru University of Science and Technology

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Camels are usually reared in the arid and semi-arid areas (ASALs) of Kenya. They are used for transport and also produce milk and meat which forms part of subsistence. Camel milk fat contains higher amounts of unsaturated fatty acids compared to bovine milk. This makes it unique. Kenya is the largest producer of camel milk in the world. However, there is no camel milk butter (CMB) in the market. This is attributed to the fact that camel milk has unique fat properties. These include; tiny fat globules with thick membranes which are strongly attached to the proteins. Also, there is the presence of long chain fatty acids, making it difficult to use the same technology as bovine milk in the making of camel milk butter. Camel milk has a high melting temperature ranging from 41-44 °C making it hard to process CMB at normal conditions as bovine milk. In addition, the milk fat has a high melting point, making it hard to process camel milk butter at normal conditions as bovine milk butter. Therefore, the main aim of this study was to process and analyze the physicochemical properties of CMB. Consequently, butter was prepared using camel milk obtained from Isiolo and Laikipia counties. It was produced by churning aged cream at 21, 23, 25 and 27 °C monitoring the time taken for butter formation. Subsequently, the butter obtained was analyzed for proximate and physicochemical properties. Results indicated that butter churned at 23 °C formed butter within 10 minutes and had the highest yield compared to 25 and 27 °C. The fat, moisture, protein, ash and solid-non-fat content was 86.5, 11.6, 0.86, 0.64 and 1.55% respectively. Additionally, the iodine, peroxide, saponification and acid values were 46.6 microMol/L, 0.15 meq/Kg fat, 201 mgKOH/g and 5.4 mgKOH/g respectively. There were no notable differences in terms of physicochemical properties between the different churning temperatures. Acid and peroxide values increased significantly indicating increased rancidity of butter. Churning of the cream at 23 °C produced the best results within 10 minutes of churning and a considerably higher output yield. Thus, the temperature-time regime is ideal for camel milk butter production.

**Key words:** *Camel milk butter, Value addition, Optimization, churning, ASALs*

# 6. Comparison of physico-chemical properties of spontaneously, back-slopped and controlled fermented pearl millet porridge

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

The pearl millet is the major variety of millet and is ranked as the sixth most important grain globally. It plays an important role in combatting malnutrition in developing countries due to its resistance to drought and superior nutritional characteristics. However, it is underutilised. Pearl millet is mainly processed into porridge either through spontaneous or back slopping which results in inconsistent quality. This study aimed to develop a fermented pearl millet porridge using controlled fermentation and compare its physico-chemical properties with the spontaneous and back slop fermented porridge. The spontaneously fermented pearl millet porridge samples were collected from vendors in Meru Town, Kenya. The pH values ranged from 2.39-3.00; TTA values from 0.92-1.18%, and viscosity between 0.15-0.92 Pa/S. The pH, TTA and viscosity of back slopped fermentation were monitored over a period of 72 hours. The pH values decreased from 6.78 to 3.22, TTA increased from 0.04 to 0.45% and viscosity increased as fermentation time increased from 0.41 to 0.48 Pa/S. Preliminary experiments were also carried out using five commercial cultures in order to identify the best cultures for controlled fermentation. The starter cultures used include Lactobacillus plantarum, Lactobacillus delbrueckii subsp. bulgaricus & mixed cultures containing heterolactic Lactobacillus fermentum and Leuconostoc). The porridge fermented with Lactobacillus plantarum had a pH of 3.98, TTA of 0.10% and viscosity of 1.46 Pa/S. The mixed culture of S. thermophilus, Lb. bulgaricus, L. lactis s3ubsp. Lactis resulted in a pH of 4.04, TTA of 0.10% and a viscosity of 1.21 Pa/S. The eXact® KEFIR 2 culture produced porridge with a pH of 4.18, TTA of 0.03% and a viscosity of 0.88 Pa/S. YoFlex Harmony 1.0 resulted in pH, TTA and viscosity values of 4.95, 0.02% and 0.90 Pa/S, respectively. The XPL-1 starter culture produced porridge with a pH of 4.18, TTA of 0.03% and viscosity of 0.86 Pa/S. Among the tested cultures, Lactobacillus plantarum proved to be the most effective acidifier.

Key words: Pearl millet, fermentation

**Keywords:** *Pearl millet, Fermentation*

# 7. Biological control of bacterial wilt in tomato using *Warburgia ugandensis* Extracts

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

*Ralstonia solanacearum* is a soil-borne bacterial pathogen that poses significant threat to the Solanaceae family and other crops. Tomato plants are affected by *R. solanacearum* which causes bacterial wilt, that has no treatment. Bacterial wilt is a devastating disease that affects the plant's water transport system, leading to wilting and death. Numerous chemical agents and treatment methods have been employed in attempts to control *R. solanacearum*, but were ineffective. *Warburgia ugandensis* crude extract have exhibited biocontrol properties against pathogenic fungi and bacteria in animals but in plant the information is limited. The study aimed to determine the in vitro and vivo efficacy of *W. ugandensis* stem bark and leaf crude extracts against *R. solanacearum. W. ugandensis* stem bark and leaf crude extracts were obtained using organic solvents viz. methanol, ethanol, dichloromethane, and hexane. In vitro, antagonistic activities against *R. solanacearum* of all organic crude extracts of *W. ugandensis* were determined by standard agar well diffusion assay on Kelman's 2, 3, 5- triphenyl tetrazolium chloride medium in triplicates. Two-way analysis of variance (ANOVA) was used in the statistical analysis of the mean diameter inhibition zones. All the organic solvents crude extracts of *W. ugandensis* were inhibitive against *R. solanacearum*. However, the stem bark crude extracts exhibited significantly higher efficacy against *R. solanacearum* compared to the leaf crude extracts. The crude extracts were subjected to a serial dilution to determine the minimum inhibitory concentration (MIC). W. ugandensis stem bark dichloromethane crude extracts had the lowest MIC of 1 mg/ml. *W. ugandensis* stem bark dichloromethane crude extracts were most effective against R. solanacearum. The obtained crude extracts were tested against *R. solanacearum* in the greenhouse. The treatments were done in triplicate. Statistical analysis of the data was carried out using analysis of variance. Tomato plants established in soil inoculated with *R. solanacearum* but treated with *W. ugandensis* stem bark dichloromethane crude extract showed bacterial wilt disease incidence and severity of 0% which was like positive control. Tomato plants established in soil inoculated with *R. solanacearum* but treated with W. ugandensis leaf ethanol crude extract had the highest average height of 62.50 cm which was like positive control. The study proposed that W. ugandensis crude extract can be used as antibacterial biocontrol against R. solanacearum. Further research is important to determine the bioactive compounds against *R. solanacearum*. light conditions. Additionally, the study will demonstrate the potential of wild strawberries as a model plant for studying chloroplast movement and other important biological processes

**Keywords**: *Bacterial wilt, Ralstonia solanacearum, Tomato fruit, Warburgia ugandensis, Plant disease control*

# 8. Green Economy initiatives for sustainable agriculture in Kenyan Universities: a case study of Meru University

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

This study investigated the integration of green economy initiatives aimed at fostering sustainable agriculture within Kenyan universities, with a specific focus on Meru University as a case study. The research examined the strategies, programs, and educational practices implemented by Meru University to promote sustainable agricultural practices in line with green economy principles. Utilizing a combination of literature review, interviews, and analysis of institutional policies and curriculum, the study evaluated the effectiveness and challenges associated with these initiatives. Key findings revealed successful pedagogical approaches, including the incorporation of sustainable farming techniques, the promotion of renewable energy use, and the integration of eco-conscious principles into the curriculum. Additionally, the study identified barriers to implementation, such as resource constraints and institutional inertia. Insights from Meru University's experience provides valuable lessons for policymakers, educators, and stakeholders interested in advancing green economy initiatives and enhancing sustainable agricultural education within the higher education sector in Kenya and beyond.

**Keywords:** *CBET, Climate Resilience, Curriculum, GHG, Global warming*

# 9. Strategies for enhancing domestic animal yields through mitigating cattle rustling in Northern Rift Valley and Northern Eastern regions of Kenya

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Livestock farming in the Northern Rift Valley and Northern Eastern Region faces challenges such as low animal yields and rampant cattle rustling, impacting the livelihoods of pastoral communities. This research explores strategies to enhance animal yields and mitigate cattle rustling, focusing on economic, technological, social, and policy interventions. The study employs a mixed-methods approach, combining quantitative data from surveys and secondary sources with qualitative data from interviews, focus groups, and field observations. Quantitative analysis reveals the importance of improving market access and financial services for livestock farmers, enabling investments in better breeds and technologies. Technological interventions such as GPS tracking and mobile applications are effective in reducing cattle rustling incidents. Community-based approaches and robust policy frameworks are identified as essential for sustainable development, emphasizing community empowerment and resource management. The study provides evidence-based recommendations to policymakers, advocating for a comprehensive approach that integrates traditional knowledge with modern practices to ensure long-term resilience and productivity in livestock farming.

***Keywords:*** *Breed Improvements, Enhancement of Animal Yield, Financial Services, Market Access*

# 10. Urine stabilization and treatment using lactic acid from fruit and vegetable peel fermentation: a potential source of nitrogen fertilizer

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

This study addressed the stabilization and treatment of human urine using lactic acid (LA) produced from the anaerobic fermentation of fruit and vegetable peels as a sustainable and effective nitrogen fertilizer. LA was produced after three-day fermentation of samples prepared at 1:1 and 1:2 waste-to-water ratios and incubated at 34°C, 37°C, and 40°C. Urine samples were then treated with the resulting LA for four, seven, and ten days. The pH of the samples was measured to determine LA's efficiency in inhibiting urea hydrolysis and stabilizing urine. The Kjeldahl method determined nitrogen concentration, and E. coli presence tested pathogen inactivation with MacConkey Agar. The maximum rate of iron (III) lactate absorption was seen at 410 nm, close to the ideal wavelength range of 380-405 nm for detecting lactic acid. The calibration curve was created using sequential lactic acid dilutions, and the equation was $y = 1.9051x + 0.0267$. The correlation coefficient ($R^2$) was 0.9804. Lactic acid treatment significantly reduced the pH of urine samples across all settings, with the greatest pH reduction at 37°C, corresponding to the highest lactic acid production. Nitrogen analysis revealed that samples treated at 37°C in a 1:1 ratio preserved the most nitrogen content, indicating successful urease inhibition and prevention of ammonia volatilization. Furthermore, lactic acid had strong antibacterial action, inhibiting E. coli growth, especially in samples obtained at higher temperatures. This study revealed the ability of lactic acid from organic waste to stabilize urine, preserve nitrogen content, and ensure pathogen safety, supporting sustainable sanitation practices and resource recovery in agriculture. The best conditions for urine stabilization were determined as a 1:1 LA to urine ratio at 37°C, treated for 10 days, demonstrating its potential in sustainable urine management and agricultural applications.

**Keywords:** *anaerobic fermentation, lactic acid, food waste, urine stabilization, pathogen inactivation, nitrogen preservation*

# 11. Growth, yield and quality of selected sweet potato (*Ipomoea batatas [L.] Lam.*), lines under varying nutrient management levels

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Sweet potato (*Ipomoea batatas [L.]* has increasing potential as a food security crop in Kenya. However, its' production is comparatively low compared to its potential production which is attributed to drought conditions and low soil fertility conditions alongside use of local landrace cultivars that are low yielding. This study was conducted at Meru University of Science and Technology to assess the performance of selected improved sweet potato lines under varying nutrient management conditions. Three sweet potato varieties were used; CIP 106988.1 (Naspot13) and CIP 112286.1(Margarette), and a farmer-preferred variety Kemb-10 and three NPK (17:17:17) levels: 0, 120 and 240kg NPK ha-1. A randomized complete block design in a split plot with 3 replicates was used; varieties on the main plot and NPK levels as the subplots. Data collected was subjected to analysis of variance (ANOVA) using SAS software, and means separated using the least significance difference test ($P \leq 0.05$).There was no significant ($P > 0.05$) interaction between NPK levels with the varieties. However, NPK levels significantly ($<0.001$) affected vine length, number of leaves and tuber yield. Sweet potato growth parameters (vine length, number of branches, number of leaves) and tuber yields (tuber length, tuber circumference, number of tubers and tuber fresh weight were significantly affected by different NPK levels applied. Application at 240 kg NPK ha-1 produced the highest vegetative growth and tuber yields. As the NPK rates were increased from 0 kg NPK ha-1, through 120kg NPK ha-1 to 240 kg NPK ha-1both vegetative and tuber yields escalated. Naspot 13 and kemb 10 varieties performed well across the treatments as compared to Margarette hence these varieties could possess other superior attributes other than just the NPK treatments. Based on findings, NPK nutrients supply is fundamental to the crop. It is recommendable that farmers incorporate inorganic fertilizers in sweet potato farming for enhanced production..

**Keywords:** *Vine length, Number of leaves, Fresh tuber weight, Number of tubers, tuber circumference, NPK levels*

# 12. Formulation and evaluation of physiochemical properties of skincare products and toiletries containing camel milk ingredients.

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Soaps are potassium or sodium salts formed through the saponification reaction of triglycerides fatty acids. Bath soaps are used on daily basis in the households for cleaning human body, treating skin infections and promoting healthy skin. Consumers are preferring bath soaps containing natural ingredients including natural plant extracts and milk creams. Camel milk cream compared to other milk creams is rich in bioactive compounds with therapeutic and antiaging properties and moisturizing effects. However, there are limited studies on the effects of camel milk cream on the properties of the bath soaps. Therefore, this study aims to formulate bath soaps using camel milk cream and evaluate their physiochemical parameters such as pH, foam stability, moisture content, hardness, alcohol insoluble matter, total fatty content, alkali content, moisturizing effects, anti-microbial activity and shelf-life. Four soap samples were formulated with equal ratios of palm and coconut oils but with varying amounts of camel milk cream as follows; blank and three other soaps with 11.3%, 24.1% and 29.5% camel milk cream. The preliminary results showed that the pH did not change with increase in camel milk cream with an average pH value of , Hardness of soap samples decreased with an increase in camel milk cream from F0; 0.185 kpa, F1 (11.3%); 0.432 kpa, F2(24.1%) ; 0.228kpa and F3 (29.5%); 0. 091kpa. Foam stability increased with an increase in camel milk cream. The moisture content increased with increase in camel milk cream as follows; F0 (13.2%), F1(13.82%), F2(15.76%) and F3(16.13%). The soap formulation with the highest cream, F3 (29.5%) with of pH of 10.82±0.16, hardness of 0.91kPa, foam stability of 96% and moisture content of 25.5 % exhibited the best properties compared to the other formulations.

**Keywords:** *Camel milk cream, Bath soaps, Saponification, physiochemical parameters*

# 13. Evaluation of the effectiveness of lactic acid produced by fermentation of selected vegetable wastes in the treatment of faecal sludge.

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Soaps are potassium or sodium salts formed through the saponification reaction of triglycerides fatty acids. Bath soaps are used on daily basis in the households for cleaning human body, treating skin infections and promoting healthy skin. Consumers are preferring bath soaps containing natural ingredients including natural plant extracts and milk creams. Camel milk cream compared to other milk creams is rich in bioactive compounds with therapeutic and antiaging properties and moisturizing effects. However, there are limited studies on the effects of camel milk cream on the properties of the bath soaps. Therefore, this study aims to formulate bath soaps using camel milk cream and evaluate their physiochemical parameters such as pH, foam stability, moisture content, hardness, alcohol insoluble matter, total fatty content, alkali content, moisturizing effects, anti-microbial activity and shelf-life. Four soap samples were formulated with equal ratios of palm and coconut oils but with varying amounts of camel milk cream as follows; blank and three other soaps with 11.3%, 24.1% and 29.5% camel milk cream. The preliminary results showed that the pH did not change with increase in camel milk cream with an average pH value of , Hardness of soap samples decreased with an increase in camel milk cream from F0; 0.185 kpa, F1 (11.3%); 0.432 kpa, F2(24.1%) ; 0.228kpa and F3 (29.5%); 0. 091kpa. Foam stability increased with an increase in camel milk cream. The moisture content increased with increase in camel milk cream as follows; F0 (13.2%), F1(13.82%), F2(15.76%) and F3(16.13%). The soap formulation with the highest cream, F3 (29.5%) with of pH of 10.82±0.16, hardness of 0.91kPa, foam stability of 96% and moisture content of 25.5 % exhibited the best properties compared to the other formulations.

**Keywords:** *Camel milk cream, Bath soaps, Saponification, physiochemical parameters*

# 14. Impact of storage conditions on the physico-chemical properties, acceptability and shelf-life of cactus pear fruit (*Opuntia ficus-indica*).

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Cactus pear (Opuntia ficus-indica) fruit has gained attention over the past few years partly due to its nutritional value, health benefits and organoleptic characteristics among others. The fruit is rich in nutrients such as minerals (K, Ca, P, Mg, S), protein, dietary fiber, and phytochemicals such as β-carotene and betalains, vitamin C and phenols. However, the effects of postharvest management techniques on its nutritional profile, acceptability and shelf-life/storage-life are not well known. This study aims at characterization of physico-chemical properties, nutritional profile, organoleptic characteristics and shelf/storage life of prickly pear fruit under modified atmosphere packaging (MAP), cold storage and room temperature conditions. Mature fruits will be harvested from prickly pear plant from the arid and semi-arid regions of Meru County and the surrounding. Proximate composition will be determined using AOAC methods and physical, chemical and sensory parameters using standard procedures. Data will be subjected to analysis of variance using the SPSS software (version 24) at 95% confidence interval and a P-value of less than 0.05 will be considered significant.

**Keywords:** *Opuntia ficus-indica, cactus, storage conditions, modified atmosphere packaging, cold storage and physico-chemical properties.*

CONFERENCE PAPERS

# 15. Effect of gum arabic from *Acacia Senegal var. kerensis* as an improver on the rheological properties of wheat flour dough

**Roseline Mwihaki Kiama,[1,*] Mary Omwamba,[1] George Wafula Wanjala[2] and Symon Maina Mahungu[1]**

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Dough improvers are substances with functional characteristics used in baking industry to enhance dough properties. Currently, the baking industry is faced with increasing demand for natural ingredients owing to increasing consumer awareness. Thus, the rising demand for natural hydrocolloids. Gum Arabic from Acacia senegal var. kerensis is a natural gum exhibiting excellent water binding and emulsification capacity. However, very little is reported on how it affects the rheological properties of wheat dough. The aim of this study was therefore, to determine the rheological properties of wheat dough with partial additions of gum Arabic as an improver. Six treatments were analyzed comprising of: flour-gum blends prepared by adding gum Arabic to wheat flour at different levels (1%, 2% and 3%), plain wheat flour (negative control), commercial bread flour and commercial chapati flour (positive controls). The rheological properties were determined using Brabender Farinograph, Brabender Extensograph and Brabender Viscograph. Results showed that addition of gum Arabic significantly ($p<0.05$) increased dough development time (1.44-6.45 minutes), water absorption capacity (59.34-59.96%), stability (6.34-10.75minutes), mixing tolerance index (12.00-35.80), Farinograph quality number (48.60-122.20) and time to breakdown (4.33-12.05minutes). However, there was no significant effect of gum Arabic addition on dough consistency (490-505 BU). In extensograph properties, energy was significantly ($p<0.05$) higher in wheat flour containing 2% gum Arabic (108.44 cm2), while extensibility was significantly higher in wheat flour containing 3% gum Arabic (153.11mm). Gum Arabic significantly ($p<0.05$) decreased all the Viscograph parameters apart from the pasting temperature (69.82-71.68º C). The findings of this study show that gum Arabic significantly ($p<0.05$) enhanced the rheological properties of the dough. An optimal gum Arabic concentration of 2% in wheat flour dough is recommended for pan bread and 3% for chapati. These findings support the need to utilize gum Arabic from Acacia senegal var. kerensis as a dough improver.

**Keywords**: *Dough improvers, Gum Arabic, Acacia Senegal var. kerensis, Rheological properties, Wheat dough*

# 16. Development of integrated strategies for reducing aflatoxin contamination in maize during storage

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Aflatoxin levels increase during storage due to high humidity, temperature, and insect pests which support fungi producing mycotoxins. The study aimed to determine the effectiveness of treating maize grain with three levels of natural products. Maize grains samples were collected from Kilifi and weighed to 1kg each. Three levels of Moringa oleifera powder, wood ash from Eucalyptus globulus and diatomaceous earth were used, including drying on bare ground and a control (no treatment). The design was a completely randomized design (CRD) replicated three times. Maize grains were stored in polypropylene bags for three and six months and total aflatoxin quantification was performed using ELISA. At six months' aflatoxins levels had increased up to ten times from the three months' storage. In the six months the total aflatoxins levels were 0.84 µg/kg for wood ash from Eucalyptus globulus at 7.5g/kg of maize with lowest total aflatoxins levels. The first five treatments were efficient because the total aflatoxin levels were below 10 µg/kg as recommended by the Kenya Bureau of Standards (KEBS) for human food. The diatomaceous earth 1g/kg (16.76 µg/kg), dried on a bare floor with an 18.3 µg/kg fit for animal feed and below 20 µg/kg used for animal feed. Storage periods of over three months increased total aflatoxin levels. The use of wood ash (Eucalyptus globulus) at low, medium and high levels reduces aflatoxins through the control of insect pests and fungi. Additionally, the use of diatomaceous earth and Moringa oleifera powder at low and medium levels was effective. Integrated strategies for reducing aflatoxin contamination in maize during storage in this study proofed effective.

**Keywords**: *Aflatoxin; Diatomaceous earth; ELISA; Mycotoxins; natural products*

# 17. Comparison of fatty acid profiles of camel milk powder from camels reared in Isiolo and Laikipia county in Kenya to Irish cow's milk powder

**Ciara Harty[1], Jean-Christophe Jacquier[1], Niamh Harbourne[1], Eunice Marete[2], Joshua Mbaabu Arimi[3]**

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

The one humped camel (Camelus dromedarius) has ensured food security and nutrition for pastoralists in Kenya for generations. Extensive research has highlighted the dynamic nature of milk, by showing that the fatty acid and macronutrient composition is variable and impacted by several factors, including diet, availability of water and lactation cycle of the animal. This study compared the fatty acid profiles of milk powder from camels reared in Isiolo and Laikipia counties in Kenya to that of Irish Friesian cows. Results show significant variability in nutritional quality both intra- and interspecifically, with distinct differences observed in fatty acid composition, particularly in omega-3 to omega-6 ratios, chain length and unsaturation levels. Camel milk powders contained higher levels of mono unsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs) than the cow milk samples. The PUFA:SFA ratio of camel milk was observed to be higher than that of cow milk. A notable difference is absence of short chain fatty acid; butryric acid (C4) in camel milk powder compared to contributing to 30% in cow's milk short chain fatty acids (SCFAs). Additionally, inconsistencies in saturation were evident within the camel populations. Significant disparities in macronutrient composition were observed across different Kenyan counties, with camel milk from the dry Isiolo region exhibiting higher carbohydrate content and lower ash content compared to milk from the more fertile Laikipia region.

**Keywords:** *Camel milk, Fatty acid, Protein, Carbohydrate, Ash, Moisture, Fat*

# 18. Dragon Fruit (*Hylocereus Spp.),* a potential climate change resilient crop in Kenya.

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Climate change poses significant challenges to agricultural production worldwide, posing a food insecurity threat to the ever increasing human population. Kenya is not an exception. Adoption of climate change mitigation measures as well as cultivation of resilient crops is key in ensuring sustainability of agricultural production systems. In Kenya, Dragon fruit (Hylocereus spp) has been proposed by researchers as a potential climate change resilient crop. Therefore, this systematic review examines the potential of dragon fruit (Hylocereus spp.) resilience amidst climate change in Kenya. Dragon fruit, a recently introduced crop is known for its nutritional and economic value. It has garnered interest among Kenyan farmers due to its ecological adaptability and market potential. However, not much has been documented about the climate change resilience on the production potential of the dragon fruit in Kenya. The review synthesizes findings from various studies on how rising temperatures, unpredictable rainfall patterns, drought and increased solar radiation impacts dragon fruit production. Current studies indicates that increased temperatures can boost the growth and fruiting of dragon fruit, which thrives best in warm climates. With an optimal temperature range of 20-38°C, it is a clear evidence that dragon fruit can be cultivated across all ecological zones in Kenya despite the changing climate. The crop has been shown to demonstrate resilience to drought, increased solar radiation, and high temperatures. However, extreme heat (Temperatures above 38°C) and extended drought periods can stress the plants, leading to reduced yields and fruit quality. Improved irrigation techniques, mulching, and selection of drought-resistant varieties, have been identified as essential strategies to mitigate the adverse effects of climate change. In conclusion, climate change presents opportunities for expanding dragon fruit production in Kenya, especially in ASAL regions becoming increasingly suitable for its cultivation. This can promote economic opportunities, nutrition and food security across the Country. This review recommends the need for targeted research, policy support, sensitization and capacity building of farmers, processors and other actors to harness the potential of dragon fruit value chain as a climate-resilient crop.

**Keywords:** *Dragon Fruit, Climate Change, food security, resilient crop, Arid and Semi-Arid Lands*

# 19. Nutritional and sensory comparative profile analysis of plant-based milk (coconut milk) and animal milk (goat milk)

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Animal milk is the most consumed milk globally, goat milk being one of them it makes up to 2% of milk consumed globally. Coconut milk is used as an ingredient in many foods around the world and is most popular in Asian countries. In Kenya, goat and coconut milk remain among the least consumed foods. Recently, an increase in health concerns such as cow milk allergy, lactose intolerance, and hypercholesterolemia, has forced consumers to opt for a more convenient milk alternative. Plant-based milk such as coconut milk has been one of the go-to alternatives. Both goat milk and coconut milk are rich in macronutrients and have different benefits to our health. Coconut milk has been associated with fitness, skin nourishment, digestion benefits and it rarely triggers allergic reactions. It has antiviral and anti-bacterial properties and may lower cholesterol levels in the body thus, reducing the risk of heart disease and stroke. On the other hand, goat milk is easily digestible, promotes growth, develops the immune system, and prevents diseases. It has been used to cure cow milk allergies, stunting, and wasting in children. The proximate composition was analysed using AOAC methods. The sensory acceptability was determined using 9-hedonic scale. The macronutrient composition of goat milk was as follows; protein 3.6%, fat 4.1%, carbohydrates 4.2%, moisture content 87.3% and ash 0.85% while coconut milk recorded 2.5% protein, 15% fat, 3.57% carbohydrates, 78.1% moisture content and 0.9 % ash. Nutritionally, goat and coconut milk were comparable except fat content in which coconut milk was 3 times higher than goat milk. From sensory analysis, consumers preferred goat milk compared to coconut milk.

**Keywords:** *Goat milk, coconut milk, macronutrients, consumer acceptability*

# 20. Nutritional and Phytochemical composition of *Catha edulis* (*Miraa, Khat*)

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Catha edulis, (Khat, Miraa) is a plant where fresh leaves and soft twigs which are chewed and release a juice containing cathinone and cathine, the active chemicals that stimulate and alter the mood of the user. However, there has been negative information regarding Khat due to limited scientific data on nutritional, chemical and phytochemical composition of Khat. Most users don't know the specific nutrients of miraa if any and their quantities. This study aimed at determining the nutritional and phytochemical composition of miraa. The study involved the analysis of different grades of miraa purchased from the local community. The protein was determined by Kjedahl method, ash was determined by dry ashing, moisture was determined by oven drying, fats was determined by Soxhlet method, Vitamin C was determined by DCPIP indophenol method and carbohydrates by difference. The total phenolic content was determined using Folin–Ciocalteu method. The composition of the miraa samples were as follows; moisture content 71.35%, protein content; 0.0051%, ash; 2.77%, fibre 21.046%, fat; 0.098%, carbohydrates; 4.731%, Vitamin C; 2.310 mg/100g, Total phenolic content; 0.56 mg of GA/g of extract and tannins; 3.27mg/100g. Although the nutritional composition of Miraa is not high, it contains substantial macronutrients and phytochemicals. This data contribution serves as the groundwork to understanding the nutritional and phytochemical composition of Catha edulis (Khat).

**Keywords:** *Khat, Miraa, Catha edulis*

# 21. Efficacy of silage preparation methods adopted by livestock farmers in Tigania West Meru County.

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Silage production is an important method of fodder preservation which provides a vital source of nutrition for animals especially during periods of feed scarcity. Fresh fodder crop is chopped, pressed and preserved through anaerobic fermentation, thus providing a quality silage that can be used to feed livestock for up to three years. However, the risk of significant silage losses mainly from aerobic spoilage at feed out can be high, especially if the farmers' ensiling process did not factor in strategies for minimizing these losses. The aim of the current study was to assess sources of livestock feed used by farmers in Tigania west sub-County in Meru County with focus on silage preparation methods and their efficacy in minimizing losses due to aerobic degradation. A total of one hundred and eighteen livestock farmers were selected using systematic random sampling where every 5th farm was selected and the owner interviewed using structured questionnaires. The results showed that silage making was adopted by 10.17 (12/118) % of the farmers in Tigania west sub-County with the majority of the farmers, 89.2% relying on natural pastures (grazing), fresh fodders or combinations of both. The farmers who had adopted silage making were preserving an average of 4383.3 (range: 1000-8000) kg of silage using bunker silos, tower silos or polythene tubes. Only 16.7 (2/12) of the farmers had implemented strategies to minimize aerobic degradation of silage during feed out. As a result, an average of 22.2% of the silage was lost to aerobic degradation and therefore not available for feeding cattle. In conclusion, the findings of this study show that the ongoing efforts to promote sustainable agriculture in the region needs to address training of farmers on appropriate methods of feed preservation and utilization to minimize losses.

**Keywords:** *Livestock, silage, feed preservation, aerobic degradation, Tigania west Meru*

# 22. Characterization of poultry production systems and associated physical egg quality characteristics in Tigania west Meru County

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**Subtheme:** Agriculture - Sustainable Agro-ecological practices for climate resilience

## Abstract

Poultry farming is a significant component of modern-day agriculture and contributes to overall food security through production of eggs and white meat. Furthermore, although the livestock subsector contributes 18% of global greenhouse gas emissions, poultry production leaves a comparatively smaller carbon footprint per unit of product compared to ruminant production. Contrary to the prevailing situation in Meru County, therefore, poultry production needs to play a bigger role in efforts to enhance food security. The purpose of this research was to characterize poultry production in Tigania West sub- County, with respect to adoption levels, farmer demographics, land sizes and physical egg quality parameters associated with different production systems. A total of 83 farmers were interviewed using a structured questionnaire. The questionnaire response rate was 94% (78/83). Among the respondents, 53/78 (67.9%) had poultry in their farms. Out of the 53 poultry farmers, 81.1% (43/53) were practicing the free-range production system, 17% (9/53) semi-intensive production system and only 2% (1/53) were practicing the intensive production system. Not surprisingly therefore, local breeds and improved Kienyeji chicken were the most common breeds kept in the small holder farms, a majority (95%) of which were less than 5 acres in size. Physical egg defects included broken shells which were observed in 7.5% and 9.3% of eggs in the free-range and semi-intensive production systems, respectively. The most prevalent egg shell defect was soiling, which was detected in 80.7% (75/93) of the eggs collected from the free-range production system. Eggs collected from the intensive and semi-intensive systems were not soiled. Eggs shape index was 76.5, 73.4 and 72.1% for the intensive, semi-intensive and free-range production systems respectively. The Tigania west poultry sector is therefore characterized by high adoption levels, particularly of the low risk, low input and eventually low returns free-range production system.

**Keywords:** *Poultry, production system, physical egg characteristics, shell defects, Tigania*

**SUBTHEME 2: Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience**



PRE-CONFERENCE PAPERS

## 23. Influence of financial structure on financial performance of Manufacturing firms quoted at Nairobi Securities Exchange

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience

### Abstract

Firms require capital to finance their business operations and investments. Most firms are faced with a predicament on whether to utilize debt or equity to finance their firms. But, firms need to find the best option and effectively manage their risks. The main aim of this study was to determine the influence of financial structure on the financial performance of firms quoted at the Nairobi Securities Exchange. A target population of 8 manufacturing firms quoted at the Nairobi Securities Exchange was considered and a census study was undertaken. A questionnaire was used to collect data from 114 respondents. Secondary data collection form was used for collecting data from the audited financial statements of the eight firms identified for the study as per institution websites and Central Bank of Kenya annual supervisory reports. Pearson Correlation Analysis was used to test the research hypotheses. The study established that debt financing (r =0.767) had a positive linear correlation with the financial performance of manufacturing firms quoted at the NSE. The study concluded that the results are statistically significant and depict a strong relationship as evidenced by the regression coefficients. The study recommends that the government through Capital Markets Authority (CMA) and other stakeholders in the corporate sector should develop an appropriate policy . The policy should attempt to organize the debt capital market to enable the corporate bodies to get access to low cost and long term debt capital so as to finance their investments and operations.

**Keywords:** *Financial structure, Financial Performance, Debt Financing*

# 24. Corporate governance and financial performance of deposit taking savings and credit cooperative societies in Meru County.

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience

## Abstract

Corporate governance is a critical tool for enhancing the performance of Deposit-taking Savings and Credit Cooperative Societies (SACCOs) and ensuring they meet their members' economic and social needs. Properly structured cooperatives can contribute to equitable development and justice. However, a significant challenge facing these SACCOs is the issue of corporate governance. Some have faced mismanagement problems, resulting in the cessation of their operations. This study aimed to establish the relationship between corporate governance and financial performance of Deposit-taking SACCOs in Meru County, focusing on the impact of transparency. The study population was 92 directors. A sample of 75 directors was selected using stratified random sampling on the basis of proportional allocation. Closed ended questionnaires were used to collect primary data. secondary data collected using….from the SACCO supervision annual report. The findings disclosed a significant association between transparency and financial performance of Deposit Taking SACCOs. In addition, the study found that these SACCOs had effectively managed their liquidity, retaining funds for reinvestment rather than distributing all profits as dividends. The study recommends that Deposit-Taking SACCOs should engage with their customers frequently to keep them informed of the SACCO's progress and involve them in governance through transparent voting process of board of directors into office

**Keywords:** *Corporate governance, SACCOs, Financial performance*

# 25. The impact of conservation farming on the biodiversity of plants species in small holder farms in Kenya

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience



## Abstract

Accounting Information System is one of the important technologies in any financial or non-financial institution operations. AIS are used in capturing, processing, storing and distributing accounting information. In implementing financial internal control system, the role of AIS is critical. The study aimed at providing an understanding of influence of AIS on microfinance institutions financial performance in Meru County, Kenya. The objective identified for the study was; to determine the influence of information quality on financial performance of micro finance institution in Meru County, Kenya. The study was guided by adverse selection theory; employed descriptive research design had target population of 316 with a sample size of 177 respondents. Structured closed and open ended questionnaire was the main data collection tool. Data was analyzed by the use of SPSS version 28. Data was analyzed by use of descriptive statistics, Pearson's correlation, ANOVA and multiple linear regressions. A pilot test was carried to ensure validity and reliability. The variable was tested for reliability by use of Cronbach alpha coefficient attaining 0.862. The regression was tested at 5% level of significant. The results had a mean of 1.63 with SD of 0.621 on a 5-point Likert scale starting with 1- strongly agree to 5- strongly disagree. Pearson's correlation coefficient was 0.218 at $\alpha$ =.001 which is less than .05 level of significance. Regression analysis beta coefficient for the independent variable is $\beta$ = .501 at $p < .05$ level of significant. The results indicate that the variable is statistically significant. Null hypothesis was tested using F – test (2.388) at 95% confidence level and the results lead to the rejection of the null hypothesis. The study concluded that financial performance of MFIs in Meru County has increased moderately. Thus, there is need to adopt AIS in order to improve in financial performance.

**Keywords:** *Accounting Information System, Financial Performance, Financial Institutions*

# 26. Digital logistics systems and supply chain performance of tea factories in Meru County

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience

## Abstract

The logistics sector has crucial impact to the economic performance of any country. This is due to the fact that goods and services can only be availed to consumers through the use of Logistics. Logistics has gradually evolved over the centuries, with the fourth industrial revolution heralding better performance for Logistics, because it brings about integration and connectivity of all Logistics functions include: Transport, Warehousing and Inventory. Some of the Digital technologies used in Logistics are; IoT, AGV and RFID. The implementation of these technologies brings about Digital Logistics Systems, that comprise of: Transport Management Systems, Warehousing management systems and Inventory Management Systems. Many Manufacturing and Logistics companies have heavily invested in the implementation of Digital Logistics Systems. However, the case is different for the Agro-processing Industry, where Tea Factories lie. There has been a low uptake of Digital Logistics Systems in many Tea Factories around the country, with many putting their focus on automating their production function only. Meru County is one of the Tea Growing areas with Tea being the second most profitable cash crop in the region. This shows how significant it is to digitalize all the logistics functions involved in availing the end-product of this influential cash crop to the consumer. Studies have also shown that there is still a tangible gap between academic literature in the theory of Logistics 4.0, which is Digital Logistics, and its practical application across industries especially the Agro-processing ones in Africa. This study will seek to determine the influence of Digital Logistics Systems on Supply Chain Performance of Tea Factories in Meru County. The theories adopted in this study are: Material Flow Theory, Theory of Constraints, Six Sigma Theory and Supply Chain Operations Reference Model. This study will use Analytical Cross-Section Research Design, with the research approach being quantitative in nature. The target population will be 1,230 respondents, with a sample size of 302. Stratified sampling technique will be used to sample the target population. The sample size will be determined using the Slovin's formula. Purposive selection will be done when selecting respondents. Data collection instruments will comprise of both primary and secondary data, with questionnaires being used as the primary source of data. Construct and content validity will be used to check the validity of research instruments. Representation of data will be done through tables. Data will be processed by editing, coding, entering and cleaning the data. Data collected will be analysed using descriptive statistics with the help of SPSS.

**Keywords:** *Supply Chain Management, Digital logistics, Warehousing management*

# 27. Computerized Accounting Systems and financial performance of insurance companies in Kenya

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience

## Abstract

Computerized accounting systems represent a technological evolution in financial management, replacing traditional manual accounting methods with automated processes. These systems leverage software and digital tools to streamline and organize various accounting functions within an organization. The study aims to address specific objectives, each focusing on different aspects of the computerized accounting systems. For instance, the study will look into how Kenyan insurance companies' financial performance is affected by automated internal control systems. The purpose of the study is to evaluate the effects of computerized accounting systems on the financial performance of insurance companies in Kenya. Specific objectives include: To find out the effect of automated internal control systems on the financial performance of insurance companies in Kenya, To establish the effect of automated data processing on the financial performance of insurance companies in Kenya, To determine the effect of relational database management on the financial performance of insurance companies in Kenya and To examine the effect of automated reporting on the financial performance of insurance companies in Kenya. This study's significance lies in its contribution to the understanding of factors that may improve the financial performance of insurance companies in Kenya. By exploring the impact of automated internal control systems, automated data processing, relational database management, and automated reporting systems, this study will provide valuable insights for insurance companies seeking to enhance their financial performance. The study will adopt a descriptive correlational research design as a result of the ability of the design to accurately portray the characteristic of a phenomena. The target population is composed of 4060 respondents from the 58 companies as given by the IRA (2020) report. The study shall then use stratified random sampling as well as purposive sampling to arrive at the required Sample. The study will then use Yamane (1964) formulae in calculating the required sample, sample size of 364 will be considered. Data collection tool will be questionnaires that are designed in a structured way to capture all the study objectives under review. The data collection process will be through the trained research assistants that will use a drop-and-pick method in administration of the questionnaires.

**Keywords:** *Computerized Accounting, Insurance Company, Financial Performance*

# 28. Brand loyalty and customer citizenship behavior among students of selected universities within Mount Kenya region

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience

## Abstract

Enrollment in Kenya' public universities has been declining. This study seeks to determine the effect of brand loyalty on customer citizenship behavior among students of selected universities within Mount Kenya region. The study is anchored on Keller brand theory. The study adopted a descriptive research survey. The accessible target population was 3000 4th year students of selected universities within Mount Kenya region. The study used sampling formula proposed by Israel (2009) to obtain the required sample size of 254 respondents from the study. Primary data was collected using both closed and open-ended questionnaires. The questionnaires were carefully structured and pre-tested and adjusted to meet the demands of the study. Data was analyzed using descriptive and inferential statistics. According to correlation outcome, brand loyalty had a strong positive and significant correlation with customer citizenship behavior ($r = 0.658$, $p = 0.000$). Regression findings showed that brand loyalty had a positive and significant effect on customer citizenship behavior ($\beta = 0.174$, $p = 0.002 < 0.05$). The study concluded that brand loyalty contributes significantly to enhanced customer citizenship behavior. The university management should create brand loyalty of the university by ensuring that they offer quality education which can enhance competitiveness and thus increase the number of students enrolling in the universities.

**Keywords:** *Brand loyalty, customer citizenship behavior, universities in Mount Kenya region*

# 29. Digital marketing and organizational agility of Saving and Credit Cooperative Organizations (SACCOs) in Meru Town, Kenya.

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience

## Abstract

Savings and Credit Cooperative Organizations (SACCOs) are essential for economic growth, providing financial services such as deposits, loans, savings accounts, money transfers, insurance, and payment services. Despite the availability of digital media to enhance business processes and organizational agility, its adoption among SACCOs is relatively new. This study aimed to investigate the impact of digital marketing on the organizational agility of SACCOs in Meru Town, Kenya, focusing on social media, mobile, and website marketing. A descriptive research design was employed to examine the relationship between digital marketing and organizational agility. The study targeted five SASRA-licensed SACCOs in Meru Town, collecting data from 52 respondents through a semi-structured questionnaire and using a stratified sampling method. A pilot study with five respondents ensured the reliability and validity of the questionnaire. Data analysis involved descriptive and inferential statistics, including tabular, graphical, and numerical representations, and multiple linear regression to explore the relationship between digital marketing and organizational agility. Results indicated that social media, mobile, and website marketing positively influence SACCOs' organizational agility, with an R-squared value of 0.180. This means that 18% of the variance in organizational agility is explained by these digital marketing strategies. However, the moderate explanatory power suggests other factors also impact organizational agility. The study encourages decision-makers to integrate digital strategies into a broader framework of organizational transformation and adaptation. The findings contribute to the understanding of how digital marketing strategies intersect with organizational agility, emphasizing the importance of a holistic approach to digital integration in enhancing SACCOs' resilience and responsiveness to change. In conclusion, the study highlights the significant role of digital marketing in enhancing the organizational agility of SACCOs, indicating that by adopting comprehensive digital strategies, SACCOs can improve their resilience, responsiveness to change, and overall engagement with their ecosystem.

**Keywords:** *digital marketing, organizational agility, SACCOs, social media marketing, mobile marketing, website marketing*

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# 30. Sustainability reporting and financial performance of commercial banks in Kenya

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience

## Abstract

This concept paper explores the relationship between sustainability reporting and the financial performance of commercial banks in Kenya. It aims to provide an overview of existing literature, identify research gaps, and propose a framework for further investigation. The paper highlights the growing importance of Environmental, Social and Governance (ESG) considerations in the banking sector, outlines potential mechanisms through which ESG factors can influence financial performance, and suggests avenues for future research.

**Keywords:** *Sustainability Reporting, Commercial Banks, Environmental Scoial and Governance (ESG)*

CONFERENCE PAPERS

# 31. Public Procurement price variance in Kenya: extent, drivers, and proposed mitigation elements.

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience

## Abstract

Developing economies, often dependent on donor funding and debt, such as Kenya could benefit from sealing budget leakages. Public procurement price variance is deemed a key inefficiency in public expenditure contributing to the loss of colossal amounts of Money. Mechanisms to achieve realistic public procurement prices are stipulated in the existing public procurement regulatory regime; However Price variances, manifesting in inflated tenders, are abound. The extent and drivers are yet to be empirically examined. This study adopted an exploratory approach to examine the extent of public procurement price variance; by conducting variance analysis of market prices and prices of goods contained in procurement contracts of 336 public procuring entities (Ministries, Departments, and Agencies) in Kenya in the 2022/2023 Financial Year. Analysis of data drawn from a random sample of 40 MDAs, indicates that all items acquired by MDAs were overpriced: at between 20% and 220% of the market price. Analysis of drivers of overpricing ranked: "budgeted kickbacks/bribes"; "Response to Late Payments by MDAs"; "Collusive Bidding"; and "Over-use of non-competitive methods"; as key drivers. The study reviewed the price oversight mechanism of the public procurement system in Kenya and recommends the adoption of a live internal public procurement audit model to monitor and oversight pricing. This will require a review of the regulatory regime to entrench the internal procurement audit model into the public procurement process. The study also recommends a public procurement study to examine the extent and magnitude of procurement price variance across Kenya and its fiscal effect on the Economy.

**Keywords:** *Public Procurement Overpricing, Procurement Price Variance, Public procurement overpricing; Internal Procurement Audit.*

# 32. Uptake of digital innovations on financial performance of commercial banks in Kenya.

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience



## Abstract

The rapid evolution of digital innovations has transformed the banking sector globally, and commercial banks in Kenya are witnessing profound transformations in their operations driven by digital innovations. Despite the momentous benefits associated with digital innovations, a gap persists in realizing the precise influence of these innovations on financial performance of commercial banks. This study sought to assess the effect of uptake of digital innovations on financial performance of commercial banks in Kenya.. The study was guided by; Rogers Diffusion of Innovation theory, Evolutionary Theory of Economic Change, Disruptive Innovation theory and Theory of Dynamic Capabilities. The study adopted Positivism philosophy and a target population of 1,470 employees from the 39 Commercial Banks in Kenya were utilized in the study. A sample size of 315 comprising of senior management, supervisory management and junior officers was reached at by use of stratified random sampling technique. A descriptive study design was employed and primary data was collected using structured questionnaires while secondary data was obtained from banking sector supervisory and innovation survey reports. Pilot test was carried out to estimate the reliability and validity of data collection instruments. Reliability was estimated using Cronbach's Coefficient Alpha while content validity was tested using Kaiser-Mayor-Oklin and Bartlett's test of sphericity. Descriptive analysis was presented using frequency tables, pie charts, and bar graphs. Panel linear regression model was used where, a simple linear regression model was applied for each variable, then a joint model was done to determine the joint effect with significance level of $P<0.05$. The model was tested for linearity, normality, heteroscedasticity and multicollinearity. The findings were 89%($R2=0.89$, $F=396.633$, $P<.0001$) of the variations in commercial banks ROE were explained by digital process, product, marketing and organizational innovations. There was positive and significant correlation between uptake of digital innovations and financial performance of commercial banks (ROE, $P<0.05$). The study recommends that commercial banks leverage talent development strategies, strategic innovative collaborations, prioritize customer centrality, embrace decentralized decision making and stay abreast with regulatory requirements so as to positively and significantly improve financial performance. To optimally benefit from digital innovations, commercial banks need to invest in GreenTech products, navigate content creation complexities and implement agile management policies to flatten hierarchies that stifle innovation. Policy makers need to provide clear guidelines and harmonization of regulatory environment, **Keywords:** *Digital innovations, Financial performance, Talent development, Regulatory framework, GreenTech products, Technological infrastructure*

# 33. Effect of budgetary control on financial performance of public universities in Mount Kenya region, Kenya.

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience



## Abstract

Managers use budgetary control to match financial performance objectives with budgets, compare budgets with the actual outcomes, and implement essential modifications. Attaining robust financial performance stands as a fundamental goal for any prosperous organization. Nonetheless, public universities in Kenya persist in encountering obstacles in their financial performance. The main objective of the research was to establish the effect of budgetary control on the financial performance of public universities located in the Mount Kenya Region of Kenya. The specific objectives for the study were; to establish the effect of budget planning, budget implementation, budget monitoring and budget participation on financial success of the public universities in Mount Kenya region. This research majorly used the hypothesis of budgeting, the agency hypothesis and the stakeholder's hypothesis. The design used in the investigation was descriptive. The target population was 7 universities located in Mount Kenya Region. The specific respondents were the 284 heads of departments in both Academic and Administration divisions of the universities. Since the target population was small, all the 284 respondents were used in the study. Collection of data for this study was conducted through the implementation of structured questionnaires.. Data were analyzed using descriptive techniques, correlations and regressions. The analyzed data were presented by use of the charts and tables. The study results showed that budgetary planning had a positive and significant effect on financial performance of public universities. Further results showed that budgetary participation had a positive and significant effect on financial performance of public universities. In addition, results showed that budgetary monitoring had a positive and significant effect on financial performance of public universities. Further results showed that budgetary implementation had a positive and significant effect on financial performance of public universities. The study concluded that most public universities were not able to fully involve their employees in the budgetary process. Further most public universities employees are not committed to ensuring an effective budget process. The study concluded that though the public universities had budgetary committees the committees were not able to periodically meet and review the budget performance. In addition, most public universities budget policies were not able to help in monitoring budget spending limits. Further, budget auditing enhanced the performance of the institutions. Further, effective communication and transparency during the budgetary process enhanced the financial performance of the universities. Universities must work with budgetary control techniques that contribute significantly to improving the financial performance of universities because of their effectiveness. Therefore, to improve the budgetary control measures, it is recommended that the university should give wide attention to developing budgetary control through proper planning, monitoring, implementation of the budgets as well as allowing participation of employees in the budget process. **Keywords:** *Budgetary control, Financial Performance, Higher Learning Institutions*

# 34. Local environmental stewardship and restoration of wetlands in Uringu ecological zone, Meru County, Kenya

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience



## Abstract

The purpose of the study was to explore local environmental stewardship efforts being employed for protection of the diversity of wetland habitats, flora and fauna within Uringu ecological zone. The study explored factors that are either enabling or inhibiting the success of environmental stewardship. The study carried out interviews through a focus group method with 65 members of Kieiga Conservation SHG, a local community based organization(CBO) involved in environmental conservation within Uringu ecological zone. The study focused on restoration of two types of wetland through afforestation of Kieiga forest, which forms part of Nyambene ranges. The 10 year old afforestation project by the CBO focused on restoring rivers and swamps. The study observed that well managed wetlands improve water quality as well as serving as important nursery and breeding areas for animals, fish and birds. Wetlands also serve as a good Source of food such as fish and rice. The study further observed that two springs that had dried up prior to the reforestation project were now restored and some members of the neighbouring community had harvested piped water for their homes. Members were asked to indicate their perception on the benefits accrued from the restored forest. On a likert scale of 1-5 the responses yielded the following results: A source of animal grazing and watering points( mean of 4.2),source of fuel and building materials (4.1), domestic water supply (4.68)),Research and education (3.3),recreational and aesthetic sites for bird watching, hunting, and fishing(3.8) Key challenges and threats to wetlands identified in the study include encroachment for settlement and agriculture ,pollution, Over-exploitation of wetland goods and services and other human land degradation practices. The study recommends Construction of water pans by local CBOs to store storm water in order to create more watering points, Encourage appropriate and sustainable land uses that can be easily supported by the fragile environment, Promote water and soil conservation measure to curb soil erosion and reclamation of river banks through restoration of indigenous trees.

**Keywords:** *environmental stewardship, wetland restoration, Sustainable land use.*

# 35. Trade unionism in Public universities in Kenya: a boon or a curse to university leadership?

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience



## Abstract

A trade union is an organized association of workers formed for the protection and promotion of their common interests. This Study targets to investigate the conditions under which a union positively in a health way increases wages, and explores ways of modeling the competing preferences of unions and management. This descriptive, cross sectional study , explores trends in two measures of union power – union density and union coverage – over the period 2010 to the most recent year for which these data are available. In Kenya, there are several trade unions for different cadre of staff. Among them are Universities' Academic Staff Union (UASU), Kenya Universities Staff Union (KUSU) and KUDHEHA. UASU is a labor based union for academic staff in public universities The study utilize systemic review investigate conventional economic analysis help in defining and measuring the success of labor unions and democratic indicators unions. Utilizing secondary data analysis with emphasis on themes based on grounded theories in organizational structure, democracy, job satisfaction, negotiation theories are utilized as grounded theories to investigate in themes. These indicators combine two measures: union density and the relative union-nonunion wage gap. The indicators are applied to describe the movement of union welfare in the university settings over the past 15 years, the differences in union success among university staff workers, and the variation in union well-being across university. Population and sample; This study further investigated Union Membership and density, Challenges facing the trade union movement, function, role of unions in democratization of individuals, groups, and institutions. Results; Kenya has two federations, COTU (K) and TUC-Ke. There are about 50 registered trade unions, most of which (44) are affiliated to COTU (K) while a few such as the Kenya National Union of Teachers (KNUT), Union of Kenya Civil Servants (UKCS), Universities Academic Staff Union (UASU) and the Kenya Universities Staff Union (KUSU) affiliated to the newly formed Trade Union Congress of Kenya (TUC-Ke). Conclusion The study established that the trade unions mostly use letters, mails, notice boards as well as phone calls to communicate with their members and leaders. To make the unions visible, trade unions invested in the use of campaigns, proper representation and negotiation of pro worker CBAs that effectively address their concerns as workers. Most of the unions have engaged in social dialogue through CBA negotiations as well as in dispute resolutions to enhance industrial harmony. Through the social dialogue set up, most unions have been able to negotiate their CBAs.unions experience challenges which include Limited financial and human resources for the operations of the unions, Establishing an effective and fully functional organizing policy, strategy and team, Continuously sensitizing union leaders and members through education and training on labour laws and industrial relations, including sector specific labour matters, Pooling relevant human and capital resources for effective running of the union operations and most important internal democratization and accountability in union. **Keywords:** *union strategy, consensus, democracy, staff, Institutions*

# 36. Organizational behavior: manning multi-generational perspective expectation for performance.

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**Subtheme:** Business and Economics - Sustainable Entrepreneurship in Business & Economics for climate resilience



## Abstract

For the first time in history, there are five generations in the workplace.; Traditionalists—born 1925 to 1945, Baby Boomers—born 1946 to 1964, Generation X—born 1965 to 1980, Millennia's—born 1981 to 2000, Generation Z—born 2001 to 2020, (preparing for (GenAlpha 2021-). The commonalities are more than the difference, but often we focus on differences that are obviously due to each generations experience and circumstance, to the detriment of health life-work relationship and workplace organizational performance. The study method utilized is systematic review of studies on differences and commonalities of the generations. Unveiling and unmasking the myths that comes with Multigenerational presence in organizations. This knowledge's goal is form basis for intervention that create multigenerational teams for wellbeing at work place as well as performance and success of the organization. Results indicate that there are generally four generations in modern workplace. Each of the generation carry with the characteristics that peculiar to them, as well as history with experiences different epoch events in their time and shaped their perspective, as well as their value systems both at work place and personal life. The study also unveiled multiple myths that contribute to making it difficult for multigenerational team to work together. The study recommends models of team building interventions in work place and organizations as well as in community setting for wellbeing of the organizations and staff.

**Keywords:** *Multigenerational, generations, traditionalist, baby boomers, generation Z, Millennia's Gen Alpha*

**SUBTHEME 3: Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience**

PRE-CONFERENCE PAPERS



# 37. On the investigation of structure and properties cyclic codes over gf(2) and application of these codes to encryption and decryption of data.

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

Cyclic codes are a crucial subset of linear error-correcting codes with distinct algebraic properties that facilitate efficient encoding and decoding. These properties make them highly suitable for various cryptographic applications, including encryption, decryption, error detection, and error correction. The research delves into the theoretical foundations of cyclic codes, focusing on their algebraic structures, including generator polynomials, invariance under cyclic shifts, and closure properties. The study also investigates encoding and decoding techniques, as well as error correction capabilities, using both analytical and practical approaches. Cyclic codes are implemented in various real-world cryptographic systems for tasks such as Redundancy Check, error-checking, and error correction. Their structure allows for efficient hardware and software implementations using shift registers. The research highlights the practicality and efficiency of using cyclic codes in secure communication protocols, enhancing the reliability and security of data transmission. The findings reveal that cyclic codes, defined by their generator polynomial, exhibit invariance under cyclic shifts and closure under addition and multiplication. The length of a cyclic code is determined by the degree of the generator polynomial plus one. The study shows that these codes can be systematically organized, simplifying the decoding process. Practical applications demonstrate that cyclic codes are effective in encrypting and decrypting data, providing robust security measures for cryptographic systems.

**Key Words:** *Cyclic codes, Encryption, Decryption*

# 38. Depression, social media, deep learning, machine learning, natural language processing, and mental health

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

Depression is a prevalent mental health disorder affecting millions worldwide, with a significant impact on individual well-being and societal functioning. Early detection and intervention is crucial for mitigating its adverse effects. This study investigated the potential of utilizing social media data to predict signs of depression, leveraging deep learning techniques. Using a dataset comprising social media text posts, we developed a deep-learning model, specifically a Recurrent Neural Network with Long Short-Term Memory (RNN-LSTM) , for depression prediction . Our model achieved remarkable results, demonstrating an accuracy of 97%, outperforming traditional models. Moreover, we explored the ethical considerations surrounding the use of social media data for mental health prediction. We proposed guidelines and best practices for responsible and ethical data usage in mental health research, emphasizing privacy, consent, and confidentiality. This research contributed to the growing body of literature on leveraging social media data for mental health prediction and highlighted the potential of deep learning techniques in enhancing prediction accuracy. Additionally, our ethical framework provided valuable insights into addressing ethical challenges in this domain, promoting responsible and ethical research practices.

**Keywords**: *Depression, social media, deep learning, machine learning, natural language processing, and mental health*

# 39. A hybrid ensemble boosting model for enhanced blood donor retention

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

Emergency situations such as accidents, medical operations and diseases necessitate regular blood transfusion. In Kenya, seven people require a blood transfusion every 10 minutes yet the country suffers a shortage of blood supply. One of the reasons for the acute shortage is lack of proper donor retention strategies. Existing predictive models for blood donor retention are often based on single algorithms, which suffer from their inherent weaknesses and most of them have low predictive accuracies. The Light GBM algorithm employs leaf-wise growth strategy, excels in loss reduction and hence improves accuracy. However, this may lead to potential overfitting, on the other hand, the XGBoost algorithm employs a level-wise growth strategy, which is computationally intensive but incorporates a robust mechanism for combating overfitting, such as the regularization parameter, column sampling, and weight reduction on new trees. This study aims to develop a hybrid ensemble gradient boosting model based on XGboost and Light GBM. The hybrid ensemble model aims to leverage on the strengths of both algorithms to enhance robustness, stability, and generalization while mitigating their individual biases and reducing overfitting hence leading to more accurate and consistent predictions. The base models were trained in parallel with data obtained from blood banks in Kenya. A weighted ensemble model was created by assigning weights to the respective prediction results of each model, the ensemble model was then evaluated and the accuracy compared with the accuracy achieved by the individual algorithms. The ensemble model achieved a performance accuracy of 89.6% better than XGBoost (88.3%) and the Light GBM (87.8). This study will enable blood agencies to accurately predict blood donor retention, reduce constant donor recruitment efforts and hence save time and costs. Additionally, it will provide insights for targeted retention strategies, ensuring a steady blood supply, ultimately saving lives.

**Key words:** *Blood transfusion, Predictive Models, Blood bank.*

# 40. A systemic review of crop diseases detection and recommender models: techniques applications and future directions.

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

In modern agriculture, the timely detection and management of crop diseases are crucial for ensuring food security and minimizing economic losses. This systemic review delves into the current landscape of crop disease detection and recommender models, highlighting the techniques, applications, and potential future directions in this field. The review synthesizes findings from numerous studies, focusing on the technological advancements in disease detection methods, including imaging, spectroscopy, and machine learning algorithms. Furthermore, it examines the development and implementation of recommender systems that provide actionable insights for farmers and agronomists. The methodology involved a thorough search of relevant databases, including IEEE Xplore, ScienceDirect, and Google Scholar, to identify and synthesize studies published between 2018 and 2023. The review reveals that convolutional neural networks (CNNs) are the most widely adopted architecture for image-based crop disease detection, with modifications and advancements in CNN architectures leading to improved performance. Furthermore, the review identifies gaps in existing crop disease recommendation models, highlighting the need for large language models (LLMs) that can leverage textual data sources, such as agricultural reports and expert knowledge, to provide more comprehensive and context-aware recommendations. The study also examines real-world applications and deployment strategies of these models in precision agriculture and decision support systems, underscoring the importance of user-friendly interfaces and integration with existing agricultural practices. Finally, the review outlines future research directions, including the fusion of spatial transformer networks for enhancing the efficiency of disease detection models by accounting for spatial variations in plant images. Incorporation of LLM in crop disease recommender models and integration of explanation mechanisms is in AI crop models to enhance trust and interpretability in crop disease management. This systematic review serves as a valuable resource for researchers, agronomists, and technology developers working towards sustainable and intelligent crop disease monitoring and control strategies.

**Key words**: *Convolutional Neural Networks(CNNs), Large Language Models(LLMS), Recommender Models, Spatial Transformer Networks(STN), User Interfaces(UI).*

# 41. Suitability of mobile banking interfaces for the elderly users: a literature review

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience



## Abstract

This literature review evaluates the suitability of mobile banking interfaces for elderly users, a demographic that is increasingly engaged with digital platforms yet often encounters usability challenges. Given the critical role of mobile banking as a financial service, it is essential to understand how interface design impacts elderly users to ensure inclusive access. This review synthesizes findings from existing research on the unique needs and preferences of elderly users, identifying key factors that influence their interaction with mobile banking platforms. Support features of mobile phones, such as adjustable text sizes, voice commands, and touch sensitivity adjustments, are examined for their impact on usability for the elderly. The study design involves a comprehensive literature review, systematically analyzing articles from academic databases and industry reports published between 2019 and 2024. Sampling techniques include keyword searches and selection based on relevance and quality, focusing on studies addressing usability challenges and design solutions for elderly users. Key study tools utilized in this review include usability assessment frameworks and design guidelines tailored to the elderly. The review highlights that elderly users often face difficulties with small text sizes, complex navigation, and insufficient feedback mechanisms. Effective strategies identified include larger touch targets, simplified interfaces, and enhanced customer support, which significantly improve usability for this group. However, gaps remain in understanding how to integrate accessibility features without compromising user experience. This review underscores the importance of user-centered design principles tailored to the elderly, advocating for the incorporation of intuitive design and accessibility features in mobile banking interfaces. Financial institutions can better serve the aging population by addressing these challenges, thereby enhancing overall user experience and promoting digital inclusivity.

**Keywords:** *Mobile Banking, User Interface, Human Computer Interaction*

# 42. Risk predictive model for coronary artery disease using machine learning: a systematic review

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

Heart disease is a regular occurrence and one of the leading causes of death all over the world. Among these diseases, coronary artery disease (CAD) is one of the common diseases around the world. Early identification and accurate risk prediction of Coronary Artery Disease (CAD) can enable timely interventions, potentially reducing morbidity and mortality rates associated with the disease. Predicting cardiac illness is a difficult undertaking, it is necessary to automate the process in order to avoid the risks connected with it and to inform the patient well in advance. This paper presents a systematic literature review of existing Risk Predictive Model for Coronary Artery Disease using Machine Learning. The paper provides a detailed analysis of Machine Learning Techniques such as Random Forest Tree Classification, Decision Tree Algorithm and K -Nearest Neighbor Algorithm (KNN) and Logistic Regression in relation to their effectiveness and accuracy in predicting CAD. The existing Machine Learning techniques' performance are evaluated on the basis of their strength, weakness and the level of accuracy in predicting CAD. The study reveals the need to improve the accuracy of Machine Learning techniques by leveraging on the power of various Machine Learning techniques for early identification of individuals at high risk of developing coronary artery disease (CAD). The study also proposes integration of a wide range of patients' data to enhance the accuracy and effectiveness of machine learning techniques in risk prediction.

**Keywords:** *Coronary artery disease, Risk prediction, Machine learning, Predictive model.*

# 43. A review of the literature on deep type 2 Fuzzy Logic in explainable AI for building construction cost estimation

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience



## Abstract

Accurate cost estimation is essential to the successful completion of building projects in Kenya's dynamic construction industry. This study of the literature looks at how Explainable Artificial Intelligence (XAI) and Deep Type 2 Fuzzy Logic can be combined to improve cost estimation procedures in building development. The study presents an advanced, AI-driven model and critiques conventional cost estimation techniques by combining quantitative and qualitative research methodologies. In order to fill these gaps, the study carefully examines the literature to show where conventional methods fall short and where advanced AI applications can step in. It offers a thorough theoretical framework that makes use of artificial intelligence for predicting strength combined with fuzzy logic's skill at addressing uncertainty. The evaluation uses a stratified sampling technique to collect data through surveys, interviews, and historical data analysis. It classifies construction projects according to their size, type, and location. The efficiency of XAI models in managing complicated factors in building cost estimation is revealed by a critical investigation of these models in conjunction with Deep Type 2 Fuzzy Logic. The knowledge gathered from this research not only enhances scholarly debate but also aids Kenya's construction sector in a practical way by facilitating better decision-making and producing more accurate, transparent, and reliable cost estimates for building project management.

**Keywords:** *Building projects, Deep Type 2 Fuzzy Logic, Explainable Artificial Intelligence, Construction Cost Estimation, Kenya's Construction Sector*

# 44. Determinants of career pathway selection in Competency-Based Education

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

In Competency-based Education (CBE), learners acquire skills and knowledge through a personalized and flexible learning path, based on their prior knowledge and skills. Selecting a career pathway is crucial and needs to be thought of carefully because of its long-term impact on an individual's future career. With the implementation of competency-based education in Kenya, learners will need to choose from four career pathways before joining senior high school. Knowing the factors that may determine learners' career pathway selection can be helpful in the development of strategies that may help them make informed decisions. In this study, data from 1575 teachers teaching Grade 7 and Grade 8 learners in 151 junior secondary schools in Meru County were analyzed, to determine the variables associated with career pathway selection using principal component analysis, linear regression analysis, correlation analysis, and factor analysis. An online survey was used to collect the data. The research tool was subjected to two domain experts to assess the content validity and also two domain experts to measure the face validity of the tool used. The average rating for face validity was 75% and content validity was rated at 70%. A pilot study of 100 junior secondary school teachers teaching Grade 7 and Grade 8 learners was conducted in Igembe North sub-county, in Meru County. A reliability test was done using SPSS to measure the Cronbach Alpha internal consistency of the instrument which was found to be 0.834%. Results showed that interest, performance, extracurricular activities, career goals, and the job market were critical factors in determining the career pathway selection of learners in competency-based education. The study provides insights into the factors determining career pathway selection among junior secondary school learners in Meru County. The study's results could inform policy aimed at improving competency-based education and helping learners make informed decisions about their about their future education and career paths.

**Keywords:** *Competency-Based Education, Career Pathway, factors, Interest, extracurricular activity, career goal*

# 45. The role of IoT solutions in transforming mobility in transport sector

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience



## Abstract

The integration of Internet of Things (IoT) solutions is revolutionizing the transportation sector, enhancing safety, sustainability, and efficiency. This paper examines the impact of IoT on traffic management, public transit, and logistics, highlighting how these solutions are transforming mobility in the transportation industry.The research utilized a mixed-methods approach, involving both quantitative and qualitative data collection and analysis. It surveyed stakeholders like governmental organizations, for-profit businesses, and private citizens to understand their current use of IoT technology, and examined case studies of successful IoT-based transportation initiatives to identify best practices and lessons.The adoption of IoT solutions in the transportation sector has significantly improved traffic management, with 75% of respondents reporting less congestion and 60% reporting higher public transportation efficiency. IoT-based logistics management systems also reduced delivery times and transportation costs by 25% and 30%, respectively.This research is crucial because it sheds light on how IoT technologies can revolutionize logistics management, public transit efficiency, and traffic flow. By leveraging a systematic review of existing research, the study not only explores the design and application of monitoring models but also highlights the transformative impact of IoT across industries, including transportation.Sensors, connectivity solutions, and data analytics are the cornerstones of IoT technology. By implementing these technologies in the transportation sector, organizations can achieve significant improvements. Real-time monitoring of vehicles allows for proactive maintenance, preventing breakdowns and delays. Traffic data can be used to optimize routes, reducing congestion and travel times. Predictive analytics can identify potential safety hazards, leading to improved passenger security. Additionally, personalized experiences for passengers can enhance the overall service quality.Ultimately, the benefits of IoT in transportation extend beyond operational efficiency. By addressing air pollution, auto accidents, and infrastructure maintenance needs, IoT has the potential to create a more sustainable transportation system. This, in turn, will improve the overall quality of life for citizens and spur economic growth. Furthermore, this research serves as a foundation for further development in the field, facilitating the establishment of robust and interoperable transport monitoring systems. Implementing these systems in public service vehicles can unlock the vast potential of IoT, leading to a future of safe, efficient, and sustainable transportation.

**Keywords:** *Internet of Things, Smart Mobility, Public Transportation, Fleet Management, Real-time Data*

# 46. The role of citizen journalism in documenting and reporting climate change and adaptation efforts.

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

Citizen journalism has emerged as a pivotal force in documenting and reporting climate change and adaptation efforts. This phenomenon leverages the accessibility and immediacy of digital platforms, enabling ordinary individuals to contribute valuable data and narratives that complement traditional media and scientific discourse. This paper explores the multifaceted roles of citizen journalists in climate change documentation, highlighting its contributions to raising awareness, providing real-time data, and influencing policy through grassroots engagement and fostering community resilience. By leveraging social media platforms and digital tools, citizens can document environmental changes, and share local adaptation strategies. This paper examines case studies, highlighting the effectiveness and challenges of citizen journalism in climate reporting. It concludes with recommendations for enhancing the credibility and impact of citizen-driven climate narratives. The study is grounded in the theories of participatory communication and public sphere. Participatory communication theory posits that inclusive and active involvement of community members in communication processes leads to more democratic and effective outcomes. This aligns with the role of citizen journalism, where community members actively document and report on climate change. Public sphere provides a framework for understanding how citizen journalism creates a platform for public discourse, enabling the exchange of ideas and fostering democratic engagement in climate change discussions. The study will adopt a descriptive survey design using both quantitative and qualitative approaches. Data will be collected using Focus Group Discussions, Key Informant Interviews, Questionnaires, Observations, Secondary Data, and Digital Data Analysis. Data will be analyzed using both descriptive and inferential statistics. The study acknowledges numerous potential limitations such as generalizability since findings may not be generalizable across different contexts due to cultural, social, and environmental differences, transferability of findings may be limited by lack of infrastructure, internet accessibility and community engagement levels. The findings will be disseminated through learned conferences, seminars, and workshops.

**Keywords:** *Citizen Journalism, Climate Change Reporting, Digital Platforms, Community Resilience, Participatory Communication, Public Sphere*

CONFERENCE PAPERS

# 47. Comparative study on matching algorithms used in biometric systems and parameters that affect them

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

Biometrics continue to gain popularity due to their ability to uniquely identify an individual as compared to other method. The performance of a biometric system depends on reference threshold. However, the accuracy of the threshold and its adaptability leads to two kinds of errors that these biometric systems experiences namely False Acceptance Rate (FAR) which is a situation where the system accept impostors into the system; and the other one is False Rejection Rate (FRR) which is the number of genuine users who are rejected by the system. There are many algorithms that have been proposed but their performance and their accuracy remains a major concern in the industry. Due to the nature of biometrics, each feature varies from time to time even though they belong to the same individual. In this, study we explore and evaluate existing CCN algorithms that have been proposed in addressing the performance of these biometric systems together with parameters that affect them.

**Keywords:** *Biometric systems, Biometric algorithms*

# 48. Direction aware personalized privacy preservation framework in participatory sensing

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

Mobile phone users in participatory sensing systems are requested to collect information from their nearby locations. The user's location should be concealed all the times. Several techniques in participatory sensing have been proposed recently to provide user protection. These techniques ignore the fact that mobile users in most cases are not stationary but rather moving objects, characterized by inevitable time varying uncertainty changes. Besides, they do not treat each user as an individual with special privilege. Users have personalized privacy requirements whose violation by other peers results in unauthorized access of information hence a privacy intrusion. The knowledge of user movement by an adversary poses privacy threats in participatory sensing systems. Existing techniques tend to protect mobile users against being identified by associating their queries with query location and background information, paying no attention to impacts of movement on privacy. We propose direction aware personalized privacy preservation framework in participatory sensing. In this paper mobile objects are assigned tocollect data in stated moving directions.

**Keywords:** *Direction, directional attacks, participatory sensing, prediction, privacy conditions*

# 49. Revolutionizing soil quality monitoring with IoT: a comprehensive system design

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience



## Abstract

In the era of precision agriculture, the need for real-time soil quality monitoring has become increasingly crucial. This study presents the design of an innovative IoT-based soil quality monitoring system that integrates advanced sensor technologies, efficient data collection mechanisms, and robust data analytics techniques. By leveraging the power of the Internet of Things (IoT), this system aims to revolutionize the way farmers and agronomists assess and manage soil conditions, ultimately enhancing productivity and sustainability in the agricultural sector. The proposed system employs a multi-layered approach, combining sensor integration, cloud computing, and mobile applications to create a comprehensive monitoring solution. Sensors for measuring soil quality parameters are strategically deployed in the soil, with a microprocessor and microcomputer collecting and transmitting real-time data to a cloud platform via wireless communication. A mobile application serves as a user-friendly interface, allowing remote access to soil data and ensuring low power consumption for extended operation. To enhance the accuracy and reliability of soil quality predictions, the study introduces a novel data prediction strategy based on the deep Q network (DQN) reinforcement learning algorithm. Towards achieving real-time monitoring with the required accuracy, the system will maintain a 3-second window of the soil properties exact acquisition moment, ensuring timely and precise data for informed decision-making. In conclusion, this IoT-based soil quality monitoring system represents a significant advancement in the field of precision agriculture. By integrating cutting-edge sensor technologies, efficient data collection mechanisms, and advanced predictive models, the system enables farmers and agronomists to diagnose soil conditions with unprecedented accuracy, ultimately supporting sustainable agricultural practices and enhancing overall productivity.

**Keywords:** *Internet of Things (IoT), Soil Quality Monitoring, Sensor Integration, Data Analytics, Precision Agriculture, Sustainable Agriculture*

# 50. Responsible use of Generative AI in research: are Kenyan universities ready?

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience



## Abstract

As generative artificial intelligence (GenAI) continues to revolutionize the landscape of academic research, universities in Kenya are adapting this technology to redefine scholarly activities. This article examines the different responses of Kenyan higher education institutions to the integration of GenAI in research practices. Through reviews of policy adaptations, ethical considerations, and capacity-building initiatives, we explore how these universities are balancing the opportunities presented by GenAI with the challenges it poses to academic integrity and intellectual property rights. We highlight pioneering case studies from leading Kenyan universities that illustrate innovative approaches to GenAI deployment in research, including collaborative efforts with international bodies like UNESCO for policy guidance. The article also addresses the critical role of infrastructure development and digital literacy in facilitating a conducive environment for GenAI utilization. Based on an in-depth analysis of institutional policies, we provide insights into the proactive strategies adopted by Kenyan universities to harness the potential of GenAI while safeguarding ethical standards and fostering a culture of responsible AI use in research.

**Keywords:** *Generative Artificial Intelligence, Academic Research, Responsible Computing*

# 51. Harnessing Information Systems for Climate Action: A Librarian's Perspective

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

In the contemporary era, librarians play a pivotal role in addressing the global challenge of climate change by leveraging information systems to enhance climate action initiatives. This study explores the intersection of library science and climate science through the lens of a systematic review. The ideal situation hypothesizes librarians as proactive agents utilizing information systems to bridge the gap in climate knowledge management. The identified problem lies in the underutilization of librarians' potential in climate action, creating a gap in efficient information systems for climate research. The objective of this systematic review is to assess existing literature, methodologies, and initiatives where librarians actively contribute to climate action. The methodology employed involves a comprehensive systematic review of peer-reviewed articles, reports, and case studies, ensuring a thorough exploration of the librarian's role in climate-related information management. The research design follows established systematic review protocols, ensuring the validity and reliability of the findings. Quality assessment criteria are applied to selected studies to uphold the consistency of the review process. Key findings reveal that librarians significantly contribute to climate knowledge management through information systems, enhancing the accessibility and dissemination of critical climate data. The brief discussion emphasizes the importance of integrating librarians into interdisciplinary collaborations addressing climate change. The application of these findings lies in informing institutions, policymakers, and library professionals about the potential impact of librarians in climate action. Conclusively, the systematic review underscores the need for recognizing and empowering librarians in the broader discourse on climate resilience. Recommendations include the integration of climate literacy into library science education, fostering collaboration between librarians and climate scientists, and developing information system frameworks tailored to climate research needs. This research contributes to the ongoing dialogue on the vital role of librarians in achieving sustainable climate action.

**Keywords:** *Librarianship, Information Systems, Climate Action, Knowledge Management, Interdisciplinary Collaboration.*

# 52. Artificial Intelligence (AI) for climate action: bridging Kenya's digital divide for a greener future

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience



## Abstract

This paper explores the innovative use of Artificial Intelligence (AI) in promoting climate action and bridging the digital divide in Kenya, under the theme "Science in the Service of Climate Action." Our research utilizes a mix of qualitative and quantitative methods to examine the current state of digital access and infrastructure, identifying key socioeconomic barriers to digital inclusion. We highlight novel AI-driven solutions that mitigate climate change impacts, focusing on applications in climate monitoring, agriculture, and renewable energy. Case studies and policy analysis reveal the transformative impact of successful AI initiatives on environmental sustainability and digital equity. We offer specific policy recommendations to support AI implementation, advocating for a collaborative framework involving government, private sector, and civil involvement. This paper concludes by discussing the limitations of current initiatives and proposing directions for future research. Through these insights, we underscore AI's potential to foster community resilience and enhance environmental health, ensuring equitable digital opportunities for all Kenyans

**Key words:** *Artificial Intelligence, Climate Change, Climate Action*

# 53. The role of television shows in mitigating climate change in Kenya

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience



## Abstract

The media plays a pivotal role of informing, educating and entertaining viewers. This informative role involves the use of computing and informatics technologies to disseminate information to the masses. Governments and their citizens depend on the mass media to disseminate information and set agenda for development and other activities. Electronic media such as television form part of the mass media that wield the power to set and build agenda for climate adaptation and resilience. This paper explores the role and effectiveness of television in mitigating climate change through television news and other programmes coverage, aimed at informing the masses on the effects of climate change. The objective of this study was to trace the role and effectiveness of television in conveying information on green energy utilization and pollution mitigation. A purposive sampling was done to select TV shows airing agriculture/climate change content. Guided by the amassed literature and on-line survey, a case study research design of different Kenyan television shows was studied using thematic content analysis. The paper relied on secondary data gleaned from library research, internet sources and data published on the pertinent issue. The results show that television has a significant role to play on viewers' knowledge on the issue of climate change. However, Kenyan television has not lived to this reputation. In Kenyan newsrooms stories on climate change and environmental degradation are relegated to the background as they compete with political, health and economic matters in news that attract more public attention. The recommendations enumerate the mitigating roles that the media can play in efforts to curb global warming and the attendant climate change. There is need to give prominence to stories on matters environment. Global warming has led to depletion of natural resources and burning of fossil fuels has become a threat to the environment. This threat can be mitigated through well packaged and delivered messages using the media which is a powerful tool for disseminating information and diffusion of innovations and ideas.

**Keywords:** *Climate change, mitigation, environment, mobilization, agenda setting, Mass Media*

# 54. Use of social media for climate engagement and awareness among the young people in Kenya

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

Climate change presents significant challenges to the global community, and Kenya is not exempt from its effects. The effects of climate change have significantly influenced the livelihoods of people worldwide in aspects encompassing health, agricultural practices, transportation, education and beyond. This calls for innovative ways to address the climate change challenges. Engaging and raising awareness among young people about climate change is essential due to their high energy levels and greater effectiveness in transmitting knowledge. This helps bridge the gap in climate change awareness, particularly among the rapidly growing younger generation who will become future decision-makers. Additionally, this contributes to the promotion of a sustainable future in relation to efforts to address climate change. To effectively engage young people, we must align our approach with their behaviors. Mostly the youthful generation exhibit a way of living that involves a lot of interactive activities notably through the social media platforms. Given the increasing number of social media users and Kenya ranking as the top country in East Africa for social media usage, it is crucial to recognize the significance of utilizing social media for climate change initiatives. This study investigates the use of social media for climate change engagement and awareness among the young people in Kenya by the use of structured questionnaire with respondents from diverse parts of Kenya. Some of the findings indicated that about 33.3% respondents spend more than four hours daily on social media while 36.7% reported that they rarely encounter any climate change content on the platforms. 80% of the respondents believe that social media can lead to a real world action on climate change. The study will be used to inform strategy on the climate change action.

**Keywords:** *climate change, social media, young people, Kenya, climate change action, climate change initiatives*

# 55. Portable multi sensor participatory sensing application system for environmental monitoring

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

Mobile phone users in Participatory Sensing Systems (PSS) are invited to collect information from their immediate locations. Authors believe that sensor-equipped mobile phones will transform many sectors of Kenya economy, including environmental monitoring. Significantly, today's smartphones are programmable while others come with a growing set of cheap powerful embedded sensors, such as Global Positioning Systems etc. which are enabling the emergence of crowd sensing applications. Gas detectors and sensors play a critical role in ensuring safety, environmental protection, and industrial efficiency. With advancements in technology and ongoing research efforts, gas sensing technologies continue to evolve, offering enhanced performance, versatility, and applicability across diverse domains. Despite the stable growth of participatory sensing application worldwide, there is still little understanding of participatory sensing adoption and user's experiences in other countries, especially in Africa. These few research efforts have provided valuable findings and lessons for improving users' experiences and adoption; however, the participants in all these studies were drawn in the U.S., Europe, and Asia. The extent to which these findings about adoption and experiences generalize to other regions, such as Kenya, is still largely neither unaccounted nor unknown. To achieve this objective, the researchers conducted a questionnaire-based study involving 400 participants to investigate the possible key preconditions necessary for successful implementation of Participatory sensing in Kenya. To this end, we present a generic multi sensor tool that collects real time data simultaneously to monitor air quality. The selected multiple gases are carbon monoxide, carbon (IV) oxide, Ozone, particulate matter, methane, smoke, acetone, pressure, temperature, and humidity.

**Keywords:** *Participatory sensing, Air quality, Assessment, Embedded sensors, Portable sensing device*

**NB:** This work was supported in part by the National Research Fund (NRF), Kenya, Multidisciplinary Research, under Grant 2016/2017.

# 56. A review of the literature on seizing the potential of reliable, secure, and safe artificial intelligence systems for sustainable development

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**Subtheme:** Computing and Informatics - Leveraging Computing and informatics Technologies for Climate adaptation and resilience

## Abstract

The sustainable development goals (SDGs) can be greatly advanced by artificial intelligence (AI) through resource optimization, efficiency improvements, and the facilitation of creative problem-solving. However, utilizing this potential responsibly requires guaranteeing the security, dependability, and safety of AI systems. This review of the literature looks at how artificial intelligence (AI) can help sustainable growth while upholding strict safety, security, and trust norms. The development of trustworthy AI systems, ethical issues in the application of AI, and legal frameworks for security and safety are important areas of study. The assessment tackles the need for fair and transparent algorithms that ensure inclusion and eliminate bias by examining the ethical deployment of AI. It also covers legal structures and guidelines that control AI security and safety, showcasing industry case studies and best practices. The methods for creating reliable AI systems are examined, with a focus on rigorous design, validation, and ongoing process monitoring. The study provides a thorough overview of the opportunities and difficulties in this sector by synthesizing current knowledge and identifying gaps in the existing literature. It provides insights into the kinds of future policy and research approaches that are required to guarantee that AI balances associated dangers with a beneficial contribution to sustainable development. Stakeholders, including researchers, legislators, and practitioners, can work together to improve the integration of trustworthy, safe, and secure AI in accomplishing sustainable development goals by building on this synthesis.

**Keywords:** *AI, Policy Development, Regulatory Frameworks, Reliable AI Systems, Safety, Security, Trust, Ethics, and Sustainable Development*

**SUBTHEME 4: Engineering: Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.**

PRESENTATIONS

# 57. Role of formal and informal actors in sanitation delivery in Mukuru Kwa Reuben.



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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Possible interventions and options to address sanitation issues in informal settlements have been advanced through research. However, upscaling and improving fecal sludge management in informal settlements has been a challenge because of overpopulation, land tenancy issues, complex roles of stakeholders, and technical and political constraints. This study sought to investigate the role of formal and informal actors in sanitation delivery in Mukuru Kwa Reuben. The study used a case study design with a qualitative approach. Snowballing and purposive sampling techniques were used to enroll 52 participants, including Public Health Officers, Mechanical and Manual Pit Emptiers, Landlords, and actors from ministries, sanitation enterprises, and non-governmental organizations. Data was collected using focus group discussion and key informant interviews and analyzed thematically in NVivo version 12. The landlords, Mechanical and Manual Pit Emptiers were primary providers of sanitation facilities, however, they expressed that "cartels," controlled the provision of water and sanitation services. Nairobi Water and Sewerage Company provided connections to sanitation and water systems. The Public health officer expressed they were enforcing and coordinating sanitation, however, the Public Health Act cap 242 was cited as old with low fines. The UN-Habitat official expressed the role of a town multi-stakeholder forum in the delivery of basic sanitation services. FSM Alliance official expressed the role of capacity building as a component of coordinating fecal sludge management which could be built politically The NEMA official expressed the role of self-regulation and compliance assistance in ensuring that facilities comply with regulations. The FSM Alliance employee explained the role of targeted subsidies and user fees in maintaining non-sewered sanitation infrastructures. African Development Bank official discussed the role of urban sanitation investment funds as the traditional sources of funding were not enough. The study concluded that the governance of sanitation delivery in the slum was inadequate and fragmented due to the conflicting roles between actors, controlling cartels, unresponsive financial arrangement and partially implemented WASH Acts. The study recommends the need for more investment in sanitation services and coordination strategies to ensure improved sanitation in slums.

**Keywords:** *formal actors, faecal sludge management, manual operators*

# 58. Faecal waste collection practices performance of sanitation service chain in Marsabit town; Marsabit county, Kenya

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**Subtheme:** Engineering and architecture



**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Much of the evidence linking latrine promotion to improved sanitation focuses on reporting the size of short-term treatment effects rather than long-term impacts (Kim et al., 2017). While the literature focuses on latrine adoption, few studies evaluate sustained latrine use, even though the use of latrine is essential to achieve health benefits (Cairncross et al., 2016).. A cross sectional descriptive study design was employed for the study. Both qualitative and quantitative data were collected. The study majorly described the safely managed faecal waste and unsafely managed faecal waste in Marsabit town for the purpose of public health planning. Data was collected on individual characteristics by identifying the sources of water and types of toilets residents of Marsabit used for their daily activities. The study design aided the researcher to comprehensively understand the exposure risk factors to sanitation related illnesses that residents of Marsabit faced as they used their toilets. Sampling design of simple random was used to select the participants within the zones of Marsabit town and enabled each member of the population an equal chance of being selected. Qualitative was carried out using audio recording and duly-filled questionnaires. The recordings of respondent voice were transcribed into written texts and the data was compared with notes written by research assistants. Quantitative data collected at the households was analyzed using the descriptive statistics in SPSS version 25. Descriptive data was presented in tables. Out of total 612 Marsabit town respondents 18.79% (n=115) of participants used flushed to pit latrine, 24.02% (n=147) used ventilated and improved pit latrine, Pit latrine which contain slab was the preferred method of waste collection at 31.86% (n=195), 14.87% (n=91) used open pit, 1.47% (n=9) used composting toilet, 5.72% (n=35) used hanging toilet, and 3.27% (n=20) of participants had no toilet facility. Pit latrine with slab constitute highest classification of waste disposal 31.86% (n=195) followed by Ventilated improved pit latrine at 24.02% (n=147). waste collection practice along sanitation service chain was indirectly and directly influenced by economic status of the community for safe management and disposal. This community practice pit latrine with slab as the main form of waste collection at 31% (n=195). improved social economic status of the community through economic growth and wealth creation will improve effective waste collection practices along service chain.

***Keywords**: latrine, sanitation service chain, faecal waste*

# 59. Influence of operation and maintenance to utilization of sanitation facilities by women in Mukuru Kwa Reuben in Nairobi City County

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Accessing basic sanitation services is still a challenge in slums and sanitation needs of women at times remain unmet. This study aimed at assessing the effect of the operation and maintenance to the utilization of sanitation facilities by women in Mukuru kwa Reuben, Nairobi city county Kenya. The study was premised on the Health Action Process Approach and targeted all women aged 18 and above who consented and were the primary users of sanitation facilities and resident in Mukuru Kwa Reuben community. Sample for the study was 395 gotten using the Yamane formula. Sampling was by use of clustered and simple random sampling for women in households. The main instruments of data collection were questionnaire, focus group discussions, and observation check list. Quantitative data was analyzed for descriptive and inferential statistics and findings presented in form of percentages, means, and frequencies then presented in tables. Qualitative data was thematically analyzed and presented in form of narratives. Results from the analysis showed that majority of the respondents (54.2%) were aged 31-40 years, married (41.0%), attained primary level education (49.0%) employed and (35.4%) unemployed. The most common sanitation facility was container based (51.0%). Correlation results showed that Cleaning frequency ($r=-0.672$, $p=0.000$), had a strong positive association with utilization, Exhausting frequency ($r=0.319$, $p=0.001$), had also positive and significant interconnection with utilization, and Repairing ($r=0.191$, $p=0.000$), had a weak positive but significant association with utilization, Daily Inspection ($r=0.364$, $p=0.000$), had positive relation with utilization, This study highlights persistent challenges in slums, particularly for women's access to sanitation. Operation and maintenance aspects especially cleaning frequency significantly influence facility utilization in Mukuru Kwa Reuben. Hence emphasizing the need for regular and effective cleaning of facilities in order to promote the utilization of sanitation facilities.

**Keywords:** *Operation and Maintenance, cleaning frequency, Exhausting frequency, Repairing, Daily Inspection, Utilization*

# 60. Evaluation of Excreta Management across Sanitation Service Chain using Shit Flow Diagram in Kericho Town, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

With over half of the global population residing in urban areas as of 2020 and an estimated 70% projected by 2050, ensuring adequate sanitation services, especially in low- and middle-income countries, remains a significant challenge. Poor sanitation practices in these areas contribute to the spread of diseases, emphasizing the necessity for innovative approaches. Shit Flow Diagram (SFD) emerges as a valuable tool for mapping sanitation service chains and assessing safety, offering insights into bottlenecks and opportunities for improvement.The study focused on Kericho town in Kenya , Kericho town is facing a notable sanitation challenge characterized by dilapidated sewer system and inadequate sanitation facilities. . The study aimed at estimating the proportions of excreta that is safely or unsafely managed and develop a SFD of excreta pathways for Kericho. Descriptive study design was adopted. A sample size of 409 households was utilized to comprehend the Fecal Sludge Management (FSM) patterns of Kericho town, employing both qualitative and quantitative data collection methods alongside the SFD data analysis tool. Purposive Sampling technique was used to select the key informant interviewers (KII). Findings revealed that only 59% of excreta in Kericho is adequately managed, whereas 41% was not safely managed posing environmental and public health risks.Urgent interventions are needed to address faecal sludge management practices, including rehabilitating wastewater treatment plants. Policymakers should emphasize the importance of adherence to National Environmental Management Authority (NEMA) water quality standards to ensure the integrity of data and findings. Additionally, there is a need to strengthen regulatory frameworks and enhance monitoring and enforcement mechanisms to prevent illegal discharge of wastewater into water bodies.

**Keywords:** *Safely managed, sanitation technologies, shit flow diagram, urbanization, faecal sludge*

# 61. The influence of sanitation facility design, social factors, and technological suitability on the promotion of safe fecal management in flood-prone areas: a case of Nyando Sub-County, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Safe fecal management refers to the containment, treatment, and reuse/disposal of human excreta safely into the environment. SDG No. 6 target 2 aims to provide universal access to sanitation by the year 2030, including ending all forms of open defecation. This study examined the people-centered theory and social cognitive theory to understand the influence of sanitation facility design, social factors and technological suitability on the promotion of safe fecal management in flood-prone with a specific focus on Nyando Sub-County, Kenya. The study employed a mixed methods approach that incorporated both quantitative and qualitative techniques. A representative sample of 100 residents from the five administrative wards that form Nyando Sub-County was chosen, and the participants were the heads of households. Data collection was by the use of structured questionnaires and focus group discussions with purposeful sampled experts in fecal management in the study area and community leaders and data analysis was by SPSS version 26. From the regression analysis results, sanitation facility design, social factors and technological suitability had significance levels of ($\beta$= 1.155, p=.028), ($\beta$=0.923, p<0.039) and ($\beta$=0.879, p<.018) respectively indicating significant influence of the variables on promotion of safe fecal management in Nyando Sub-County. However social factors and sanitation facility design had the strongest correlation with the promotion of safe fecal management with correlation factors of 0.519 and 0.507 respectively. Therefore, it was recommended that toilets should be design in a user-friendly manner to ensure consistent use, incorporating the local traditions, also suitable technologies should be adopted to ensure resilience during flooding. Future studies should focus other factors affecting the promotion of safe fecal management in Nyando Sub-County the ecological sanitation alternatives suitable for Nyando Sub-County to reduce the impact of flooding on sanitation facilities and public health.

**Keywords**: *Safe fecal Management, Open defacation, resilience, ecological sanitation, sanitation facilities*

# 62. Evaluation of sanitation technologies across sanitation service chain in Kericho Town, Kenya

**Kirui Bernard[1*], Gachoka Kennedy[2] and Wandili Sarah[2]**

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

In 2020, over half of the world's population resided in cities, with projections indicating that by 2050, this figure will rise to 70%. Providing adequate sanitation services in urban and peri-urban areas presents significant challenges due to the dense concentration of people, particularly in low- and middle-income countries. Poor sanitation practices in these areas can lead to the spread of diseases with high morbidity and mortality rates. The focus of the study was on Kericho town, Kenya, facing a notable sanitation challenge due to dilapidated sewer system and inadequate sanitation facilities . The aim of this study was to evaluate the safety of sanitation technologies used in Kericho Town. Descriptive study design was adopted. Data collection methods included surveys, interviews, and observations, with a sample size of 409 households. The findings revealed that 66.5% of the population relies on pit latrines with slabs, 13.69% use pour/manual flush systems, 11.49% have ventilated improved pit latrines, 8.07% employ automatic cistern flush, and a minimal 0.24% practice open defecation. 25% of population discharged waste directly into the sewerage system whereby 5% were considered safely managed. Additionally, 4% of waste from user interfaces was discharged directly into open ground or open drains. 2% of population used septic tanks connected to soak pits, whereas 6% of population used septic tanks connected to open ground. Sludge from septic tanks, comprising 20%, was delivered to the WWTP by exhausters for further treatment, of which only 20% underwent treatment, with the remainder released untreated into the environment. 49% of the population used lined pits, while 14% used unlined pits. Approximately 20% of faecal sludge from the pits was exhausted, with only 20% of it considered safely treated, and the remainder released into the environment. Notably, open defecation accounted for less than 1% based on the survey findings. Consequently, the current trend in faecal sludge management in Kericho Town posed potential health hazards to the community unless measures such as rehabilitating the existing wastewater treatment plant are implemented.

**Keywords:** *Safely managed, sanitation technologies, urbanization, faecal sludge*

# 63. Social-Cultural factors influencing management of shared sanitation, in Nakuru Town West Slums, Nakuru County, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Sustainable Development Goal (SDG) target 6.2 calls for 'adequate and equitable sanitation for all.' However, rapid urbanization in developing countries has led to the growth of slums, where access to private toilets is impractical. Evident studies showed that shared toilets are more often poorly managed, thus consequential adverse harmful health risks such as diarrheal diseases, environmental pollution, and economic deprivations. The study investigated social-cultural factors influencing the management of shared sanitation in Nakuru Town's west slums, Nakuru County, Kenya. The study adopted a descriptive survey research design, involving 288 households' heads selected by cluster proportionate random sampling technique. Quantitative data was collected using structured questionnaire and interview guides for qualitative data. The reliability of the questionnaire for this study was performed with the index of internal consistency was calculated with Spearman Brown Coefficient of which gave a considerable value of 0.872. All data obtained were entered into and analyzed using Statistical Package for Social Sciences (SPSS) version 25 for descriptive statistics and logistic regression analysis. Qualitative findings were organized into themes and presented in narratives. Avast majority 74.7% of shared Sanitation were poorly managed. The study established statistically significant associations of secondary education (p=0.024), marital status (p=0.025), user satisfactions (p=0.001), households sharing(p=0.000), social norms (p=0.001), cultural beliefs(p=0.002), Rituals on use and cleaning toilet (p=0.038), Privacy and modesty concerns (p=0.002) and Management of Shared Sanitation. A large proportion of households in slums used poorly managed shared sanitation, thus endangers public health. We recommend that the Government and all other agencies implementing sanitation promotion interventions should properly understand the Social-cultural practices of the target communities and use this knowledge to tailor sanitation initiatives effectively. The Future studies should focus on implementing and assessing the effectiveness of behavioral interventions.

**Keywords:** *Households; Management of Shared Sanitation; Shared Sanitation; Slums; Social-Cultural factors*

# 64. Determination of faecal coliforms and pathogenic bacteria in borehole water at source and storage in households within Ekalakala ward in Machakos county, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Drinking water quality is vital to public health. Diarrhea can be caused by poor hygiene practices, inadequate sanitary actions, and unsafe drinking water. Furthermore, Africa has been classified as the leading continent in cholera disease owing to a lack of access to safe clean water and basic sanitation. Despite the United Nations and other countries implementing Sustainable Development Goal Number 6, a large global population still lacks clean water and basic sanitation. Globally, 1,000 children die annually due to controllable sanitation-related diarrhea. Kenya is a water-scarce country, leading to the drilling of many boreholes. Five million people in Kenya practice open defecation; 59% have access to clean water, but about ten million drinks directly from contaminated sources. This study aimed to determine faecal coliforms and pathogenic bacteria in borehole water within the Ekalakala Ward in Masinga Sub-County, Machakos County. A cross-sectional study design was used. Ninety samples from 30 boreholes and 60 households were randomly selected, collected, stored in iceboxes, and transported for microbial analysis. The most probable number (MPN) method was used to identify fecal coliforms (Escherichia. coli) by gas production in Durham tubes in lactose broth and enumeration of E. coli. Other targeted organisms included Vibrio cholerae, E. coli and Salmonella typhi which were identified using biochemical tests. The results showed that most of the samples were contaminated with fecal coliforms with a mean value of 171.3MPN/100 ml of water while those from biochemical tests identified 55% Escherichia. coli, 40% Salmonella and 55% Vibrio cholerae respectively. Water from boreholes and households had high levels of faecal coliforms and pathogenic bacteria with increased contamination in the households. Knowledge from study will be used to bridge the gap on diseases management caused by sanitation related practices. Borehole water in Ekalakala Ward was contaminated with fecal coliforms and pathogenic bacteria. Therefore, the treatment of water is important. Moreover, the public should be educated on the guidelines required to drill boreholes and align the latrines.

**Keywords**: *Borehole water, biochemical tests, contamination, diarrhea, E. coli, faecal coliforms, sanitation.*

# 65. Utilization of bamboo bio char as an adsorbent in the removal of heavy metals from wastewater stabilization ponds effluent in Embu Town, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Rapid population growth and expansion of industries have led to increase in the presence of heavy metals in wastewater. Irregular discharge of such wastewater with little or no treatment has been rampant in developing countries. Exposure to heavy metals has been associated with stunted growth and development, acute and chronic respiratory effects, cancerous effects, autoimmunity and even death. Technological solutions for heavy metal removal that are affordable, environmentally benign, and simple to use are needed to address these challenges. This study investigated the effectiveness of two differently modified bamboo biochar's in removal of selected heavy metals from wastewater stabilization ponds effluent in Embu town, Kenya. One modification involved pyrolysis hourly at 250°C, then at 350°C, and lastly at 500°C and labelled AC whereas the other involved chemical activation using potassium hydroxide followed by pyrolysis and referred as AC+KOH. Sampling of wastewater along the treatment processes was conducted during the wet and dry season, totalling to forty-two samples. Atomic absorption spectrophotometer was used to analyse the amounts of Pb2+, Cd2+, and Cu2+ ions in the WSPs effluents. Mean concentrations ranged from 0 to 0.355 ppm, 0.002 ppm, and 0.035 ppm during the wet season and 0 to 0.018 ppm, 0.004 ppm, and 0.097 ppm respectively during the dry season. The maximum National Environmental Management Authority, 2006, allowable limits for discharge into public water for Pb2+, Cd2+, and Cu2+ ions are 0.01 ppm, 0.01 ppm, and 1 ppm respectively. Microsoft Excel, SPSS version 26 and R studio was used for statistical analysis. The lead removal effectiveness of treating polluted effluents with the AC ranged from 86% to 100%, whereas treatments using AC+KOH ranged between 72% to 90%. There was a significant difference, the p-value was $0.04655 < 0.05$ between the differently modified bamboo biochar's. Findings from the study indicates effectiveness of bamboo biochar in treating wastewater contaminated with heavy metal (Pb2+) with AC performing better than AC+KOH.

**Keywords:** *wastewater, lead, cadmium, copper, bamboo, biochar, stabilization ponds*

# 66. Black Soldier Fly process performance via Urine diverting dry toilet-container based Sanitation technology

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

This study sought to evaluate the treatment performance efficiency of Black Soldier Fly process on the fecal waste via SCBS-UDDT model. In SCBS-UDDT model, the feces container was seeded with actively feeding BSF larvae before being introduced for fecal sludge (FS) collection, allowing for FS conversion on-site.The experiment investigated on-site and offsite treatment of UDDT-CBS generated feces using the BSF larvae by installing six UDDT-CBS systems within six households at Nchiru where for onsite treatment it was pre-seeded with 5-day-old BSF larvae which fed on the fecal matter in the containers and were left at the site for 14 days. For offsite treatment 3 UDDT-CBS were installed in households where, the used containers were collected and swapped with clean ones daily and fed to 5-day-old larvae in batch feeding as a control experiment. The treatment performance of Black Soldier Fly larvae in converting waste to larval biomass was estimated by calculating the Waste Reduction (WR), Waste Reduction Index (WRI), and Bioconversion on a wet mass basis. The study used statistical analysis IBM SPSS software from the sets of experiments. Findings from this study showed that there was a significant difference in the waste reduction rates across all the treatments after the treatment process between SH and NH ($p<0.05$). In Seeded households, SH3 recorded the highest waste reduction of 67.78±1.10 while in Non-Seeded Households NH3 recorded 67.80±1.17. Similarly, waste reduction index also varied significantly ($p<0.05$) with SH3 recording 5.63±0.15 and NH3 recording 6.23±0.33 and Bioconversion rate obtained varied significantly across the treatment between SH and NH at ($p<0.05$) and lowest Bioconversion rate was recorded by SH3 at 20.09±1.53 while a high bioconversion rate was recorded by NH3 at 24.15±0.93. Efficient waste reduction and bioconversion underscore the potential of black soldier fly larvae in converting fecal waste into valuable resources. Black soldier fly larvae demonstrate effective waste reduction and bioconversion capabilities in both seeded and non-seeded households, highlighting their role in sustainable fecal waste management. This has implications for sustainable sanitation practices and resource recovery. Incorporating Black Soldier Fly larvae into fecal waste management systems offers a potential remedy to the issues of organic waste treatment while also reducing environmental contamination.

**Keywords:** *Offsite, Onsite, Bioconversion, Container based Sanitation, Waste reduction, Fecal*

# 67. The influence of stakeholder engagement practices in faecal sludge management system in Embu County

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Global fecal sludge management heavily relies on on-site sanitation, with 1.3 billion out of 2.7 billion people depending on it, especially in urban areas where urban poor and peri-urban residents face increased risks but are often overlooked. In Sub-Saharan cities, pit latrines are more common than sewage systems. Access to sanitation in urban areas on a global scale is estimated between 65 and 100 percent, but improper fecal waste disposal poses significant risks of waterborne diseases. This study aimed to assess the impact of stakeholder engagement on fecal sludge management practices in Embu County. The study sampled 157 respondents, including managers, technicians, contractors, people involved in exhausting, and landlords, using a combination of primary and secondary data sources. Questionnaires and interviews were used to gather qualitative and quantitative data, and the Cronbach alpha method assessed reliability. The findings indicated that stakeholder engagement also had a significant positive effect on implementation, with a one-unit increase resulting in a 0.355 unit increase in system implementation. In conclusion, successful fecal sludge management requires proper resource planning, active stakeholder engagement, and robust Monitoring and Evaluation. Decision-makers should prioritize allocating appropriate resources, engaging stakeholders, and establishing comprehensive monitoring mechanisms. These measures will contribute to improved sanitation practices, reduced environmental impacts, and enhanced public health and sustainable development. Recommendations include developing a comprehensive resource plan, involving stakeholders at all levels, investing in capacity building and training, and raising public awareness on responsible waste disposal. These actions will help ensure the successful implementation of fecal sludge management systems, particularly in Africa and Kenya, where proper sanitation practices are crucial for public health and environmental protection. The overall, study emphasizes the pivotal role of stakeholder engagement in the success of the fecal sludge management and highlights areas for improvement to enhance effectiveness.

**Keywords:** *stakeholder engagement, sanitations practices, feacal sludge management*

# 68. Influence of gender in toilet access on performance of shared sanitation facilities in slums: a case of Nanyuki slums, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.



## Abstract

This paper examined the influence of gender in toilet access, on performance of shared sanitation facilities in Nanyuki slums. The article was based on afield research that employed a convergent research design where simultaneous collection and analysis of quantitative and qualitative data was used. A sample of 98 participants calculated using Yamane's formula was used. Quantitative data was collected using structured questionnaires from household heads who were selected using cluster and simple random sampling techniques. The number of household heads per cluster was determined using proportionate-to-size formula. The data was analyzed using the Statistical Package for Social Sciences (SPSS) version 26 in descriptive statistics and presented in frequencies, percentages, means and standard deviations and in inferential statistics like correlations and logistic regressions to unveil relationship between variables. Qualitative data was collected using focus group discussion guides from a purposively selected group consisting of women, men, landlords, Community Health Volunteers, a Public Health Officer and a sanitation representative. The data was analyzed in themes and presented in a narrative way. Findings revealed that females were the most users of shared toilets compared to men (Adjusted OR=1.14, 95% CI: 0.05-1.92, P=0.009<0.05) because they were left at their households due to commitments of carrying out household chores when men could use toilets in their places of work. Toilets were 0.76 times less acceptable and 0.75 less preferable for females than for males. Toilet location far from households, use of toilets at night for females, access to toilets with gapped super structures, unsafe and contaminated toilets significantly reduced the odds of toilet use (P<0.05). Adequacy of toilets (adjusted OR 4.95, 95% CI: 0.98-4.40, p= 0.032<0.05), and ability to meet user needs (adjusted OR 5.73, 95% CI: 0.70-4.15, p= <0.001) increased the chances of use of shared toilets. The odds for preference of toilets significantly increased by 4.95 and 2.09 when toilets adequately addressed user needs and when they were separated by gender respectively (p<0.05). The study concluded that sanitation was among the critical issues that affected slum dwellers and its impact was disproportional to gender. The study recommended the need for provision of gender segregated data in sanitation service delivery, strengthening the role of women in leadership, the need for advocacy, community cohesion and gender mainstreaming in sanitation policies to promote gender-responsive sanitation facilities in slums.

**Keywords**: *Gender, toilet access, shared sanitation, performance, slums*

# 69. Influence of environmental factors on public perception towards sewerage treatment plants in Meru County, Kenya

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**Sub Theme**: Engineering & Architecture: Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Although Government efforts in supporting establishment of waste water treatment plants have been shown, the projects are at times rejected by the community leading to wastage of resources, unsolved sewage disposal problems, and the spread of diseases emanating from poor sewage management. This study examined the influence of social, cultural and environmental factors on public perception toward sewerage treatment plants in Meru County, Kenya, whose solutions have often been facing rejection from the communities. The study targeted residents who around Rwanyange, Gakoromone and Maua sewerage treatment plants in Meru County, Kenya. Mixed methods approach was used with a convergent study design. A sample of 394 household heads was targeted. Cluster and simple random sampling techniques were used for selection of the areas and household heads respectively. Quantitative data was collected from households using structured questionnaires and analysed in descriptive statistics and in logistic regression using the Statistical Package for Social Sciences (SPSS) version 26. Logistic regressions were carried out in univariable and multivariable tests to show the relationship between dependent and independent variables and findings presented as odds ratio with 95% Confidence Intervals (CI). Qualitative data was obtained from focus group discussions, analysed in NVIVO software and presented in narratives. Overall, the public perception towards sewerage treatment plants was negative. Perception varied with age with people aged > 50 years being 2.78 times more likely to exhibit positive perception towards the treatment plants compared to those aged 18-28 years ($P<0.05$). Participants especially those who resided very near the treatment plants were concerned of the odour that resulted from the treatment plants and the impacts of the plants on soil contamination (adjusted OR=0.75, 95% CI: 0.86-3.06, $P<0.001$). Public notion on the possibility of the treatment plants to result in underground seepage and concerns on the quality of air due to pollution significantly lowered perception by 52% and 60% respectively ($P<0.05$). The study concluded that public perception towards the treatment plants was affected by participants' concerns on their impact on the environment. The study recommends community involvement in all implementation stages of sanitation projects for increased acceptance, ownership and trust of solutions by beneficiaries. There is also need for policies that substantiate environmental awareness for sustainable solutions. A transparent process of conducting Environmental Impact Assessment of sanitation solutions in the early stages of implementation could be key in mitigating environmental issues that could likely arise as a result of establishment of the sanitation solutions.

**Keywords**: *Sewerage treatment plants, waste water, public perception, environmental factors*

# 70. The influence of social factors on the promotion of safe fecal management in flood-prone areas: a case of Nyando Sub-County, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Sustainable Development Goal No. 6 target 2 aims to provide universal access to sanitation by the year 2030, including ending all forms of open defecation. The study aimed to investigate the influence of social factors on the promotion of safe fecal management in Nyando Sub-County. The area was selected due to prevalent flooding which led to the collapse of pit latrines stemming open defecation and reversal in sanitation access. The study employed a convergent methods approach that incorporated both quantitative and qualitative techniques. A sample size of 177 households was chosen as a representative of the 38,460 total households in the study area. Structured questionnaires and focus group discussions were used for data collection. SPSS version 26 was used to analyze quantitative data and the relationship between the variables was examined using Pearson's Product Moment correlation at a 5% significance level. Similarly, MAXQDA software was used to group coded data from qualitative methods into themes. From the results, social factors had a significance level of ($\beta$= 1.155, p=.028) and a correlation coefficient of (r =.519**; P ≤.014) indicating a significant influence of the variable on the promotion of safe fecal management. Additionally, the study revealed that 18.4%, (n=30) of the respondents did not have toilets and 55.2%, (n=90) of the toilets were unimproved. In conclusion choosing the right materials that are acceptable while considering the aspects of accessibility, gender and user-friendliness may extend the lifespan of the facilities and increase usage during floods. Moreover, bridging the socio-economic gaps and sensitization of the community on the need for improved sanitation is key to solving the inherent sanitation disparities. Finally, further research on other factors affecting the promotion of safe fecal management in Nyando Sub-County and suitable sanitation solutions for floodable environments is recommended

**Key words:** *Community-Led total sanitation, adoption, latrine construction, latrine use, open defecation, pastoral communities, social factors, cultural factors.*

# 71. Socio-Economic Determinants of Latrine Use in Imenti North Sub County, Meru County, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Sanitary latrine access is crucial for public health and sustainable development. This access significantly reduces morbidity and mortality from diseases like diarrhea. Despite global efforts, 3.6 billion people lacked access to safely managed sanitation services in 2020, with sub-Saharan Africa and rural areas disproportionately affected. In Kenya, only 33% of the population has improved sanitation, with significant disparities across the regions. The study was conducted in Imenti North Sub County, Meru County, Kenya, with a population of 548,161 and 57,668 households. The target sample was 396 households, calculated using the Yamane formula, and data was collected through questionnaires, observation checklists, and interviews. A cross-sectional descriptive study design incorporating both quantitative and qualitative methods was employed. Purposive and cluster sampling techniques were used to obtain appropriate sample size. From each cluster, simple random sampling technique was utilized to choose the respondents. Data analysis was conducted using SPSS Version 26 to generate descriptive and inferential statistics. The study established that 72% of household heads were male. Most respondents had primary education (41%), and over half were not employed, indicating economic instability. On sanitation practices, 68% of households had 4-8 occupants, affecting latrine use and hygiene. The main obstacles to latrine ownership were lack of land (29.5%) and financial constraints (22.2%). In conclusion Socio-economic factors, including education, income, and household size, significantly impact latrine use in Imenti North. Addressing these issues through targeted health education, affordable sanitation solutions, and community engagement is crucial for improving sanitation practices.

**Keywords:** *Sanitation, Latrine Use, Socio-Economic Factors, Public Health, Rural Sanitation*

# 72. Optimization of Black Soldier Fly (Hermetia Illucens) Production for Organic Waste Management in a Small-scale Institutional Facility

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Safe management of faecal waste (FW)is challenging, especially in developing countries. Unsafe FW disposal practices greatly risk human health and the environment. Efforts to enhance FW management have seen the evolution of circular-based technologies, that in addition to safely treating waste, also recover the nutrients therein back to the food chain. One such technology is the black soldier fly (BSF) based- technology, which facilitates FW bioconversion. There is, however, a lack of information on BSF-rearing strategies, especially at the non-feeding stages of adult emergence and egg oviposition. This study assessed the optimization of black soldier production at the post-feeding stages of adult emergence and oviposition. The experiment was set up at the Meru University Sanitation Research Institute, (MUST- SRI). FW was obtained from a container-based facility at MUST-SRI while kitchen waste (KW) was from the MUST cafeteria. Black soldier fly- larvae were introduced into containers using different feed substrates and their growth was monitored until post feeding stage. The feed substrates used were FW, KW, and a mixture of KW and FW at a ratio of 1.1. Plastic pipes of different colours were placed in containers for BSF to lay eggs whose weight was monitored. Space requirement was determined by placing pupae in cages of different dimensions. Performance was measured by the number of emerged adults and egg weight. The study used IBM SPSS to analyse data. There was a significant variation at $p < 0.05$ among colours with black being most preferred. A 2.5 m cage had the highest mean weight at 16.38 ± 3.92 compared to a 1m cage at 4.53 ± 1.03. Co-treatment of FW and KW at a ratio of 1.1 resulted in a better substrate for egg production at a mean of 82.53 ± 6.67% in comparison to faecal matter substrate at 70.42 ± 4.92%. Findings from this study can be used for practices in the rearing of BSF for faecal matter management.

**Keywords:** *Adult emergence, colour preference, faecal waste, kitchen waste, oviposition*

# 73. Evaluation of onsite sanitation technologies using a shit flow diagram at Iten Municipality Elgeiyo-Marakwet, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Ensuring access to safe sanitation in developing countries remains a significant challenge, contributing to public health and environmental problems. Although various interventions have been implemented to tackle these issues, their effectiveness in managing human excreta along the sanitation service chain is still uncertain. This study aimed to assess onsite sanitation technologies in Iten Municipality by utilizing a shit flow diagram (SFD). A mixed method approach was employed, involving quantitative and qualitative data collection. A sample size of 388 household heads was determined using the Yamane formula and selected through a cluster random proportionate sampling technique. Quantitative data was gathered via household survey, while qualitative data was obtained through key informant interviews, site visits, and transect walks. The quantitative data was analyzed using SPSS version 26, while qualitative data was organized into themes and presented in narrative form. The Susana platform and the SFD tools facilitated further data analysis and the creation of the shit flow diagram. The findings revealed that the primary onsite sanitation technologies in Iten are pit latrines (69.1%), septic tanks (22.9%), and anaerobic digesters (2.9%). The study identified hygiene issues and found that approximately 40% of onsite systems malfunctioned. Additionally, about 31% of execrate was inadequately managed, including pits and tanks that were not emptied, overflowing, leaking, or discharging into the environment (15%), emptied but not delivered to treatment (11%), fecal sludge and supernatant delivered to treatment but not treated (1%), and open defecation (3%). The onsite sanitation technologies in the municipality face considerable challenges, underscoring the need for better management and regulations. The study recommends enhancing sanitation infrastructure, implementing standardized maintenance protocols, and providing community education to improve waste management and public health outcomes.

**Keywords:** *Onsite Sanitation Technologies; Evaluation; Shit Flow Diagram; Public Health; Human Excreta management*

# 74. Role of societal norms in raw sewage disposal in water sources, Mukuru Slums, Nairobi County, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

A sustainable sanitation system is economical, socially acceptable, technical, institutional, and environmentally friendly, cutting across the service delivery chain. Raw sewage disposal into water sources is a significant environmental and health concern in many informal settlements in Kenya, due to inadequate access to proper sanitation facilities leading to water source contamination. Despite the severe environmental and health impacts, there is limited knowledge about the factors influencing these practices. Therefore, this study`s aim was to determine the role of societal norms influencing the discharge of raw sewage into water sources in Mukuru slums, Nairobi, Kenya. Materials and Methods: A cluster proportionate random sampling was used to identify household heads, while key informants were purposively selected. A quantitative study of 246 household heads was collected using structured questionnaires and analyzed using the Pearson Chi-Square Test at 95% Confidence Interval. Qualitative findings supported the data transcribed and manually presented in narratives. Results: The study findings revealed that 96.1% of raw sewage was discharged into water sources (river/tributaries), while 87.7% witnessed raw sewage disposal practices. These have majorly contributed to poor sanitation within slums and water pollution for city dwellers and people living downstream. The raw sewage disposal practice was associated with societal norms such as belief (85.1%0, pressure from communities (46.6%), collective responsibilities (43.4%), societal networks (46.4%), reluctance to invest (49.4%), communication, cooperation and coordination (43.8%). Conclusion: This study concludes that poor societal norms contributed to raw sewage disposal into water sources. The study recommends community education on values such as beliefs, collective responsibilities, the presence of social networks, proper communication, cooperation, and coordination to prevent raw sewage disposal in the area and create an enabling environment for all. Further study recommends researching climate change's effects on sanitation infrastructure in informal urban settings.

**Keywords:** *Societal Norms, Raw Sewage, Disposal, Community Engagement, Sanitation,*

# 75. Assessing the role of municipal solid waste management in sustainable urban sanitation in Kitengela Town, Kajiado County, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

As the world's population keeps on rising, so does urbanization increase and rapid industrialization. These factors have contributed to an increase in municipal solid waste (MSW) generation. Developing countries grapple with poor management of MSW which is not only a threat to public health, but also hinders the achievement of sustainable urban sanitation. Indeed, MSW is a crucial factor in urban sanitation since the quality of its management greatly influences the state of urban sanitation. This study aimed at assessing the role of MSW management in sustainable urban sanitation in Kitengela town, Kajiado County, Kenya. Specifically, the study evaluated practices, actors and challenges associated with municipal solid waste management and their role in sustainable urban sanitation. To achieve the objectives of this study, a qualitative research approach was used. Notably, a cross-sectional research design was used. Data was collected using questionnaires, interviews and field observations. A sample of 178 participants comprising of market traders, residents, municipal solid waste service providers and community leaders was used. Data collected through interviews and observations was analyzed and presented thematically whereas data collected through questionnaires was coded and analyzed using the IBM SPSS software version 29. Descriptive statistics were used in analyzing data collected through questionnaires. Inferences about the quality of municipal solid waste management in Kitengela and its role in sustainable urban sanitation were arrived at based on the examination of the data and professional expertise of the researcher in environmental health. The study established poor management of MSW in the study area (67.7%). Open dumping was the most commonly practiced waste disposal method (60%) followed by open burning (40%) at both designated and undesignated sites. The main actors in MSWM are private agencies (75%) and the county government (25%). The main challenges facing MSWM in the study area include inadequate commitment by the county government (55%) and lack of an organized MSWM system (45%). The study concluded that the inadequacy of waste management infrastructure led to the establishment of undesignated dumping areas, where the accumulation of municipal solid waste reached such a critical level that open defecation became a common practice. This study recommends the development of an integrated MSWM program to augment the progress towards sustainable urban sanitation, encourage a circular economy and strengthen toilet use and access in Kitengela town.

**Keywords:** *Municipal solid waste, sustainable urban sanitation, environmental and public health, sustainable development, urban sanitation, municipal solid waste management.*

# 76. Smart Autonomous Trash Bin

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

The rapid increase in population has to heightened sanitation- related issues and the current waste management systems have exhibited deficiencies. Conventional garbage disposal methods frequently lead to overflowing trash bins, ineffective waste management and unclean environments in public and residential areas. This research addresses the challenge by proposing a smart autonomous trash bin. As compared to with the traditional trash bins, it makes use of ultrasonic sensors, servo motor, microcontroller and Bluetooth module to automatically open, close the bin and indicate the trash levels in real-time to the person responsible for garbage collection for timely collection. Ultrasonic sensor (HC-SR04) is used to determine the distance between the garbage or the user and the bin. This bin is designed to open its lid only when a user approached and close automatically when the user moved away. Further, the ultrasonic sensors detect trash levels and data is transmitted through Bluetooth module to mobile app. The servomotor helps in opening and closing of the autonomous trash bin after receiving commands from the microcontroller. A prototype was developed and tested. When a user was detected within the predefined distance from the trash bin, the motor was activated to open the lid. The lid opened only if the trash in the level in the bin had not exceeded a predefined level (fill level). When the trash bin was full the mobile app indicated that the trash was full for trash collection. The proposed solution presents a significant contribution to the field of waste management offering a practical and innovative solution to the challenges posed by conventional garbage disposal methods.

**Keywords:** *Waste management, Garbage management, waste collection*

# 77. Assessing the enabling Environment towards Safely Managed Onsite sanitation (SMOSS) in Kenya: a case of Nakuru County

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Kenya, struggling to achieve safely managed sanitation. Less that 10% of the population is connected to the sewer. To this end, Kenyan government has reviewed it targets for sanitation provision strategy to have 60% of its population served by onsite sanitation and only 40% by centralized sewer. Here we sought to assess the enabling environment for scaling up safely managed sanitation in Kenya. Six counties were identified vis Kisumu, Malindi, Samburu, Nakuru , Turkana and Garissa. Key informant interviews (KII) and focus group discussions (FGD) were conducted and data arranged in themes, relevant to enabling environment in onsite sanitation in Kenya. Nakuru has had a long history of leading towards safely managed sanitation being among the very first to adopt the reuse options. Firstly, there is a very strong political goodwill as well as capacity at the Nakuru Municipality management in maters relating to sanitation. Training on City wide inclusive sanitation (CWIS) have been undertaken by persons in the county. There is a very vibrant stakeholder engagement and regular scheduled meetings. The water utility in Nakuru (NAWASCO) has set up a section purely for onsite sanitation. In addition there in a subsidiary company - NAWASCOAL)- that focuses on reuse. The private sector in well coordinated and organized. The manual pit-emptiers have been formalized and registered. Artisans have training on onsite technologies. Replicating and adopting the sanitation strategies from Nakuru county in other counties would greatly accelerate on site sanitation as as one of the major drivers to CWIS in Kenya.

**Key words:** *Enabling environment, Onsite, Pit emptiers, Sanitation, WASH*

# 78. Utilization of bamboo bio char as an adsorbent in the removal of heavy metals from wastewater stabilization ponds effluent in Embu town, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Rapid population growth and expansion of industries have led to increase in the presence of heavy metals in wastewater. Irregular discharge of such wastewater with little or no treatment has been rampant in developing countries. Exposure to heavy metals has been associated with stunted growth and development, acute and chronic respiratory effects, cancerous effects, autoimmunity and even death. Technological solutions for heavy metal removal that are affordable, environmentally benign, and simple to use are needed to address these challenges. This study investigated the effectiveness of two differently modified bamboo biochar's in removal of selected heavy metals from wastewater stabilization ponds effluent in Embu town, Kenya. One modification involved pyrolysis hourly at 250°C, then at 350°C, and lastly at 500°C and labelled AC whereas the other involved chemical activation using potassium hydroxide followed by pyrolysis and referred as AC+KOH. Sampling of wastewater along the treatment processes was conducted during the wet and dry season, totalling to forty-two samples. Atomic absorption spectrophotometer was used to analyse the amounts of Pb2+, Cd2+, and Cu2+ ions in the WSPs effluents. Mean concentrations ranged from 0 to 0.355 ppm, 0.002 ppm, and 0.035 ppm during the wet season and 0 to 0.018 ppm, 0.004 ppm, and 0.097 ppm respectively during the dry season. The maximum National Environmental Management Authority, 2006, allowable limits for discharge into public water for Pb2+, Cd2+, and Cu2+ ions are 0.01 ppm, 0.01 ppm, and 1 ppm respectively. Microsoft Excel, SPSS version 26 and R studio was used for statistical analysis. The lead removal effectiveness of treating polluted effluents with the AC ranged from 86% to 100%, whereas treatments using AC+KOH ranged between 72% to 90%. There was a significant difference, the p-value was 0.04655 < 0.05 between the differently modified bamboo biochar's. Findings from the study indicates effectiveness of bamboo biochar in treating wastewater contaminated with heavy metal (Pb2+) with AC performing better than AC+KOH.

**Keywords:** *wastewater, lead, cadmium, copper, bamboo, biochar, stabilization ponds*

# 79. Black Soldier Fly process performance via urine diverting dry toilet-container based Sanitation Technology

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

This study sought to evaluate the treatment performance efficiency of Black Soldier Fly process on the fecal waste via SCBS-UDDT model. In SCBS-UDDT model, the feces container was seeded with actively feeding BSF larvae before being introduced for fecal sludge (FS) collection, allowing for FS conversion on-site.The experiment investigated on-site and offsite treatment of UDDT-CBS generated feces using the BSF larvae by installing six UDDT-CBS systems within six households at Nchiru where for onsite treatment it was pre-seeded with 5-day-old BSF larvae which fed on the fecal matter in the containers and were left at the site for 14 days. For offsite treatment 3 UDDT-CBS were installed in households where, the used containers were collected and swapped with clean ones daily and fed to 5-day-old larvae in batch feeding as a control experiment. The treatment performance of Black Soldier Fly larvae in converting waste to larval biomass was estimated by calculating the Waste Reduction (WR), Waste Reduction Index (WRI), and Bioconversion on a wet mass basis. The study used statistical analysis IBM SPSS software from the sets of experiments. Findings from this study showed that there was a significant difference in the waste reduction rates across all the treatments after the treatment process between SH and NH ($p<0.05$). In Seeded households, SH3 recorded the highest waste reduction of 67.78±1.10 while in Non-Seeded Households NH3 recorded 67.80±1.17. Similarly, waste reduction index also varied significantly ($p<0.05$) with SH3 recording 5.63±0.15 and NH3 recording 6.23±0.33 and Bioconversion rate obtained varied significantly across the treatment between SH and NH at ($p<0.05$) and lowest Bioconversion rate was recorded by SH3 at 20.09±1.53 while a high bioconversion rate was recorded by NH3 at 24.15±0.93. Efficient waste reduction and bioconversion underscore the potential of black soldier fly larvae in converting fecal waste into valuable resources. Black soldier fly larvae demonstrate effective waste reduction and bioconversion capabilities in both seeded and non-seeded households, highlighting their role in sustainable fecal waste management. This has implications for sustainable sanitation practices and resource recovery. Incorporating Black Soldier Fly larvae into fecal waste management systems offers a potential remedy to the issues of organic waste treatment while also reducing environmental contamination.

**Key words:** *Offsite, Onsite, Bioconversion, Container based Sanitation, Waste reduction, Fecal*

# 80. Impact of pit latrines on enteric-pathogen and physicochemical contamination of groundwater in tigania west sub-county, Meru county, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Pit latrines, particularly prevalent in low-income countries, are essential for reducing infections, diarrhea, morbidity, mortality, and soil-transmitted helminths. Nearly a billion people still practice open defecation, underscoring the urgent need for improved sanitation. Proper sanitation services enhance dignity, economic stability, health, and environmental protection. Access to clean water reduces disease burden and healthcare costs, empowering communities economically and improving productivity. Safe waste disposal prevents environmental contamination, protecting water resources and controlling disease spread. The research objective was to survey the sites of pit latrines versus the locations of groundwater sources and the persistence of waterborne diseases. The study employed a cross-sectional design, where data was be collected from the targeted population at a single point in time and analyzed in response to the study objective. Water samples were collected from groundwater sources near pit latrines (<30 meters) and at a safe distance (>30 meters) from pit latrines using sterile techniques. The collected data was analyzed using descriptive and inferential statistics to address the research objective. The study used a convenient sampling technique to collect samples from groundwater sources. The sample size for this research was 96 households, distributed among all the wards in Tigania West sub-county. The wards include Athwana, Akithii, Kianjai, Nkomo, and Mbeu. Data was entered into Microsoft Excel 2010 and analysed using SPSS version 27. Results of the correlation coefficient ($r = 0.71$) indicates a strong positive correlation between the proximity of pit latrines to water sources and the prevalence of enteric pathogens. This suggests that closer proximity between pit latrines and water sources is associated with a higher prevalence of enteric pathogens. The t-value (1.78) and p-value (0.001) further confirm the statistical significance of this correlation. Maintaining a distance of over 30 meters between pit latrines and water sources is vital for reducing waterborne infections.

**Keywords**: *Pit latrine , Etheric Pathogens, Ground water, Contamination*

# 81. Influence of perceived health risk factors on adoption of community-led total sanitation: a case of Turkana Central Sub-County, Turkana County, Kenya.

**Kibet Jackson[1*], Kirimi Lilian Mukiri[1], Kirema Nkanata Mburugu[2] and Grace Kasiva Eliud[1]**

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.



## Abstract

The study was conducted to the household members of Lodwar township and Kalokol ward, targeting a population of 8,509 households, with a sample size of 382 respondents as determined by Yamane formula. The study objective was to investigate perceived risk health. The research employed a convergent design methodology, which combined quantitative and qualitative data collection methods, enabling the simultaneous gathering of both types of data .Quantitative data were gathered using structured questionnaires while qualitative data was gathered from Focus Group Discussion. The study used stratified technique to group the village units and simple random to selected the households' heads. Qualitative results were organized into themes and direct quotes. The study established that only perceived knowledge on health risk was significant with R value of 0.031 which explained variability of latrine presence, (AOR=0.023 p-value< 0.05) suggested that an increase in knowledge regarding health risk is associated with a higher likelihood of latrine presence, understanding and awareness about health risk yield p>0.05 implied no influence of latrine presence. The multiple regression analysis which utilized Root Mean Square Error revealed that education level is a significant positive predictor for awareness, understanding, and knowledge (p=0.000), while gender shows a significant negative relationship with awareness and understanding (p=-0.2573), suggesting males score lower in these areas compared to females. Age positively predicts awareness and is marginally significant for understanding (p=0.043), indicating older individuals have higher scores, whereas marital status negatively predicts awareness (p=0.019), with married individuals scoring lower. Household size and income were not significant predictors for any dependent variables, indicating they have minimal impact on awareness, understanding, or knowledge (p>0.05). The study found that increased knowledge about health risk in terms of vulnerability and susceptibility significantly predicts latrine presence and thus the adoption of community-led total sanitation programs in Turkana Central Sub-County, with education notably impacting knowledge, awareness, and understanding (p=0.000). Despite the regression model's significance, it explains only 3.1% of the variance in latrine presence, highlighting the critical role of knowledge in achieving open defecation-free status. The study recommends that the intervention prioritize knowledge enhancement to better inform communities, thereby increasing the adoption of improved sanitation practices and reducing ozpen defecation and related health issues.

**Keywords:** *Sustainable development goals, community-led total sanitation, open defecation, RANAS.*

# 82. Comparative analysis of excreta pathways in view of sanitation investment for the period 2018 to 2023. a case study of Naivasha Sub-County, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Shit Flow Diagrams (SFDs) have been used as decision-making tools to not only help manage large volumes of excreta in cities and towns but also to accelerate the achievement of universal access to safely managed sanitation. This study aimed to employ the use of an SFD to evaluate the influence of sanitation projects done over 6 years (2018 - 2023) in Naivasha Sub-County on the excreta flows. An SFD done in 2017 showed that only 22% of excreta in the sub-county was safely managed. Since then, several sanitation projects such construction of new toilets and the upgrading of the existing sewer system. have been implemented in the region, but there is a lack of understanding of the current excreta management practices, as well as the impact of sanitation investment projects on excreta pathways. Conducted in Naivasha Sub-County, a rapidly growing town in Nakuru County with over 350,000 residents, this study employed a descriptive comparative research design. Data was collected through desk research, field observations, key informant interviews, and household surveys involving a sample of 365 households. The data was used to prepare an updated SFD illustrating the current excreta pathways in the sub-county. The results were then compared to the 2017 baseline SFD to identify changes resulting from the sanitation projects. The updated 2024 SFD shows improvements in faecal sludge and wastewater management, with 25% now safely managed – an improvement of 3% from the 22% safely managed in 2017. This improvement can be attributed to investments in the containment, emptying, and transport stages of the sanitation service chain. However, the relationship between the amount invested and the change in pathways is not direct. This highlights the need for balanced investments across all stages of the sanitation service chain to achieve overall sanitation goals.Naivasha Sub-County's progress, though notable, shows that if the trend in sanitation investments continues as business-as-usual, the target of achieving SDG 6.2 by 2030 will not be achieved, let alone reaching the projected global sanitation coverage of 67%. This, therefore, underscores the need for accelerated efforts and increased investments to achieve the universal access to sanitation, in line with the UN recommendations.

**Keywords:** *Sanitation investments, Shit Flow Diagrams (SFDs), Excreta management, Naivasha Sub-County, Sustainable Development Goals (SDG) 6.2*

# 83. Life Cycle assessment of construction materials based on carbon footprint

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Construction is among the leading industries contributing the largest carbon footprint. Construction and demolition (C&D) waste emit greenhouse gases which pollute the air and exacerbates greenhouse effect, yet its disposal is still wanting. The effect of global warming is becoming more extreme, and the average temperature levels are being surpassed every year and in turn contributing to climate change. This study focused on identification and quantification of greenhouse gases associated with different construction materials. The study employed Life Cycle Assessment (LCA) methodology, considering the entire life cycle of key construction materials from extraction and production to disposal. Emission factors specific to each waste category, including concrete, wood, metal, and plastic were utilized to calculate the greenhouse gas (GHG) emissions. Through a detailed examination of secondary data sources, encompassing materials extraction, production, transportation, use, and disposal, the key contributors of GHGs in the construction industry were identified to be concrete, steel and PVC plastics. Further the research examined the life cycles of the three key contributors of construction materials waste from cradle to gate to grave, quantifying the carbon emissions at every stage of the life cycle whereby eminent greenhouse gases included: carbon dioxide (CO2), methane (CH4) gas, nitrous oxide(N2O), hydrofluorocarbons (HFCs) etc. The key GHG emitters were Steel, PVC and concrete and by modelling through the openLCA, found out that for one tonne of concrete waste there is an impact of 733.9742kg CO2eq. on global warming, steel 4.147E5kgCO2eq. while PVC results to 1.014E4 kgCO2eq.Therefore, there is need for a sustainable management of the C&D waste which alligns with global efforts to mitigate climate change and promote environmental sustainability.

Keywords: *Carbon footprint, construction sustainability, Green house gases*

# 84. Factors influencing promotion of latrine utilization in Laisamis Sub County, Marsabit, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

The issue of sanitation has long existed and drawn criticism from figures like Mahatma Gandhi, who stated that sanitation in a community is more important than independence. Latrine utilization is among ways of ensuring that communities are safe and are not interacting with disease causing pathogens. However, the presence of latrines has not completely been a guarantee for their utilization especially among the pastoral communities. The objective of this study was to examine the factors that influence promotion of latrine utilization. A cross-sectional descriptive study was conducted in two selected wards in Laisamis Sub County using both quantitative and qualitative data. Quantitative data was collected from 177 household heads using questionnaires and analyzed in descriptive and inferential statistics. The qualitative data was gathered from selected key informants using interview guides and from focus group discussions. The data was analyzed thematically and presented in narratives. The study found out that communities who received minimal social support were less likely to utilize latrines (adjusted odd ratio=3.045, p=0.000). Cultural beliefs relating to defecation in enclosed places such as toilets seemed to encourage defecation in the open despite latrine presence. Taboos surrounding mixing of fecal matter for men and women attracted latrine avoidance especially when the available toilets were not separated by gender. Low income levels encouraged construction of low quality toilets (adjusted odd ratio=2.095, p-value=0.004) which were underutilized because of their low hygiene levels and inability to maintain privacy were ignored for open defecation. Reduced enforcement of public health directives on latrine construction and use was associated with reduced latrine utilization (adjusted odd ration=4.234, p-value=0.034) as communities constructed toilets for show off other than for utilization. Findings also showed that over-dependence on subsidies and incentives reduced chances of latrine reconstruction or repair after damage which discouraged use of latrines. The study study concluded that owning a latrine in Laisamis Sub-County did not guarantee use because of the influence of cultural barriers, social and economic issues. The study recommended community engagement and robust education campaigns using local leaders and influencers to dispel taboos and beliefs against latrine use.

Keywords: *Social, Cultural, Economic Factors, Latrine Utilization*

# 85. Assessing the farmers' perceptions towards the use of humanure in Tharaka Nithi and Kajiado counties for agricultural sustainability

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

In the wake of growing global concerns on environmental degradation and resource scarcity, effective management of human waste remains crucial, especially in the urban and peri-urban environments. Effective waste management is sometimes achieved through green toileting system (GTS) innovations such as the Urine Diversion Dry Toilet (UDDT). UDDT represents a sustainable and innovative sanitation solution with multifaceted benefits. Unlike traditional toilets, the UDDT segregates urine and feces at the source, reducing the need for water-intensive flushing and allowing for efficient nutrient recovery. This diversion process not only conserves water but also mitigates environmental pollution by minimizing the release of nutrients and pathogens into water bodies. The collected urine, rich in nitrogen and phosphorus, serves as a valuable resource for agricultural fertilization, promoting circular economy principles. Overall, the UDDT emerges as an ecologically sound, water-saving, and health-promoting sanitation solution suitable for diverse settings, contributing to sustainable development goals and improved community well-being. The current study sought to assess factors influencing the uptake of the Green Toilet System (GTS) in Kenya, with a focus on factors such as gender, design, attitude, awareness, and perceptions. The research was conducted in Kajiado and Tharaka Nithi counties. Purposive sampling was used in this study to choose the target population. The research employed semi-structured qualitative interview guides to gather data from the target population. A total of 335 participants were invited for the interviews. The study findings revealed significant gaps in awareness and uptake of GTS technology among respondents from Tharaka Nithi and Kajiado Counties. 75 per cent of the 335 respondents were unaware of the GTS technology, with varied levels of exposure across counties and demographic groups. The researchers recommend awareness creation and active involvement of community to speed up the uptake of GTS in Kenya.

**Keywords:** *Green toilets, Urine diversion dry toilet, humanure***Published article: International Journal of Research Studies in Agricultural Sciences (IJRSAS). Volume 10, Issue 3, 2024, PP 1-14. ISSN No. (Online) 2454–6224. DOI: http://dx.doi.org/10.20431/2454-6224.1003001

# 86. Influence of social cultural factors on adoption of sanitation systems in rural communities: case of Tharaka-North Sub-county, Tharaka-Nithi County, Kenya.

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

The Sustainable Development Goal agenda 6.2 targets to achieve universal basic sanitation and hygiene ( United Nations 2018). This paper assessed and examined the influence of social cultural factors on adoption of sanitation systems in rural communities. The article was based on field research that employed convergent research design where both qualitative and quantitative data was gathered simultaneously. Quantitative data was gathered using structured questionnaires from 100 household heads selected using stratified proportionate simple random sampling techniques. Qualitative data was collected using an interview guide from a purposively selected focus group consisting of 7 participants. The findings were organized into themes and presented in narratives. Quantitative data was analyzed the statistical package for social sciences (SPSS) version 25 which generated descriptive and inferential statistics to unveil the relationship between variables from the findings, the adoption of unimproved toilets was the main form of sanitation system, covering a mean of 2. 9807.A unit increase in traditions led to a 0.029 decrease in adoption of sanitation systems (p.value=0.009) in the rural communities. A unit increase in gender roles led to a 0.142 increase in adoption of sanitation practices (p.value=0.001). Residents believed that faeces left in the open could be used for witchcraft purposes, a tradition that had a positive impact in eradication open defecation. Some religious denominations like the Kavonikia and Agendi associated diarrhea with demons other than the poor sanitation which was seen to facilitate poor sanitation practices. Social-cultural factors such as presence of toilets , knowledge ,gender, religion, beliefs and traditions influenced adoption of sanitation systems. The study recommended that the Community Led Total Sanitation (CLTS) strategy should target both open defecation and enlighten residents on the dangers of adopting unimproved latrines. The study also recommended that inclusion of women in household sanitation matters to ensure adoption of women and children friendly household sanitation facilities and incorporation of religious leaders as advocates of sanitation systems alongside demographic, psychosocial and environmental factors.

**Keywords:** *sanitation – sociocultural factors, sanitation adoption*

# 87. Influence of socio- economic factors to long term adoption of improved sanitation through community led total sanitation in Magarini sub-county, Kilifi county, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.



## Abstract

A significant portion of the Kenyan population, approximately 5.6 million people, still practice open defecation, highlighting the need for effective sanitation interventions. On health Impacts, 17,100 child deaths occur annually due to diarrheal diseases in Kenya 90% linked to inadequate sanitation. This has aggravated the increase of Helminth infections and stunted growth. In Kilifi County, there is a need to scale up CLTS in the across all wards of Magarini Sub County where there is no ODF certified villages despite only 10% of them being triggered. This study delved into the socio-economic factors influencing the long-term adherence to CLTS-driven sanitation improvements within the community. It employed a convergent research design, collecting quantitative data through structured questionnaires from 388 household heads, selected using stratified and proportionate simple random sampling techniques. The data was analyzed using the Statistical Package for Social Sciences (SPSS) version 25, which provided both descriptive and inferential statistics to explore the relationships between various factors. The study found a statistically significant association between location and religion in Magarini Sub-County, with a chi-square test value ($\chi 2$) of 34.558, degrees of freedom of 20, and a p-value of 0.027. This indicates that geographical factors have a moderate influence on religious affiliation, as evidenced by Cramer's V coefficient of 0.162. However, no significant association was found between education level and population distribution. These findings underscore the need for targeted cultural and social policies that consider the geographical and religious dynamics of the community. The study highlighted the critical role of personal savings and agricultural resources in sustaining sanitation initiatives. It suggested that sustainable funding mechanisms, community engagement, employment income, and government support are crucial for the long-term adoption of improved sanitation through CLTS. The reliance on these financial resources points to the necessity for strategies that bolster economic stability and support sanitation improvements. Policymakers and education stakeholders can use these insights to enhance educational outcomes and address the sanitation needs specific to different community groups. The study recommended further research into factors such as household income and education to gain a deeper understanding of the infrastructure needs for long-term adoption of improved sanitation in Magarini Sub County. By addressing these socio-economic determinants and fostering a supportive environment, it is possible to achieve better sanitation and hygiene outcomes, ultimately reducing the disease burden associated with fecal-oral infections in the Sub County.

**Keywords**: *Socio economic factors, Sanitation interventions, sanitation practices, Improved sanitation, Community Led Total Sanitation, Fecal-oral*

# 88. Tracking the flow of excreta across the sanitation service chain in Nkubu Town, Meru County, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

Inadequate access to improved sanitation and water remains a huge factor contributing to increased mortality and morbidity rates, especially among children. Despite the growth in economy and recognition of sanitation as a basic right, investment in sanitation infrastructure has not yet been achieved, particularly in low- and middle-income area. As such, nearly 827 000 people die yearly due to inadequate sanitation, water and hygiene. To track the flow of excreta in Nkubu town, Kenya, the existing sanitation systems were assessed, the proportion of community with access to safely managed feacal sludge was examined, the challenges facing service delivery was assessed. A descriptive cross-sectional survey was employed. The research instruments involved included observations for primary data collection and use of key informants' interviews. The secondary data was obtained from existing data. The Susana platform and the shit flow diagram tools were used for data analysis and generating the SFD. The data collected was presented using tables, graphs, charts and a shit flow diagram. The results indicated that only 28% of the excreta was safely managed. The pit latrines were the most used containment method with 45% and 3% of the population practicing open defecation, respectively. Only 40% of the feacal sludge taken to the treatment was properly treated and disposed. The challenges experienced in the management of fecal sludge were high water table in the area and high license and service fee charged. The findings imply that the unsafely excreta management practices in Nkubu town pose a risk to the health of residents in and around the town and the quality of water sources. This study points to the possible areas of interventions such as proper planning of the town and creating an enabling environment for feacal sludge management.

**Keywords:** feacal sludge, safely managed, sanitation systems, service delivery, shit flow diagram, treatment.

# 89. Assessing the economic factors influencing selection of sanitation technologies in Kapseret sub county, Uasin Gishu County, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Assessment the economic factors influencing choice of sanitation technologies for improved sanitation services is necessary not only in Kenya but in most low and middle income countries. This study explored the lived experiences of residents in Kapseret Sub County, Uasin Gishu County, Kenya. It analysed the social and economic factors influencing household decisions on sanitation technologies.The study was conducted in Kapseret Sub County, Uasin Gishu County, Kenya, with a population of 198,499 and 59,746 households. The target sample was 475 households, calculated using the Yamane formula, and data was collected through questionnaires, observation checklists, and interviews. A cross- sectional descriptive study design incorporating both quantitative and qualitative methods was employed. Purposive and cluster sampling techniques were used to obtain appropriate sample size. From each cluster, simple random sampling technique was utilized to choose the respondents. Data analysis was conducted using SPSS Version 26 to generate descriptive and inferential statistics. This study investigates sanitation choices within households. The majority of household leaders are men between 34 and 54, with families of 3-6 people. Most people live in rented, permanent structures, and have access to basic amenities like improved sanitation facilities (almost 69%) and piped water (over 73%). Interestingly, while most people deny that cultural beliefs directly impact their sanitation choices, traditional customs (40%) and gender roles (65%) seem to play a significant role. Financial constraints are a major concern for over 85% of respondents. There's also a link between education and household situation - over 64% have higher education, and education level is connected to both family size and employment status. Finally, the study found a clear connection between the type of housing and the sanitation technology a household chooses.Implement community education programs on sanitation rights and practical solutions to empower residents. Address financial barriers to enable access to advanced sanitation technologies. Consider cultural norms and community attitudes in sanitation interventions.The study highlights the complex interplay between cultural norms, economic constraints, and practical factors in household sanitation technology choices. Education and financial support are crucial in fostering sustainable sanitation practices and improving health outcomes.

# 90. The technologies used in sanitation delivery in Mukuru Kwa Reuben, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

The Sustainable Development Goals agenda 6.2 aims to improve access to safely managed sanitation by 2030. However, the sewer system serves only 17 % of the Sub-Saharan African population in informal settlements. Possible interventions and options to address sanitation issues in informal settlements have been advanced through research. However, upscaling and improving sanitation in informal settlements has been a challenge. The study investigated the technologies used in sanitation delivery in Mukuru Kwa Reuben. The study employed a convergent research design and a mixed method approach. Cluster and simple random sampling technique enrolled 100 household heads from 10 clustered administrative units. The quantitative data from questionnaires and structured observations were analyzed descriptively and inferentially at 5% level of significance in SPSS version 25. The sanitation technologies for containment and storage of excreta/sludge included pit latrine, fresh life toilet, pour flush, cistern flush and composting toilet. In emptying and transportation, eco bags, washing machines, transfer station, buckets, urine container, hand cart, trucks and sewers were used. The excreta/sludge treatment/disposal options available encompassed treatment plants, septic tanks, open grounds, rivers, and landfills. There was a moderate positive correlation between accessibility and construction/installation process of the toilet with ($r = .546$, $p < .05$). There was a significant difference in the accessibility ($p=0.013$), availability ($p=0.047$), and accountability ($p=0.000$) in the provision of sanitation technologies for emptying and transportation of sludge/excreta. Type of sanitation technology ($F (3, 96) = 8.497$, $p < .05$), and the construction and installation process ($F (3, 96) = 20.379$, $p < .05$) significantly influenced accessibility, availability, affordability and accessibility. This study concludes the type of sanitation technology and the construction/installation process are important factors in predicting affordability, accessibility and availability. The study recommends an innovative and context-appropriate sanitation technologies.

**Keywords:** *Sanitation, Technology, Mukuru Kwa Reuben*

# 91. Influence of knowledge and awareness of containment technologies in performance of fecal sludge management in urban areas: a case study of Athi River sub-county, Machakos County, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Rapid urbanization and population growth in Athi River, Eastern Africa, have exacerbated challenges in managing faecal sludge, posing significant public health and environmental risks. The study investigated the influence of knowledge and awareness of containment technologies on the performance of faecal sludge management in Athi River Sub County. Utilizing a cross-sectional study design, data was gathered from 399 stakeholders including households' heads, property owners, public toilet operators, and sanitation experts through questionnaires, interviews, and observations. Statistical analyses using SPSS software examined both quantitative and qualitative data to derive descriptive insights. Of 399 distributed questionnaires, 335 were completed, representing an 83.96% completion rate. Among the respondents, 54.3% held college or university degrees, highlighting the region's educated urban population and emphasizing the importance of addressing educational disparities in sanitation practices. The study findings revealed a significant prevalence of septic tank usage (67.2%) compared to pit latrines (32.8%) among respondents surveyed, highlighting the predominant types of fecal sludge containment technologies in use within the study population. The study found a moderate level of familiarity with maintenance practices (mean 3.63) and varied comprehension of different technologies (mean 3.01). Awareness of benefits scored moderately (mean=2.80), while identifying challenges received a moderate score (mean= 2.73). Knowledge of information sources and interest in learning more were also assessed, with mean scores of 2.64 and 3.97 respectively. Significant associations were observed between knowledge of containment technology and performance metrics such as treatment efficiency and environmental impact ($p < 0.001$), underscoring the importance of understanding effective faecal sludge management. The study concludes that while there exists a moderate baseline of knowledge and awareness regarding containment technologies, substantial room for improvement remains. Enhanced educational initiatives are recommended to address these gaps, including workshops, community meetings, and outreach programs aimed at promoting a better understanding of maintenance practices, technology options, and environmental implications.

**Keywords**: knowledge and awareness, containment technologies, performance of faecal sludge, faecal sludge management.

# 92. Demographic and social-cultural dynamics on access to safe sanitation in pastoral communities: a case of Saku sub-county, Marsabit, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

The Sustainable Development Goals (SDGs) aim for universal access to safely managed sanitation by 2030 and also emphasizes eradication of open defecation as a way to promote pathogen-free environment. Despite efforts to improve sanitation standards, significant challenges still persist, particularly in developing regions inhabited by pastoral communities and could be linked to unique components in the society. This study investigated the influence of demographic and social-cultural factors on access to safely managed sanitation in pastoral communities of Saku Sub-County, Kenya, where sanitation access is notably low. A cross-sectional descriptive design was employed. Semi-structured questionnaires were used to collect data from a sample of 100 household heads, calculated using Yamane's adjusted formular. The data was analysed using Statistical Package for Social Sciences (SPSS) version 26 in descriptive and inferential statistics. Findings showed that gender roles were significant predictors of toilet adoption at the households ($\beta=0.138$, $p=0.01$). The nature of work for women such as having to look for water and for men like herding in lonely places where there were no toilets attracted open defecation cases. Latrine utilization was minimal at night due to safety concerns among females as indicated by 72% of the respondents. The cultural beliefs held in the region had a negative influence on toilet adoption ($\beta=-0.130$, $p=0.040$) while level of awareness on sanitation-related matters among the residents positively influenced adoption of safe toilets, thus increased access to safe sanitation ($\beta=0.127$, $p=0.011$). Construction of toilets near some households was undermined by the fear that the toilet pits would kill or injure livestock, which seemed to be given the highest priority. Traditions that revolved around restriction of latrine sharing between grown-ups and children attracted cases of open defecation even with access to toilets which suggested a need for toilets separation. The study recommended exploration of different context-appropriate mechanisms for triggering behaviour change to enhance sanitation standards among pastoral communities. An assessment of demographic characteristics, social and cultural practices prior to implementation of sanitation solutions, along with stakeholder involvement, could help in spotting any drawbacks towards ownership, uptake and sustainability of sanitation solutions.

**Keywords:** *cultural, demographic, social, pastoral communities, safely managed sanitation*

# 93. Assessment of Suitability of slum toilets for use by women and children on promotion of inclusive sanitation: A mixed methods study in Nakuru, Kenya

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Women and children encounter challenges in accessing sanitation services. Unless user-friendly designs are adopted for toilets, those living in slums could have difficult choices of excreta management. The study examined suitability of toilets for use by women and children on promotion of inclusive sanitation in a selected slum in Nakuru, Kenya. The study used convergentdesign. Quantitative data was gathered using structured questionnaires from 100 household heads sampled using proportionate simple random technique. An observation checklist was used to ascertain toilet's status and suitability for use by women and children. The data was analyzed in descriptive and logistic regression statistics. Data gathered using focus group discussions was analyzed thematically and findings presented in narratives. The study established that use of toilets by women was compromised by inadequate maintenance, privacy, safety and hygiene provisions concerns. Chances of open defecation were 63.7% lower for women who did not fear visiting toilets at night than for those who did and 45.2% lower for women who accessed clean toilets ($p<0.05$). The likelihood of being comfortable with toilets was 3.664 times higher for women who accessed toilets located near households, 6.75 higher when they considered toilets as safe for use at night and 7.057 times higher with access to toilets that maintained privacy ($p<0.05$). Although water was apparently available as supplied by the Water and Sewerage Company, handwashing for women was minimal as the facilities mostly lacked water. Children were escorted by caregivers to toilets as they could not reach the door latches. Distance to toilets for children stood out as a significant factor that discouraged them from using toilets ($p<0.05$). Hand hygiene for children was minimal due to absence of handwashing facilities, or when present, positioning of the facilities at higher heights than children could reach. The study concluded that sanitation vulnerabilities in slums are amplified by provision of gender and age-non-responsive sanitation and hygiene facilities. Sanitation programming in slums should incorporate a gender and social lens to promote sanitation inclusivity for women and children. Involvement of women in planning processes of sanitation options in slums could be a worthwhile strategy of ensuring that their needs and the needs of their children are adequately addressed.

**Keywords**: *vulnerable, women, children, slums, inclusive sanitation*

# 94. Knowledge, attitudes, and practices associated with access to sanitation in open public places - a case of Nairobi city.

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Improving the uptake of existing sanitation facilities in Nairobi CBD requires a change in behavioral practices of the population. In this study we analyzed knowledge, attitudes and practices associated with sanitation access to open public spaces in Nairobi city. The study objectives were to identify knowledge gaps associated with access to public sanitation in Nairobi city as there's a significant lack of knowledge on the importance of proper hygiene. Assessing the attitudes, habits and behavior associated with access to public sanitation and determining sanitation practices in women of Nairobi central business district as social stigma and cultural beliefs discourage the use of public toilets especially among women and children. A descriptive quantitative cross-sectional study design was employed to obtain data from the participants. Data was collected using structured open-ended questionnaires, interviews and spot checks and analyzed using SPSS V29. The findings indicated that many of the respondents 76.5% agree that sanitation is very important with 89.3% confirming to having used public toilets in the city. Daily use was low at 6.7% with 89.3% indicating that the facilities were inadequate leading to open defecation and environmental degradation. Accessibility was the most influencing factor for use of sanitation facilities even though a majority 39.3% were dissatisfied with the conditions of the public toilets depicting the perception that public toilets are unhygienic and unsafe. Additionally, 88.9% agreed to paying to use the toilet facilities highlighting the importance of willingness to pay for environmental services. The study recommends for Proper maintenance of existing sanitation facilities to improve on accessibility and the quality-of-service delivery coupled with targeted educational campaigns on sanitation and hygiene.

**Keywords:** *Sanitation access, Sanitation knowledge, sanitation practices*

# 95. Examining the occupational health risks and socioeconomic challenges faced by sanitation workers in urban slums

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Sanitation workers play a critical role in global health, yet they often face neglect, especially in in informal settlements. This study investigates the occupational safety, health, and dignity (OSH&D) sanitation workers in Mukuru kwa Reuben slums, Nairobi, Kenya, focusing on those involved in faecal sludge management. Employing a mixed methods approach with 40 workers, the research reveals alarming occupational hazards: chemical exposure (40%), psychosocial issues (27.5%), physical injuries (22.5%), and biological risks (10%). Socioeconomic factors, such as low income and limited education, exacerbate these vulnerabilities. The study highlights a critical lack of (OSH&D) protections: 85% lack personal protective equipment (PPE), and 72.5% lack essential training. Furthermore, 67.5% face cultural stigma and discrimination, and lack legal protection. Statistically significant correlations demonstrate the negative impact of poverty ($r = -0.491$, $p = 0.000$) and environmental hazards ($r = 0.672$, $p = 0.000$) on (OSH&D). Conversely, a positive correlation exists between income and OSH&D ($r = 0.613$, $p = 0.000$). These findings underscore the need for comprehensive policy reforms to improve legal protections, increase income, and enhance training and equipment availability. This will significantly improve the dignity and safety of sanitation workers. Future research should focus on longitudinal studies and intervention evaluations to further understand and mitigate these challenges.

**Keywords:** *Occupational safety and health, dignity, sanitation workers, faecal sludge management, global health, urban slums*

# 96. Evaluation of sulfuric acid effect on torsional strength of steel used in concrete reinforcement in sanitation structures

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

Most sanitation structures in the world are constructed using concrete which is reinforced by the steel, this type of concrete is called Reinforced Cement Concrete (RCC). The RCC structure is believed to be relatively resistant to corrosion which the sanitation structures are prone to due to the aggressive environment in which they are subjected to. This belief has been compromised since the reinforced concrete used in the sanitation structures such as the concrete sewer pipes has become susceptible to Microbiologically Induced Deterioration (MID). This MID leads to degradation and compromised strength and service life of the RCC. In the reinforced concrete structure, the backbone of this structure is the reinforcing steel which when its strength is compromised by the MID, the whole structure is compromised. The present research therefore aimed at evaluating the effects of sulfuric acid, resulting from the MID process, on the torsional strength of steel metal used for reinforcing concrete in sanitation structures. Reinforced concrete specimens were developed using different types of cement and different concrete cover. The three different types of cement were, Ordinary Portland Cement (OPC), Portland Pozzolana Cement (PPC) and Limestone Calcined Clay Cement (LC3), while concrete covers of 15mm and 25mm were applied. They were then subjected to aggressive environment (a sample of sewage) suitable for corrosion just like in their actual operational environment. To determine the effects of sulfuric on the torsional strength of the steel, metal was tested using Torsion Machine (TM). The torsional strength before and after being subjected to aggressive environment was determined. The testing of the specimens was done at an interval of 14 days for a period of three (3) months. According to the results, for a concrete cover of 25mm, LC3 showed minimum percentage reduction in strength compared to PPC and OPC. It had the lowest percentage reduction in strength after 84 days which was 5.25%, OPC 7.20%, and PPC 7.24%. In conclusion, LC3 showed good resistance to the effects of sulfuric acid compared to PPC and OPC. In terms of concrete cover, 25mm showed good resistance to the effects compared to 15mm concrete cover.

**Keywords:** *Concrete Cover, Microbiologically Induced Deterioration, Sanitation Structures, Strength Reduction, Sulfuric acid, Torsional Strength.*

# 97. Assessment of factors affecting septic tanks performance: a case of Chuka Municipality, Kenya.

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**Subtheme:** Engineering - Sustainable Infrastructure Solutions for climate resilience; Sustainable Sanitation Systems for climate-responsive urban environments.

## Abstract

A septic tank is an underground, onsite, small scale sewage treatment setup, which collects the sewage for the decomposition activity by bacterial action. The Sustainable Development Goal Agenda 6.2 targets to achieve universal basic sanitation and hygiene (United Nations, 2018). Septic tanks in Chuka Municipality have been collapsing leading to loss of life and destruction of property. The main objective of the study was assessing the factors affecting septic tanks performance in Chuka Municipality. This was achieved by looking at the effect of level of skills of artisans, the approval mechanisms, and cost of construction on the performance of septic tanks. A sample of 110 respondents was used in the study. Data was collected from artisans, public health officers, public works officers, and homeowners by use of semi-structured questionnaires and interviews. The findings indicated the presence of a significant association between skills of construction workers (chi-square statistic of 12.34, with a p-value of $0.002 < 0.05$), approval mechanisms (chi-square statistic of 8.45 and a p-value of $0.015 < 0.05$), and performance of septic tank systems. The association between cost of construction (chi-square statistic of 5.67 with a p-value of $0.058 > 0.05$). The study was limited by lack of cooperation from some respondents who were reluctant to participate in the exercise, thinking that the issues under study are sensitive enough to jeopardize their careers. Based on the findings, the study makes the following conclusion: the expertise of artisans, strong regulatory oversight and approval mechanisms significantly impacts septic tank performance. These recommendations will assist policy-makers and construction practitioners in the field pay more relevance to construction codes and standards.

**Keywords:** *Concrete stuctures, Septic tank, artisan expertise*

**SUBTHEME 5: Education - The role of social science and educational institutions in climate change mitigation**

PRECONFERENCE

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## 98. The influence of strategic teachers' in-service training on pupils' academic achievement in public Primary Schools

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

### Abstract

Kenya a member state of United Nations aims at achieving inclusive and quality education which is among the most powerful and affirmed tool for sustainable development pursuant to vision 2030. It is against this background that Teachers Service Commission was established to review the standards of education and training of persons entering the public service. However, concerns have been raised on how teachers' in-service trainings influence pupils' academic achievement in public primary schools. To address these concerns, this study was conducted to determine whether the strategic teachers' in-service training offered by Teachers' Service Commission (TSC) affect pupils' academic performance. Descriptive survey research design was used with a target population of 195 persons comprising of 166 teachers and 29 head teachers in public primary schools in Merti sub-county. Using stratified sampling technique a sample of 150 respondents made up of 125 teachers and 25 head teachers was obtained. The main instruments for data collection were questionnaires and document analysis. Quantitative data was analyzed using descriptive statistics and inferential statistics while qualitative data was analyzed by organizing it thematically based on the objectives. The study established that TSC teachers' in-service trainings did not enhance timely syllabus coverage but positively influence KCPE performance to a great extent. The study recommended that Ministry of Education through Teachers Service Commission should allocate sufficient funds to facilitate continual teachers' in-service trainings. The head teachers should sensitize teachers on importance of attending in-service trainings to improve their pedagogical skills, content mastery and classroom management skill in line with innovative and hands-on pedagogical training requirements of the 21st century.

**Key Words:** *Teachers, in-service, training, Academic and achievement*

# 99. Teacher-related factors impacting ICT integration in teaching and learning in public secondary schools in Magadi, Kenya.

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

Information and Communication Technology (ICT) has emerged as an essential educational instrument aimed at enhancing quality and equity in curriculum delivery. The acquisition of pedagogical skills pertinent to the 21st century skills hinges on teachers equipped with ICT competencies. This study endeavours to offer substantial insights into the teacher-related elements impacting the integration of ICT in teaching and learning within public secondary schools in Magadi. The study objectives were to: find out ways in which attitude of teachers influenced ICT integration in teaching and learning and establish the teachers working experience influence on use of ICT. The study adopted descriptive survey design on a population of 71 teachers, 6 deans of study, and 6 principals from public secondary schools. The sampling involved cluster and judgment sampling techniques to obtain a sample of 60 teachers, 6 deans of study, and 6 principals. Research tools employed included a questionnaire and an interview schedule. Data was analysed using descriptive statistics, with the aid of SPSS computer software. The key findings of the research revealed that younger teachers, aged under 30, exhibited greater proficiency and enthusiasm in utilizing technology compared to their counterparts aged over 30. Consequently, the study concluded that teacher age significantly influences the adoption and utilization of ICT within the classroom environment. In terms of attitude, the results indicated that teachers' attitude towards ICT impacts its integration into classroom activities. The study proposed that the government to provide in-service training of all practicing teachers on ICT integration into teaching and learning; and to furnish schools with ICT facilities. The study concluded that school were poorly equipped with ICT facilities.

**Keywords**: *Attitude, information and communication technology, use of ICT, teaching and learning.*

# 100. Effects of teacher professional development on implementation of Competency-Based Curriculum in Junior Schools in North Imenti sub-county, Meru County

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

Kenya is experiencing a gradual transition from a content-focused education (8-4-4) to a competency-based curriculum (2-6-3-3-3). However, there has been insufficient pedagogical preparedness of teachers and the lack of comprehensive content knowledge for Competence-Based Curriculum. This research focused on examining the effects of teacher professional development on the implementation of the competency-based curriculum in junior secondary schools in North Imenti, Meru County. The study's objectives were to evaluate how enhancements in professional development, particularly in pedagogical skills, could facilitate the successful implementation of CBC. The literature review synthesizes existing studies on competency-based education, with a focus on the importance of aligning teacher professional development with curriculum demands. The study used a descriptive survey design. The target population comprised 26 junior schools in North Imenti Sub-County, Meru County. The respondents were 2 sub-county education directors, 26 head teachers, and 70 junior school teachers. Through stratified sampling, the sample size was 31 Respondents, that is 8 head teachers, 21 teachers and 2 sub-county directors of education. The data was collected using Questionnaires, interview schedules, and observation checklists. The findings indicated that most of the junior school teachers (95%) have undergone professional development on implementation of Competency-Based Curriculum. The study concluded that Teacher Professional Development is important for equipping teachers with necessary skills and knowledge for effective implementation of Competency-Based Curriculum. The study recommended for the development of continuous, competency-focused professional development initiatives that address these critical areas of instructional methodologies.

**Keywords:** *Competency-based curriculum, teachers professional development, pedagogical skills*

# 101. Pedagogical strategies for English composition instruction among learners in public primary schools within the Igembe Central Sub-County, Kenya

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

In primary education, composition writing is crucial for English language development. It improves both speaking and writing skills, fosters critical thinking, and requires careful instruction. Factors influencing instruction effectiveness must be considered by educators. This research aimed to examine the impact of specific variables on the teaching of composition writing in public primary schools located in the Igembe Central Sub-County. The study objectives were to assess the effects of teaching methodologies employed in composition writing instruction and to ascertain the impact of student motivation on the teaching of English composition writing. The research was guided by Levi Vygotsky's sociocultural theory and Noam Chomsky's language acquisition theory. Employing a descriptive survey design, the study was conducted in the Igembe Central Sub-County, focusing on a target population of 7,011 individuals, including 171 class seven English teachers and 6,840 class seven pupils across 75 public primary schools. Utilizing the finite population formula, a sample size of 361 class seven pupils and 9 class seven English teachers was determined through simple random sampling where proportionate sampling ensured each sample size (teachers and pupils) was sampled independently. Data collection involved the use of interview schedules for English teachers and questionnaires for class 7 pupils, with questions designed to align with the study objectives to ensure instrument validity. A pilot study, conducted in a school resembling the study sample, assessed instrument reliability using Cronbach's Alpha coefficient, achieving a threshold of 0.70. Collected data underwent cleaning, coding, and analysis using Statistical Package for Social Sciences (SPSS) version 26, employing descriptive statistics such as frequency and percentages, and hypothesis testing at a 95% level of significance using Chi-square. Finding indicated a significant and positive influence of teaching approach and pupil motivation on English composition writing instruction. Recommendations include English teachers adopting innovative teaching methods to enhance instruction, fostering pupil motivation, and head teachers providing support through the provision of instructional materials and incentives to encourage pupil engagement.

**Key words:** *Pedagogical, English Composition, Learners, Public Primary Schools Instruction, Teaching Methodologies and Student Motivation*

# 102. Factors undermining effective implementation of competency-based education in Junior Secondary Schools in Isiolo Central, Kenya

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

Competency-Based Education (CBE) is designed to equip learners with competencies essential for success across various fields. In Africa, including Kenya, CBE serves as a strategic response to technological advancements, globalization, and economic growth. Despite the Kenyan government's concerted efforts to implement a competency-based curriculum, significant challenges persist, particularly in junior secondary schools in Isiolo Central. The general aim of the study is to investigate the factors undermining the effective implementation of CBE in public junior secondary schools in Isiolo Central, Kenya..The study's theoretical framework is grounded on educational change theories, which emphasize the importance of contextual factors and stakeholder engagement in the successful implementation of curricular reforms. The research will consider socio-cultural, economic, and institutional variables that may influence the adoption of CBE.A mixed-methods approach will be employed, incorporating both quantitative and qualitative data collection techniques. Questionnaires and interviews will be administered to collect data from the stakeholders, including teachers, administrators, and policymakers. Data analysis will involve statistical methods for quantitative data and thematic analysis for qualitative data. The study will use stratified random sampling to ensure representation from all 15 public junior secondary schools in Isiolo Central. The study population will include teachers, school administrators, policymakers, and students. A total of 130 participants will be sampled, comprising 60 teachers, 15 school administrators, 10 policymakers, and 45 students, providing a comprehensive understanding of the implementation challenges.The findings of this study will address the existing knowledge gap regarding CBE implementation in Isiolo Central by evaluating the adequacy and condition of classrooms and buildings, assessing the availability and quality of instructional materials, analyzing the integration and effectiveness of technological resources, and investigating the role of financial resources, including government capitation. Additionally, the study will offer valuable recommendations for improving educational practices and policies, thereby enhancing the effectiveness of CBE in junior secondary schools.This research aims to contribute to the broader discourse on educational reform in Kenya and provide actionable insights for policymakers, educators, and stakeholders involved in the education sector.

**Keywords:** *Competency-Based Education, Classroom Adequacy, Instructional Materials, Technological Resources, Financial Resources, Government Capitation, Junior Secondary Schools, Isiolo Central, Kenya,*

# 103. Literature as Scientific Refrain: A Study of John Lara's *Play the Samaritan* and Henrik Ibsen's *An Enemy of the People*.

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation



## Abstract

Literary works are creative pieces, reflective of the general environment of the human society in its diversity and complexity. The motivation of scientific inventions on the other hand is the dynamics of the human life in relation to the environment, which echoes the core essence of literature and literary works. Mostly, Literary works act as harbinger between the delicate relation between the environment and the human society, thus creating a refrain synonymous to both. In literary works, Scientific theories are echoed and a reverse influence from literature to science thus radiating a congruence and refrain of purpose and focus. This research study sought to justify literature as a scientific refrain in relation to the environmental issues and concerns. The objective of the study was to justify how literary works reflect the scientific concerns in the human society and how both influence one another. The study used a descriptive research design, with the data collected from both primary and secondary sources. The selected texts for this study constitute the primary data, while others comprise the secondary data. The texts for this study were purposefully sampled, and analysed using content analysis method. The study concludes that, literature echoes science, and both play a pivotal role in addressing the environmental concerns in the human society as depicted in John Lara's play the Samaritan and Henrik Ibsen's, an enemy of the people. The study concluded that creative writers pursue thematic concerns that are scientific in nature in a creative manner, thus creating a humongous impact, thus advancing a scientific concern more forcefully that may impact on the environment

**Keywords:** *Literary Works, John Lara's Play the Samaritan*

# 104. Utilizing Quality Management Techniques in minimizing examination malpractices at Meru National Polytechnic.

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

Examination culture can shape or taint the image of an institution. Exam malpractices undermine educational integrity, eroding the value of academic qualifications and trust in the education system. Addressing this issue is critical to maintain fairness and uphold standards. This study investigated strategies to minimize exam malpractices through various supervision methods for quality management with a focus on Meru National Polytechnic (MNP) in Kenya. It evaluates the various stages of exam management; exam content setting , handling, packaging, and storage of exam materials, identifying potential vulnerabilities that erode confidence. The study utilized a mixed-methods approach, combining qualitative interviews with educators and quantitative surveys among students to identify vulnerabilities in the exam process. Additionally, a review of existing literature on exam supervision strategies was conducted to evaluate their effectiveness. The findings revealed several key vulnerabilities, including lack of water tight handling procedures, inadequate supervision, inconsistent application of rules, and insufficient training content creators, invigilators and script markers. They indicate a need for enhanced security measures, transparent marking procedures, and effective supervision strategies to mitigate malpractices. Recommendations include strengthening protocols for handling exam materials, standardizing marking practices, and implementing robust invigilation methods. By addressing these concerns, MNP can fortify its assessment processes and ensure fairness for all students. Implementing these recommendations at MNP and similar institutions can enhance the integrity of the examination process providing a roadmap for institutions to improve their examination practices and maintain high standards of academic integrity. Specific steps include mandatory content crerator, invigilator and marking training programs, adoption of surveillance technologies, and a clear communication plan for rules and consequences. These measures will help restore trust in the assessment process and ensure that academic qualifications accurately reflect students' knowledge and abilities.

**Keywords:** *Exam Malpractices, Quality Management, Supervision Methods*

# 105. Cultural factors impacting management of resources in early childhood education in Ndoto East, Samburu North Sub-county.

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

This study investigates the cultural factors influencing the management of resources in Early Childhood Education (ECE) within Ndoto east ,Samburu North, Sub-county. The problem statement identifies the challenges arising from the interplay between traditional cultural norms and modern educational practices, hindering effective resource management in ECDE settings. The objectives of the study are to examine how cultural beliefs, practices, and values impact resource allocation and utilization in ECDE, and to identify strategies for mitigating these challenges to enhance ECDE outcomes. The target population includes ECDE educators, community leaders, parents, and government officials directly involved in or affected by ECDE initiatives in Ndoto east ,Samburu North Sub-county. The sampling technique employed will be purposive sampling, selecting participants based on their relevance to the research objectives and their experience in ECDE management. A sample size of 50 participants will be selected to ensure diverse perspectives and comprehensive data collection. Data collection will be conducted through semi-structured interviews, focus group discussions, and document analysis. The instruments used will include interview guides, observation checklists, and document review templates, tailored to capture information relevant to the study objectives. Data analysis will follow a qualitative approach, involving thematic coding and content analysis. Transcribed interviews, focus group discussions, and document extracts will be analyzed to identify recurring themes and patterns related to cultural factors influencing resource management in ECDE. The findings will provide insights into effective strategies for addressing cultural barriers and optimizing resource utilization in ECDE settings within Ndoto east ,Samburu North Sub-county.

**Keywords:** *Early Childhood Education, Education management*

# 106. Secondary school principals' preparedness on implementation of Competency Based Education.

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation



## Abstract

The study sought to evaluate the secondary school principals' preparedness on implementation of competency- based education in Tigania West Sub County. The objectives of the study were to find out ways principals' ensured stability of school human resource in readiness to implementing competency-based curriculum education; establish the school initiatives undertaken by principals in readiness to implementing competency-based curriculum education and assess the principals' leadership styles exercised during the implementation process in readiness to competency-based curriculum education. The study used descriptive survey design and targeted a population of 867 participants. Using stratified sampling technique based on Yamene sample size tables, sub samples of 10 principals, 30 HoDs, 60 teachers and 10 parents were obtained. Observation schedules, checklists, questionnaires, and interviews were used. Quantitative and qualitative data was analyzed using descriptive statistics and statistical packages for social sciences version 20.0 respectively. The major findings of the study showed that; 80 % of the principals supported both teaching and non-teaching staff by facilitating them to attend to relevant workshops and seminars, being sensitive to individual needs, organizing separate joint retreats and educational trips for each category. 44.7% and 21.3% of the secondary school principals employed democratic leadership; and engaged networking and linkages to create network with local NGOs and agencies to harness learning resources in readiness for CBC implementation respectively. Further, 90% of the parents lamented additional costs they incurred in preparation for CBC. The study concluded that most of the schools were on high gear preparing for implementation of CBC. The study recommended for a harmonized way of mobilizing resources for secondary schools within the constituencies via the elected leaders' offices so as not to leave behind some secondary school.

**Keywords:** *Principals, implementation, human resource, competency based curriculum, initiative and leadership styles*

# 107. Secondary school principals' instructional leadership approaches in enhancing learners' academic achievement.

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation



## Abstract

The principal's role is to promote students' academic performance. The success or failure of a school is usually attributed to the principal. He or she is the pivot around which all aspects of the school revolve, being the person in charge of every detail of running the school, be it academic or administrative. A principal's instructional leadership skills could make a difference in a learners' achievement. It is imperative that the performance of a school is appraised against the accomplishments of the principal. So, the study evaluated secondary school principals' instructional leadership approaches in enhancing learners' academic achievement in Tigania West Sub-County. The study was guided by the following objectives: find out adequacy of teaching resources availed by the principals, assess the supervision of the use of teaching tools by the teachers and establish mentorship practices employed by the principals in enhancing academic achievement. The study used descriptive survey design to gather data on secondary school principals' instructional leadership approaches in enhancing learners' academic achievement. Using Krejecie and Cochran sample size tabulation model on the student and teachers populations of 637 and 55 yielded sample sizes of 240 and 50 respectively. The principals were picked purposively. The tools included the questionnaires, interviews and observations schedules. The study established that principals of high performing schools ensured that teachers prepared comprehensive schemes of work, updated lesson notes and documented records of work covered. Additionally, 80% of the principals from low performing schools did not motivate their students.. The study concluded that secondary school principals were inadequately prepared in mentorship skills. It was recommended that TSC in liaison with the MoE induct secondary school principals on mentorship programmes for learners and teachers.

**Keywords:** *Principals, instructional leadership, academic achievement, teaching resources*

CONFERENCE PAPERS

# 108. Managing climate change: the role of religion in selected church sponsored schools in Tigania West Sub-County

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

This study aimed at investigating the role of religion in mitigating climate change in selected church sponsored schools in Tigania West Sub-County. Religion plays a crucial role in shaping the beliefs, values, and behaviors of individuals towards their environment. However, the role of church sponsored schools in training future community leaders is not well documented. The study was conducted in selected church sponsored schools in Tigania West Sub-County in Meru County. It adopted a descriptive survey design where the principals, teachers and sponsors were targeted. Stratified random sampling technique was adopted where questionnaires and interviews were used to collect data. The study showed that the church played a great role in instilling moral values on students while little is known about their role in climate change mitigation. Therefore, this study highlights a potential gap in the education. The findings of this study suggest that there is a need for religious institutions to rethink their educational priorities and consider incorporating teachings on climate change mitigation into their curriculum. This can play a vital role in shaping the attitudes and behaviors of students towards environmental stewardship and fostering a sense of responsibility towards environment. Religion can play a crucial role in addressing climate change by promoting stewardship, inspiring action and advocacy, and providing a moral and ethical framework for decision-making. By integrating religious teachings and values into the school culture, can result to a positive impact in the society. The role of religion is significant in fostering environmental awareness, education, and action towards mitigating climate change. Thus, schools have the potential to shape the attitudes and behaviors of their students towards a more sustainable and environmentally conscious future. Climate change education could be integrated into the school curriculum; promote sustainable practices within the school community, such as reducing waste, conserving energy, and promoting eco-friendly transportation options; engage the school community in environmental initiatives such as workshops, and campaigns focused on environmental conservation and climate action; partner with environmental organizations and experts and encourage reflection on environmental stewardship.

**Keywords:** *church, climate change, mitigation, religion, schools, sponsored*

# 109. Effect of the Fourth Industrial Revolution on the future of the Competency Based Education. a case study of Nairobi County in Kenya

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

The Fourth Industrial Revolution (4IR) is the combination of the digital, physical, and biological worlds. The transition from the 8-4-4 system of education to the current Competency Based Education is accelerated by the Fourth Industrial Revolution, which is leveraging artificial intelligence, the internet of things, and the development of smart schools to improve the quality of education. The main purpose of this study was to investigate the effect of the Fourth Industrial Revolution on the future of the education in Nairobi County, Kenya. The study adopted a descriptive research design. The research objectives that guided the study were: 1) To identify the available technologies for the 4IR in schools to improve the Competency Based Education and 2) To find out whether teachers have been trained on the technologies that characterise the 4IR and influence education. The targeted population consisted of 210 primary teachers, of whom 136 were selected through stratified and simple random sampling. A structured questionnaire was used to collect data from the teachers. The data collected was processed using SPSS version 26.0 and analyzed using descriptive statistics. The findings were presented inform frequency tables, graphs and charts. The study established that the majority of primary schools have inadequate technology devices for equipping learners with requisite skills that include coding, artificial intelligence, robotics, and advanced analytics. Further to note, was the small proportion of the teachers who indicated that they have been trained on how to integrate technology in the instructional process so as to enhance active learning? The teachers need capacity building on their pedagogical, professional, personality and social competencies that are key tenets for the Fourth Industrial Revolution in improving the Competency Based Education. The government through the Ministry of Education need to equip schools with technological infrastructure and capacity build teachers in order to improve the quality of education during this Fourth Industrial Revolution.

**Keywords:** *Competency Based Education, Fourth Industrial Revolution, Technologies*

# 110. Eco-Literacy and Climate Action in Primary School Curriculum in Kenya

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

It is imperative for the 21st century schools to create graduates who are deeply connected, responsible and knowledgeable on climate matters. Whereas United Nation's Sustainable Development Goals (SGDS) intends to limit climate change, the role of children in achieving the desired outcome remains indeterminate. Children must also understand how nature works as a system. By embedding eco-literacy in educational framework, it subsequently cultivates a generation of persons who appreciates how nature works. It also equips learners with relevant knowledge, skills, attitudes and values that cares for our planet in a sustainable manner. The Kenyan government has been implementing a policy of free and compulsory basic education for all children guided by the principle of universal access to education for every child, as enshrined in article 53, 1(b) of the constitution of Kenya of 2010. The policy creates a coveted opportunity for every child in Kenya to be eco-literate. The purpose of the study was to examine the curriculum designs for pre-primary and lower primary Education in Kenya promotes ecological and environmental literacy. The study also intended to examine how numerous players in education sector contribute to climate action. Therefore, this paper discusses the role of eco-literacy in nurturing the young generation towards climate action. It underpins the role of children by evaluating numerous learning areas on environment that are entrenched in the curriculum designs. It also discusses the roles of strategic educational players in nurturing an environment-friendly learner. Descriptive design was employed in the study. Secondary data was collected from curriculum designs for pre-primary and lower primary school, analyzed and then discussed. The paper concludes that creating an eco-literate young generation through the school curriculum is the most potent and sustainable way of mitigating the impact of climate change, now and in future. Also, curriculum designs has mainstreamed greatly promoted eco-literacy among children in Kenya.

**Key Words:** *Eco-literacy, Climate action, climate change, curriculum*

# 111. Integrating gender diversity policies for enhanced service delivery in Kenyan Universities

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation



## Abstract

Integrating gender diversity policies into organizational structures is vital for sustainable development and climate action. However, there is a notable gap on how these policies impact service delivery, especially in Kenyan chartered universities. This study evaluated the influence of gender diversity policy implementation on service delivery in Kenyan chartered universities by, testing the hypothesis: There is no statistically significant relationship between gender diversity policy implementation and service delivery among chartered universities in Kenya. Employing a descriptive survey design, the study targeted population of 15,545 administrative staff and full-time lecturers. Using stratified and purposive sampling techniques, the population was divided into teaching and non-teaching staff. Random sampling was used to select 390 respondents. The study revealed that universities with effective gender diversity policies demonstrated enhanced service delivery efficiency and effectiveness. Descriptive analysis showed moderate agreement among respondents regarding policy implementation, particularly supporting flexible working hours for nursing mothers, gender-mainstreaming awareness, and prohibition of sanctions related to pregnancy or marital status. Statistical analysis indicated a significant positive correlation (R = 0.514) between gender diversity policy implementation and service delivery, explaining 26.4% of the variability. The study concluded that gender diversity policy implementation significantly enhances service delivery in Kenyan chartered universities. Inclusive policies foster environment conducive to sustainability and climate action. It was recommended that universities develop practical and comprehensive gender diversity framework, with continuous monitoring and evaluation, implementing training and sensitization programs, that assures securing leadership commitment to gender diversity initiatives.

**Keywords:** *Gender Diversity, Service Delivery, Chartered Universities, Sustainable Development, Climate Action, Policy Implementation.*

# 112. The influence of school libraries on overall performance in Kenya Certificate of Secondary Education (KCSE) in day secondary schools in Municipality Ward, Meru County

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

This study investigates the influence of school libraries on overall performance in the Kenya Certificate of Secondary Education (KCSE) in day secondary schools within Municipality Ward, Meru County. The research addresses a critical gap in understanding the impact of library resources and utilization on academic success in this context. With a focus on four-day secondary schools: Kinoru Secondary School, Meru Muslim Day Secondary School, CCM Township Day Secondary School, and Mwithumwiru Day Secondary School. This study will be guided by resource-based learning theory and constructivism learning theory. The Resource-Based Learning Theory emphasizes that access to diverse educational materials enhances learning, while Constructivist Learning Theory highlights active, self-directed, and collaborative knowledge construction. Together, these theories suggest that well-equipped and effectively utilized school libraries significantly improve students' KCSE performance. The study employs qualitative methods, including interviews and observations, to gather data from head teachers and teachers in charge of libraries who are informants in this study. In this study the sample population will be 8 respondents, out of which 4 will be the headmasters of those day secondary schools and the other 4 will be the teachers who are in charge of the schools' libraries. The findings reveal a significant positive correlation between the availability and adequacy of library resources and students' KCSE performance. Pearson's correlation coefficient quantifies the relationship between library resources and KCSE performance, with a strong positive r value of 0.75 indicating that better-equipped school libraries significantly enhance students' KCSE scores in day secondary schools in Municipality Ward, Meru County. Effective measures, such as extended library hours and collaborative teaching strategies, enhance the accessibility and relevance of library resources. Regular collaboration between teachers and teachers in charge of libraries is pivotal in integrating library activities with the curriculum, thereby supporting students' academic endeavors. Despite challenges like insufficient funding and limited resources, schools employ various strategies to overcome these barriers, including seeking external funding, updating collections, and forming community partnerships. Monitoring and evaluation practices indicate a positive correlation between regular library usage and higher KCSE performance. The study underscores the importance of continued investment in library resources, infrastructure, and collaborative efforts to further strengthen the impact of school libraries on academic success in day secondary schools in Municipality Ward, Meru County

**Keywords:** *school libraries; performance, Monitoring and evaluation practices, resource-based learning theory and constructivism learning theory*

# 113. Role of teaching practice in fostering student teachers' self-efficacy

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation



## Abstract

This study investigated the effect that teaching practicum has on the self-efficacy of student teachers in secondary schools. When student teachers enter the workplaces as interns, they are faced with the daunting task of embracing their roles as teachers while at the same time maintaining their connection with the university as learners. A descriptive research design was employed and quantitative data was collected using pre- and post- questionnaires. The study targeted all (130) fourth-year students on teaching practice from the Bachelor of Science in Education and Bachelor of Science in Agricultural Education programs at a public university in Kenya. The teacher interns were placed in all types of secondary schools' country-wide; urban, rural, boarding and /or day schools, single-sex, and co-ed schools. Seventy two (72) student teachers answered the surveys, giving a response rate of 55.4%. Preliminary results indicated that on average, student teachers had a high sense of self- efficacy. Three quarters of the respondents strongly disagreed that they generally felt as failures at all times. A similar proportion (70.8%) had a positive attitude about themselves and nearly two thirds (62.1%) strongly disagreed that they felt useless at times. Most of the students (95.8%), were, on the whole satisfied with themselves. This strong sense of self belief goes a long way in helping student teachers transition into the profession. Further, the study found that teaching practice improved student teachers' confidence in lesson presentation, and a number were able to create and facilitate effective teaching and learning environments for all students.

**Keywords:** *Self-efficacy, co-ed schools, Teachers transition*

# 114. Student leadership in Public Universities in Kenya

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

The study investigates modern university and college leadership / governance, illuminates on students' leaderocomics across the world with specific Kenya's high education private and public universities leadership experience as leaders and/or the lead and presence of any leadership training modeling to the university students. Student leadership or leadership by young people has always existed in school and community settings. While there are many programs devoted to leadership development and training, this study, focused on what young people conceive leadership to be and in what circumstances the students have experienced leadership. The study looked into the predicted consequent to the large national leadership trajectory. In addition, the study looked at leadership functions, perception and challenges as well recommendations for improvement. Kenyan Universities, both public and private have the same structure of students' leadership as guided by University Act of 2012. Student leadership in universities in Kenya is a microcosm of the national politics in the country. The study framing the review in authentic and servant, transformative leadership, integrated with best practices in learning and training. Methodology -The study followed a "systematic review", "narrative review", "meta-syntheses' design. The Objective was assessing the Student Leadership, any relationship between type of leadership and students' wellbeing in high education. Sample -The population targeted was students in college and university. The study's sample articles writing between 2015- 2024. The articles samples were obtained through online library Google scholar, ScienceDirect, Pubmed, Education Resources Information Center (ERIC), and specifically on leadership; seismic articles which include; Forbes, Fast Company, Harvard Business, and Huffington Post. The study reviewed articles utilizing specific instruments with psychometric properties of the student's leadership; Student Leadership Practices, Cronbach alpha coefficients (69 to .80) Observer version (0.82.) The Servant Leadership Scale (SL-28) (Liden et al., 2008), reliability coefficients (0.82 to 0.92) and transformational leadership (MLQ) (0.94 (94 %). Since Cronbach's alpha coefficient more than 70% is acceptable. Conclusion; Each of these instruments report Modest to strong internal reliability coefficients There is well representation of gender in students' leadership, the consistency of exposure to leadership to students from early age is recommended. An increase of exposure of students to leadership training mentors is gap that needs to be bridged and opportunities expanded from early age.

**Keywords:** *leadership; student leadership; student leadership practices inventory; leadership perceptions leadership development wellbeing, university students.*

# 115. Higher Education Fund (HEF) Students Resources mobilization in higher education

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**Sub-theme:** Education- the role of social sciece and educational institutions in climate change mitigation



## Abstract

This paper analyzed financing Tertiary education in Kenya with specific attention to the new public university funding model unveiled by the Kenya Kwanza government in 2023. Methods, utilized are that of a secondary data method literature review and policy analysis. The study makes recommendations on a viable financing framework for University education and research. Kenya's models have metamorphosed over years, 1990s The Kenya Government was financing the entire University education, including giving students' stipends. The Kamunge Report of 1988 entitled; introduced cost-sharing where the Government was to pay Ksh. 70,000 for every student admitted to University, while the parents or guardians were to pay Ksh. 16,000 as tuition fees. The students received Ksh. 50,000 from Higher Education Loan Board (HELB) as loans for their upkeep, accommodation and book allowance (HELB, 2023) The government grant per student also increased over time to a high of Ksh. 242,000 per student by 2016, with disparities within Universities. The direct tuition fees component paid by students, however, remained the same, although households continued to meet other associated costs. In FY 2017/2018 Government introduced Differentiated Unit Cost (DUC) as a model for funding public Universities. This funding model has been in place till this year (HELB, 2023). New model Proposed by The New Higher Education Funding Model, unveiled by President William Ruto on May 3, 2023, aimed to address challenges encountered by public universities and Technical and Vocational Education (TVET) institutions due to massive enrollment and inadequate funding. The framework replaces the Differentiated Unit Cost (DUC) prioritizing a student's financial need and separates placement from funding. Conclusion the funding method has great potential if and when well utilized, especially reaching out on families and students who have been left out of high education because social economic characters of poverty, no parents, and support system. However, no scientific method determines a student's level of neediness, raising concerns that students requiring scholarships and loans might not be appropriately classified for awards. Additionally, the distribution of funds lacks transparency. Details such as loan terms, interest rates, repayment conditions, and the process for appealing declined scholarship requests are not disclosed. Furthermore, the funding model excludes students under 18.The study recommends a longitudinal study that Progressive can follow funding HEF for some years step wise eligibility follow up of students applying and actual financial reception and payment in order to strongly argue for or against expected outcomes These outcomes are yet to show as indicators in a student's life being a less than 2 years old model being budget in progress.

**Keywords:** *Access to Higher Education, Teachers' Support, HIGH education funding, HELP Education funding models.*

# 116. Competency Based Education training for sustainable development: developing green skills for Kenyan Universities: a review

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**Sub-theme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

Competency-Based Education and Training (CBET) represents a promising approach to aligning education with industry demands and fostering sustainable development in Kenyan Universities. This review explores the intersection of CBET and sustainable development, focusing on the role of CBET in developing green skills, challenges in implementation, and strategies for integration within higher education institutions. The study employed a qualitative synthesis of existing literature and expert perspectives. The study established that CBET holds potential for nurturing green skills and promoting sustainability, challenges such as inadequate resources, infrastructure, and academia-industry collaboration persist. Addressing these challenges requires a comprehensive approach that prioritizes training, increases awareness, and fosters partnerships between stakeholders. Strategies for integrating green skills into CBET programs include curriculum revision, strengthening academia-industry collaboration, and enhancing education on green technology and sustainable practices. Public investment in sustainable infrastructure and interdisciplinary learning can promote environmental awareness and resilience. By embracing these strategies, Kenyan Universities can prepare graduates to thrive in a rapidly evolving global landscape while contributing to a greener, more equitable economy and society.

**Keywords:** *Green Skills, Industry, Training, TVET, Workforce*

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# 117. Analyzing uses of resources in agriculture engineering practical training at Meru National Polytechnic

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**Sub-theme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

This research investigated the adequate utilization of resources in practical training for agricultural engineering programs at Meru National Polytechnic, focusing on workshops, laboratories, tools, equipment, and machinery. The study employed an explanatory research design, combining quantitative surveys and qualitative interviews to gather data from students. The study objectives were: to examine the status of existing workshops viability for practical training in agricultural engineering; to assess the availability of tools, equipment and machinery for practical training in agricultural engineering; to analyze the utilization and quality of laboratories used in practical training of agriculture engineering. Stratified random sampling was used to obtain a sample size of 181 students. Questionnaire was used to collect quantitative data from the trainees. The findings revealed the challenges faced and opportunities for improvement in resource utilization within the institution in enhancing learners work competencies. Key findings included the predominance of scheduled monthly workshop utilization, concerns regarding accessibility to tools and equipment, and underutilization of laboratories from giving practice classes to trainees. Recommendations were provided to address these challenges, including investment in workshop upgrades, promotion of laboratory use, and establishment of industry partnerships. Overall, the study highlights the importance of optimizing resource utilization to enhance the quality of practical training and better prepare students for the agricultural engineering sector. More studies should be carried out on alignment of practical skills gained with industry expectation.

**Keywords:** *enhancing, practical training, agricultural engineering, resources, trainees, competencies.*

# 118. Health Risks of Climate Change and Variability to Maternal Health

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**Subtheme:** Education- the role of social science and educational institutions in climate change mitigation

## Abstract

Climate change has emerged as a significant global challenge with far-reaching implications for human health. Through a comprehensive review of scholarly articles, the study examines the complex interplay between climate change and maternal health and highlights the role of religion in climate change mitigation. Mothers play an integral role in creating and sustaining healthy households. Furthermore, improving maternal health is essential to achieving global sustainable development goals, particularly goal 3 (Good Health and Well-being). The paper sought to examine the physical and psychosocial effects of climate change on expectant mothers. The study explored the following objectives: the direct impacts of climate change on maternal health; Indirect impacts of climate change on maternal; and mitigation strategies. The study revealed that, rising temperatures and heatwaves increase maternal heat-related illnesses, potentially affecting birth outcomes. Vector-borne diseases, influenced by climate shifts, pose additional threats to maternal well-being. Environmental stressors, including natural disasters and climate-related migration, contribute to maternal stress, anxiety and depression affecting maternal care. Christian teachings acknowledge human life as precious and sacred. It should be protected and valued from conception until death. Religious beliefs and values lay emphasis on stewardship of the environment, social justice, compassion, and community support. Religious institutions and leaders can play pivotal roles in advocating for climate action, promoting sustainable practices, and providing psychosocial support to individuals and families affected by climate-related health issues. To effectively combat climate change effects, the study recommends that it is imperative to embrace integrated approaches that prioritize healthcare access, environmental resilience, mental health support, and community-based initiatives that integrate religious perspectives with scientific knowledge and best practices.

**KeyWords**: *Climate-change; Climate-variability, Maternal-health, Mitigation, Religion, Psycho-social.*

**SUBTHEME 6: Health Sciences- Climate Change and Public Health; Response and Impact of environmental changes on Health.**

PRECONFERENCE PAPERS

# 119. Potential of multi-sectoral collaboration in eliminating *Visceral leishmaniasis* (Kala-azar) transmission in Isiolo county, Kenya : a climate change challenge



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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

**Background**: Leishmaniasis is one of the vector-borne diseases (VBDs) caused by disparate species of Leishmania parasites. Global climate change affects Leishmaniasis like other climate sensitive VBDs. The effects of climate change on these diseases is multi-faceted and complex. Drought and aridity brought on by climate change significantly affect population mobility which is beneficial to sandfly vectors and increase the possibility of human infection by Leishmania parasites. The aim of this study was to evaluate the transmission dynamics of a climate change induced vector-borne disease (VBD) Visceral Leishmaniasis (Kala-azar) which is endemic in Isiolo County to determine challenges and specific recommendations to combat this disease. **Methodology**: This was a descriptive cross-sectional study design that utilized mixed methods for data collection. Quantitative data were collected using Participatory Epidemiology methods in purposively selected study villages. Qualitative data were collected through key informant interviews and semi-structured interviews. **Key Findings/Results**: Climate and environmental changes were determined as the major risk factors for Kala-azar in Isiolo County. Study results demonstrated lack of policies and strategies that promote multi-disciplinary Leishmaniasis outbreak response. Stakeholders' analysis revealed inadequate multi-sectoral coordination platforms for a more comprehensive approach to control in the County. Discussion: As a vector-borne disease, Visceral Leishmaniasis is a consequence of a complex web of vector-parasite-host interplays. In Isiolo, the challenges of Visceral Leishmaniasis prevention and control are multi-sectoral and exacerbated by ever-expanding human population, interaction of human with animals, climate and environmental changes. **Application:** Sustainable development goals advocate for multi-sectoral approach for health and development including for management of vector-borne diseases in accordance with the 2017–2030 Global Vector Control Plan of the World Health Organization. **Conclusions**: The study area's increasing Kala-azar burden is influenced by the effects of environmental factors and seasonal weather pattern variability brought on by climate change. Given that Kala-azar is a disease of poverty and neglect, inter-sectoral coordination is critical to achieving and maintaining the eradication levels. **Recommendations:** Integration of prevention and control strategies through multi-sectoral collaboration for ownership with strengthened surveillance while adhering to environmental conservation to lessen the effects of climate change on Kala-azar.

**Keywords:** *Climate Change, Elimination, Integrated, Multi-Sectoral, Vector-Borne Diseases, Visceral Leishmaniasis*

# 120. Practices on Menstrual hygiene management among girls aged 9 to 17 years in Mathioya sub-county, Murang'a County

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

Menstrual hygiene is crucial for women, especially in underdeveloped countries, but many face challenges in homes, schools, and workplaces. Rural girls often lack knowledge about menstruation, leading to unacceptable behaviors. Limited data exists on economically disadvantaged adolescent females in Mathioya sub-county, Murang'a County. The study aimed to assess personal hygiene habits, menstrual management materials, and disposal techniques for improving menstrual hygiene practices and overall well-being among adolescent girls in the region using a descriptive cross-sectional design and stratified random sampling technique. A study of 387 adolescent females aged 9–17 years found that 80% of them adhered to proper personal hygiene practices, with 94% changing their menstrual products every 4–6 hours. Most used soap and water for handwashing, while 86% used cloth, soap, and water for genitalia cleansing. 95% used disposable sanitary pads to manage menstrual periods, but faced challenges due to poverty. Only 92% preferred disposable pads, despite receiving information about other options. 85% of participants wished the government and ministry of education would offer complimentary sanitary products to address period poverty. 97% of participants believed pit latrines were the most efficient way to dispose of menstrual waste, but only 10% had the opportunity to use them. 83% of those unaware of the negative consequences of improper disposal were unaware of the adverse effects. The study highlights the need for improved sanitary products and education programs to address period poverty. The study suggests integrating menstrual hygiene management into the National School Health strategy to improve personal hygiene behaviors among girls, as well as collaborating with the Murang'a county government and school administration for sanitary items and waste disposal materials.

**Keywords:** *Menstrual hygiene management, Personal hygiene practices, Menstrual management materials, Disposal methods, Adolescent girls, Menstruation*

# 121. Investigating the Relationship between the cervical microbiome and HPV Status in HIV-Infected women in Meru County, Kenya.

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

Cervical cancer, caused by high-risk Human Papillomavirus (HPV), is a global burden affecting women. The cervical microbiome is associated with female health regulation. Immuno-compromised HIV-infected women are susceptible to persistent HPV infections. The aim of this study was to characterize the cervical bacterial communities in HIV-infected women and to investigate their relationship with an individual's HPV status. A cross-sectional study was conducted involving 38 HIV-infected women, with 52.63% being HPV-positive and 47.36% HPV-negative. The study was carried out at the Meru Teaching and Referral Hospital (MeTRH). The dry Evalyn brush was utilized for self-sample collection. DNA extraction and amplification was carried out at the Centre for Molecular Biosciences and Genomics. Microbiome characterization was done by 16S rRNA sequencing on an MGI DNBSEQ-G99 platform. The Bioconductor R package was used to perform sequence analysis. Ten bacterial phyla were identified with Firmicutes and Actinobacteria being the most abundant with relative abundances of 48% and 26% respectively. Proteobacteria (2.4%) and Spirochaetes (0.4%) were selectively enriched in HPV-positive women. Gardnerella, Lactobacillus, Prevotella and Sneathia were the most abundant genera. Three STI-associated genera were identified including Mycoplasma, Ureaplasma and Treponema. Alpha and beta diversity analyses rsevealed no significant differences in the microbiome composition between HPV-positive and HPV-negative women. The median Shannon diversity index was 5.733, and the median Simpson index was 0.9940. PERMANOVA on Bray-Curtis distances generated a p-value of 0.328. A t-test, p=0.4484 and Wilcoxon, p=1 was used to evaluate Shannon and Simpson. These indicated a high microbial diversity and dysbiosis. In conclusion, HIV infection is associated with a more diverse cervical microbiota. However, the overall composition between HPV-positive and HPV-negative women is similar. This could be attributed to HIV infection having already distorted the diversity of the microbial species. The findings thus highlight the need for targeted interventions to curb HR-HPV infections in HIV-infected women.

**Keywords:** *Cervical microbiome, dysplasia, Human Papillomavirus, dysbiosis, high-risk HPV, low-risk HPV.*

# 122. Exploring maternal decision-making factors in childbirth in Meru Level Five Hospital, Meru, Kenya

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

Choices of childbirth method by women have emerged as a global subject of interest to many health care providers especially considering the steady increasing rate of caesarean sections (CS), and with some countries exceeding the World Health Organization (WHO) recommendation of 10-15%. With increased access to health facilities for maternal childbirth in Meru County, it was important to understand the factors that influence the choice of delivery method by women attending antenatal care. The aim of this study was to determine the factors associated with choice of child delivery methods in Meru Level V Hospital. A cross- sectional study of 300 expectant mothers attending ANC were interviewed and data analyzed using SPSS. The mean age of participants was 28.6±5 years (19 - 42 years). Majority of women in the study had over 12 years of Education (Tertiary Education – 73%) and only 2% had Primary level education. The most prevalent method of childbirth was vaginal delivery, accounting for 53% of cases, while the rate of Cesarean section (CS) deliveries had increased compared to previous years. The decision-making process for choosing the delivery method was influenced by factors such as the social status of women and the fear of pain during delivery. The level of education for women played a role in the decision, with considerations such as knowledge of infection risk, maternal complications, healing time, and cost impacting the choice between natural delivery and CS. several significant factors were identified as contributing to the choice of delivery method, including the influence of relatives, past childbirth experiences, and information obtained from media sources. In conclusion, the decision-making process for childbirth is influenced by a combination of knowledge, attitudes, and social factors among women attending antenatal care at Meru Level V Hospital.

**Keywords:** *Childbirth, Cesarean section, Antenatal care, Maternal*

# 123. Mass media sources that promote good hygiene practices in Garba-tula Sub-county, Isiolo county, Kenya.

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

Hygiene practices are essential for maintaining public health and preventing the spread of infectious diseases. The study aimed at identifying the media sources that contribute to good hygiene practices in Garba-Tula Sub-County in Isiolo County, Kenya. Mass media has the potential to influence individuals' hygiene behaviors and attitudes. By reaching a wide and diverse audience simultaneously, mass media can effectively disseminate targeted hygiene- related messages, leading to improved knowledge. The study employed a mixed method approach with a sample size of 191, which included the household heads, public health officers, area chief and religious leaders. The study was conducted between December 2022 and February 2023. The data was analyzed by use of SPSS (2022) and ANOVA. The study found there was a moderate relationship, ($P =< 0.001$) between hygiene practices and the media. It was noted that a significant percentage of households depended on the media for hygiene messages. The study identified media representation, lack of awareness, poverty, lack of water, culture and low level of education as some of the factors associated with the poor hygiene practices in Garba Tula Sub County. The study recommends that mass media to be used exhaustively to aid in behavior change and creating awareness.

**Keywords:** *Hygiene practices, Mass media, Sanitation, Garba Tula*

# 124.
# 125. Surgical site infections among post-operative patients by Methicillin-resistant *Staphylococcus aureus*(MRSA).

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

Antimicrobial resistance is one of the major threats to global health. There has been a marked increase in the number of drug resistant pathogens in the recent past and this has had great detriment to patients worldwide. One such pathogen is Staphylococcus aureus. The world health organization (WHO), in the 2024 updated bacterial priority pathogen list (BPPL) ranks this bacterium as one of the high priority pathogens causing a huge public health effect. This bacterium has developed resistance to a Methicillin which has been for the longest time the drug of choice in management of Staphylococcal Infections among patients. The consequences of this resistant have been greatly felt by post-operative patients in surgical wards of various healthcare centers who have acquired this nosocomial infection at the Surgical site. Methicillin resistant staphylococcus aureus accounts for 37% of all surgical site infections in hospitals. This experimental study was conducted between January 2024 and May 2024 in a level six hospital in Meru County. A total of 82 patients participated in the study. Clinical samples from their surgical sites were isolated and antimicrobial susceptibility testing was carried out by the Kirby-Bauer disk diffusion method against Oxacillin and Cefoxitin which are the current gold standard indicator drugs for determining Methicillin resistance in staphylococcus aureus. The study also deployed questionnaires to determine several patient and health system factors that contribute to MRSA incidence. Out of the 82 samples analyzed 25(30.49%) were found to be positive for MRSA, and showed resistance to both Oxacillin and Cefoxitin. A number of healthcare system factors were also found to cause increased incidence such as empirical diagnosis and prescription of antibiotics. Sharing of personal effects as well as crowding within the hospital. Age was also found to be a predisposing factor since most of the infections were witnessed among older patients.MRSA incidence shows a major setback in patient management in terms of cost and prognosis. It is therefore incumbent among healthcare professionals to adhere to existing infection prevention protocols. Proper pre-operative, Intra-operative and post-operative patient care is necessary in order to optimize patient outcomes in clinical settings and to reduce resistance.

**Keywords:** *Antimicrobial resistance, Surgical site infection, Methicillin Resistant Staphylococcus aureus*

# 126. In silico analysis of virulence and antimicrobial resistance associated genes in genomes of non-typhoidal salmonella isolates from Kenya

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

Non-typhoidal Salmonella (NTS) poses a significant global health burden, causing millions of infections and substantial mortality each year, particularly in Africa. In Kenya, the problem is worsened by the high incidence of NTS and increasing antimicrobial resistance (AMR) . To address this challenge, we propose an in silico analysis of Kenyan NTS genomes to identify virulence factors and AMR-associated genes.This study involves a secondary data analysis using publicly available whole genome sequencing data. We will conduct bacterial genomic analysis that will include quality control, assembly, annotation, pan-genome, and phylogenetic analyses. Abricate software will be used to scan the following databases for antimicrobial resistance genes: CARD, ARGannot, ResFinder, and MegaRes. It will also be utilized to scan the VFDB database for virulence factors. These analyses will result in detailed phylogenetic trees, identification of virulence factors and AMR genes. The Phylogenetic trees will help us understand transmission dynamics and relationships among NTS isolates, while the identification of virulence factors and AMR genes will highlight strains linked to severe illness. This project aims to strengthen Kenya's genomic analysis capacity. We will adopt a One Health approach where we integrate data from clinical, environmental and animal sources to explain the complex interactions that lead to the spread of non-typhoidal salmonella. This research will also foster local bioinformatics expertise

**Keywords:** *Antimicrobial resistance, Non-typhoidal Salmonella*

# 127. Isolation, characterization and quantification of common enteric bacteria from edible parts of *Catha edulis* (khat) sold in the identified parts of Meru County, Kenya.

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

This study addresses the critical issue of microbial contamination in ready-to-eat (RTE) plant produce, which has led to a rise in foodborne illnesses despite advancements in global health technologies. Particularly in developing nations, inadequate disease-outbreak surveillance systems and weak health response systems exacerbate the problem. Catha edulis, commonly known as khat, is a plant consumed for its stimulant properties. In Meru County, Kenya, khat is a significant economic crop, yet it is typically chewed raw, making it highly susceptible to microbial contamination. The entire processing chain of khat, from harvesting to selling, can introduce points of contamination, raising the risk of disease transmission. This study aims to fill the data gap regarding microbial contamination of khat in Meru County by isolating and characterizing common enteric bacteria present in khat. The research aims to provide critical data to inform public health strategies and mitigate risks associated with khat consumption. Objectives:To achieve this, the study will isolate and identify common enteric bacteria at different stages of khat processing in Meru County. It will determine the prevalence and levels of microbial contamination in khat sold in various markets within the county. Additionally, the research will assess the hygienic practices of khat handlers and their impact on contamination levels. Finally, it will provide recommendations for improving hygiene practices and mitigating microbial contamination risks associated with khat consumption. Methodology:The research will focus on Meru County, covering the entire processing chain from harvesting to selling points, in areas where khat is predomSinantly cultivated, processed, and sold. The study will include isolating and identifying enteric bacteria in khat samples, assessing handling practices, and evaluating environmental impacts on contamination levels. A detailed procedure will be followed, involving sampling khat from farms, vendors, transportation, and consumer points. Isolation of gram-negative bacteria will be conducted using selective media, followed by molecular characterization through gene sequencing. This process will help identify and quantify common enteric bacteria, providing insights into contamination sources and levels. Purpose:This study aims to provide crucial data on microbial contamination in khat, highlighting public health risks and informing strategies for improving food safety in Meru County. The findings will be instrumental in developing targeted interventions and enhancing public health responses to mitigate risks associated with khat consumption.

**Keywords:** *Catha edulis, Microbial Contamination, Enteric bacteria*

# 128. Case report on efficacy of SPHEDM-S on the treatment of chronic, incurable wounds in Meru County



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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

We wish to report a breakthrough treatment of chronic wounds using a new drug combination pseudo-named SPHEDM-S, that has proven to cure otherwise untreatable wounds including diabetic, cancerous, venous and extensive burn wounds. Our observation when using this combination is that chronic wounds become odorless and painless, granulate faster. SPHEDM-S further significantly reduces sepsis, is hemostatic and stimulates epithelialization and skin re-growth. This has the overall effect of reduced hospital stays and lowers the cost of treatment. SPHEDM-S, a combination of five drugs consisting silver sulphadiazine (250g), silver nitrate (5ml of 0.01%w/v), metronidazole (1gm), doxycycline (500mg) and phenytoin (300mg). The trigger for our research was the observation that the use of silver sulphadiazine, metronidazole and phenytoin in combination gave better wound healing outcomes than the application of silver sulphadiazine alone, the recommended burn wound management drug. The triple combination gave better granulation and infection management leading to faster wound healing. We further observed that practicing clinicians were shifting from the use of silver sulphadiazine to silver nitrate solution at 0.01%w/v claiming that wounds dried faster than when silver sulphadiazine was used. Furthermore, the Meditec Group (the manufacturers of silver nitrate spray) indicated that use of silver nitrate was effective against drug resistant strains of wound microbes. We also observed that phenytoin an anticonvulsant, causes gingival hyperplasia as a side effect and desired to investigate if this would enhance wound granulation and re-epithelialization. We therefore added phenytoin to the combination and observed that it not only hastened deep wound healing but also had analgesic effect on painful wounds. This paper reports the initial clinical case reports using SPHEDM-S on deep and hard-healing to non-healing wounds.

**Keywords:** *SPHEDM-S, chronic wounds, sepsis, epithelialization*

# 129. Investigating the gut microbiome profiles associated with colorectal cancer in patients of African Descent

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

Colorectal cancer (CRC) is one of the leading causes of cancer in the world. In Kenya, CRC is the fifth most common cancer in the country and the third most frequent among Kenyan men. The human gut microbiome is a highly diverse microbial community that modulates human health through the production of short-chain fatty acids, vitamins, neurotransmitters and antimicrobial peptides. The human gut microbiome composition has been found to be a risk factor for the development of CRC. Bacteroides fragilis, Clostridium septicum, Enterococcus faecalis, Escherichia coli and Streptococcus gallolyticus are directly associated with colorectal carcinogenesis. The main object of this study is to explore the association between gut microbiome composition and diversity and CRC in patients of African descent. There is a paucity of data of the link between CRC and the gut microbiome among African patients. This will be a cross-sectional study that will involve a secondary analysis of publicly available 16S rRNA data obtained from analysing the gut microbiomes of patients with CRC. FastQ files will be retrieved from sequence databases by searching for specific keywords. DADA2 will be used to perform quality control and taxonomic classification on the obtained 16S rRNA sequence data in R 4.4.0. Phyloseq will be used to perform diversity analysis and generate data visualisations. PICRUSt2 will be used to predict microbial functions associated with CRC and MICOM for metabolic profiling of the gut microbiomes of patients with CRC. The findings from this study will generate a comprehensive analysis of the gut microbiome profiles of patients of African descent with colorectal cancer. Moreover, functional analysis will be key in identifying gene and protein families that are associated with CRC which may serve as diagnostic and prognostic biomarkers.

**Keywords:** *gut microbiome, colorectal cancer, diversity, functional, metabolic and dysbiosis.*

# 130. Prevalence and risk factors associated with HPV infections among women with HIV in Meru, Kenya

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

Cervical cancer, caused by, Human Papilloma Virus (HPV) is the leading cause of preventable deaths among women. High incidence and high mortality for cervical cancer are reported in lowand middle-income countries where immunocompromised women with HIV exhibit an increased risk. We determined circulating high-risk HPV genotypes in women with HIV in Meru, Kenya and identified risk factors associated with HPV infections in a cross-sectional study of 303 women aged 18 to 64 years. Sociodemographic and clinical details were collected using a questionnaire. Cervical specimens were obtained using a self-sampling technique, followed by HPV DNA extraction and real time PCR targeting 24 high-risk genotypes with differentiation of HPV 16, 18, and 45. Data analysis was carried out in R Studio. The association between risk factors and HPV status was evaluated using the Wilcoxon rank sum test, chi-squared test, and Fisher's exact test with $p<0.05$ considered statistically significant. Out of the 303 tested samples, 60.4% (N=183) tested positive for high risk HPV broken down as HPV 18 (36.6 %), HPV 45 (31.68 %), HPV 16 (12.20 %) and other high-risk HPV types (14.85 %). The prevalence of multiple infections with HPV 16 and 18 was 8.58% (N=26). There was a significant association between age and HPV status ($p=0.022$). The median age of HPV positivity was 38 years. In conclusion, our study reveals a high prevalence of high-risk HPV dominated by HPV 18 among women with HIV in Meru. These findings highlight the need for targeted screening programs within this population to facilitate early detection and timely interventions to prevent cervical cancer.

**Keywords**: *HIV, HPV, Cervical cancer, timely screening, Prevention*

# 131. Ex vivo snake venom detoxifying action of the aerial part extract of *Tacazzea Apiculata* Olive (*Periplocaceae*)

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

*Tacazzea apiculata* (Olive) is a woody climber indigenous to tropical Africa used ethno medicinally for treatment of pain, inflammation, snakebite among others. This study therefore was aimed at screening phytochemical constituent(s) and to evaluate the snake venom detoxification action of the aerial part extract of T. apiculate in mice. Pulverized aerial part of T. apiculata was extracted with methanol using maceration method to yield the crude methanol extract (ME). The preliminary phytochemical screening was conducted in accordance with procedures as described by African Pharmacopoeia. The LD50 of ME was conducted using Lorkes' method. The LD99 was carried out using the methods of Theakston and Reid. Venom detoxification effect was investigated at the doses of 80, 170, and 260 mg/kg extract, 0.2ml of LD99 was reconstituted with doses of extract and incubated, and 0.2ml of incubated mixture was then injected into each animal in the treatment group. The number of deaths was recorded within 24h. The Preliminary phytochemical screening of ME T. apiculata revealed the presence of secondary metabolites. The LD50 of ME and the LD99 of the venom were estimated to be 894mg/kg and 4.6mg/kg, respectively. Antivenin studies suggest that ME possess significant activity against venom ex-vivo; maximum protections were observed at the doses of (80mg/kg), (170mg/kg) with 100%, 83.3% survival, respectively. ME T. apiculata demonstrated significant ex vivo antivenin activity in mice and lends credence to traditional use of the plant in the management of snakebite.

**Keywords:** *Tacazzea, ex-vivo, snake-venom, detoxifying, LD99, phytochemical*

# 132. Prevalence and risk factors of undiagnosed type 2 diabetes among hypertensive patients attending St. Orsola Catholic Mission Hospital, Tharaka Nithi County, Kenya

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

According to the WHO, non-communicable diseases (NCDs) were a major cause of death in 2022, accounting for 41 million (74%) of deaths worldwide. Diabetes mellitus (DM) and hypertension (HTN) are two illnesses that are not contagious but are linked closely. The objective of the research was to establish the prevalence and risk factors of undiagnosed diabetes among hypertensive patients attending St. Orsola Hospital in Tharaka Nithi County, Kenya. A cross-sectional study involving 384 HTN patients attending the outpatient medical clinic was conducted from October to December 2022. The study population consisted of patients taking anti-hypertensive medication and visiting the St. Orsola Catholic Mission Hospital HTN outpatient clinic. Hypertensive patients who were under anti-diabetes medication and pregnant patients were excluded from the study. A questionnaire containing socio-demographics and behaviours was used to collect data, while the diabetes state was confirmed based on the glycated haemoglobin (HbA1c) classification. The data was analyzed using SPSS version 20.0, performing univariate, bivariate correlation, Chi-square analysis, and multivariate, and looking at statistical significance at a p-value less than 0.05 at a 95% confidence level. The age of the participants ranged between 20 and 89 years, with the majority (62%) being below 60 years. Of these participants, 66% were women and 34% were men. Seventy-five per cent (288/384) of participants were found to be non-diabetic, with 21 (5%) with undiagnosed DM and 75 (19.5%) being pre-diabetic. Risk factors associated with undiagnosed diabetes were found to be age ($\chi2$ = 24.837, df = 4, p =.000), body mass index (BMI) ($\chi2$ = 45.838, df =4, p =.000), and marital status ($\chi2$ = 11.992, df = 4, p =.017). The study found hypertensive patients with undiagnosed diabetes in a clinical setting, indicating a missed opportunity for diagnosis. The risk factors for undiagnosed diabetes are age, BMI >25 kg/m2, and marital status. Therefore, the study recommends targeted screening for DM among hypertensive patients to enable early detection and proper intervention management.

**Keywords**: *Type 2 Diabetes, Hypertensive Patients, Diabetes Medication, Diabetes*

# 133. Household Sanitation Practices Escalating Diarrhea in Children Under-Five in Igembe South Sub County, Meru County, Kenya

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

Aim: The study aimed to identify household sanitation risk factors contributing to diarrhea in children under-five years in Igembe South Sub County, Meru County, Kenya. Methodology: This retrospective study was conducted at Nyambene Sub County Hospital in Maua Town and used convenience sampling to choose 196 children under the age of five who were treated for diarrhea between December 2022 and March 2023. These cases were followed up at home to gather information on household sanitation, water, and hygiene practices using questionnaires and observations. Water samples from domestic sources were tested at Meru University of Science and Technology. Data was analyzed using SPSS version 24, with ANOVA used to investigate hygiene and sanitation variables. Results: The study received a 100% response rate, with 63.3% of caregivers being women and 46.4% being mothers. The degree of education varied, with 55.1% having completed secondary school. Immunization Status: 75.5% of children were partially immunized, with only 24.5% being fully immunized against rotavirus. Latrines were available in 70.4% of households, with 57.7% of them being improved. However 45.4% of caretakers used diapers, whereas 43.9% disposed of their excrement in pit latrines. Only 68.9% cleaned their hands after touching child feces. 57% had hand washing facilities, whereas 51% had soap available. Education on hand hygiene was received by 81% of participants. Discussion: Regression analysis revealed significant hygiene and sanitation factors influencing diarrhea prevalence, including hand washing before preparing meals (p=0.048) and household water supply (p=0.042). Poorly used and maintained sanitation facilities, as well as contaminated water sources, were major causes. Conclusion: The study emphasizes the importance of improving sanitation, water safety, and hygiene practices in reducing diarrhea among children under five in Igembe South..

**Keywords**: *Sanitation, Diarrhea, Children, Public health, Waste disposal*

# 134. Exploring Determinants of mortality among Adult PLHIV under ART at Meru Teaching and Referral Hospital, Kenya

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**Subtheme:** Health Sciences - Climate Change and Public Health; Response and Impact of environmental changes on Health.

## Abstract

HIV remains a persistent global health challenge, affecting the immune system and leading to significant morbidity and mortality despite advancements in antiretroviral therapy (ART). The study investigated the covariates that correspond to determinants linked to increased mortality among PLHIV (people living with HIV/AIDS) under ART at Meru Teaching and Referral Hospital (MTRH) over a five-year period. This retrospective cohort study utilized secondary data from hospital records between 2018 and 2022, focusing on demographic, socio-economic, and clinical variables. A logistic regression analysis was carried out to identify covariates that correspond to determinants linked to increased mortality among HIV-positive patients. The age range varied significantly, with a smaller percentage falling into younger age groups: 6.7% aged 18-25 years and 10.0% aged 26-35 years. The majority were middle-aged, with 24.9% falling into the 36-45 age group and 31.6% between 46-55 years. Older age groups were also represented, with 17.2% aged 56-65 years and 9.6% above 65 years. In terms of gender, 56.9% of participants were female, while 43.1% were male. The study results found a notable gender disparity in mortality risk, with male patients demonstrating higher odds of mortality compared to females (OR = 1.25, $p = 0.032$). Age emerged as a significant predictor, with each additional year associated with a slight increase in mortality odds (OR = 1.02, $p = 0.045$). Marital status did not significantly influence mortality risk. Smoking status was identified as a significant predictor, with smokers exhibiting higher mortality risk (OR = 1.40, $p = 0.005$). Employment status also played a role, with self-employed individuals showing marginally lower mortality risk (OR = 0.90, $p = 0.041$) and unemployed individuals facing higher risk (OR = 1.50, $p = 0.010$) all compared to the employed. Educational level showed varying mortality risks, with high school education associated with lower risk (OR = 0.85, $p = 0.030$) and tertiary education linked to higher risk (OR = 1.60, $p = 0.002$) both compared to no formal education. CD4 cell count inversely affected mortality risk (OR = 0.99, $p < 0.001$). Undergoing TB screening was associated with reduced mortality odds (OR = 0.70, $p = 0.003$). WHO stages of HIV infection significantly influenced mortality odds, with patients in advanced stages (Stage 3: OR = 1.30, $p = 0.015$; Stage 4: OR = 2.00, $p < 0.001$) demonstrating higher odds of mortality compared to those in Stage 1.

**Keywords:** *ART, Logistic regression, Determinants, odds ratios, mortality*

**SUBTHEME 7: Nursing - Harnessing Nursing and Health Systems to mitigate the effects of climate change.**

PRE-CONFERENCE PAPERS



# 135. Exploring childbirth experiences among adolescent in Imenti South Sub-county, Meru, Kenya

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**Subtheme:** Harnessing Nursing and Health Systems to mitigate the effects of climate change.

## Abstract

Adolescent childbirth experience is the aspect of giving birth as perceived and experienced by the adolescent from pregnancy, delivery to postpartum period including physical, emotional and social dimensions. Adolescent childbirth is a global health issues, 21 million girls aged between 10-19 years giving birth yearly. Adolescent childbirth is associated with higher risk of maternal and infant mortality among ages 10-19 years globally and complications during pregnancy and child birth are the second cause of death to the same population. The objective of the study is to examine childbirth experiences among adolescents seeking services in Imenti South Sub County of Meru County. A qualitative descriptive design, will be used to conduct this study in Imenti South Sub County. The study population will be adolescent mothers who have been attended in the public level four hospitals seeking antenatal and postnatal care in Imenti South Sub County. A sample size of 100 adolescent mothers will participate in the study. In-depth interviews and thematic analysis will be used to capture challenges experienced by adolescents during childbirth. A list of participants will be generated from the hospital records in the targeted study location using purposive sampling technique. The identified participants will be traced from the MOH 333 register and reached via telephone call. Focused groups discussion will be used to collect information from the participants. Data collected will be analyzed using NVivo software to organize code and analyze qualitative data. Research findings will be presented in thematic analysis. All ethical consideration will be adhered to by informing the selected participants the purpose of the study, seeking ethical clearance from Meru University of Science and Technology (MUST) Institutional Research Ethics Review Committee MIRERC and the necessary permit obtained from National Commission of Science and Technology and Innovation (NACOSTI). Informed consent will be sought from the study participants through their guardians and parents.

**Keywords**: *Adolescence Childbirth, Midwifery, Maternal health, Teen pregnancy*

# 136. Exploring pain management competencies among healthcare professionals in selected hospitals in Meru County, Kenya

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**Subtheme:** Harnessing Nursing and Health Systems to mitigate the effects of climate change.

## Abstract

Pain is an unpleasant sensory and emotional experience associated with actual and potential tissue damage. One in every five patient globally experience pain. Despite the available pain management strategies, the prevalence of pain among patients remains high. Twenty percent of the adult population in the developed countries suffers from chronic pain while in developing countries, the prevalence ranges from 13 % to 51 %. In sub-Saharan Africa a prevalence of 83% has been reported, while in Kenya the prevalence stands at 95%. The high prevalence is partly due to inadequate knowledge and negative attitude among Healthcare professionals towards pain management. Inadequate pain management affects patient outcomes by potentially increasing hospital stay and delaying recovery and significantly interfere with the patient's physical, emotional, and spiritual well-being. The objective of the study is to explore healthcare professional's competencies in pain assessment and management in selected hospitals in Meru County. . A quantitative approach will be employed. A prospective cross sectional design, will be used to conduct this study at Meru Teaching and Referral Hospital and St Theresa mission hospital-Kiirua The study population shall be qualified Doctors, clinical officers and Nurses at Meru teaching and referral hospital and St Theresa mission hospital-Kiirua managing patients in the outpatient, Accident and emergency department, adult medical and surgical wards. A sample size of 298 healthcare professionals will be selected as study participants. Data shall be collected using a self- administered that shall be filled by healthcare professionals to assess their level of knowledge, skills and attitudes on pain management. Data collected shall be entered into Statistical Package for Social Sciences (SPSS) version 24 and descriptive and inferential statistics used to analyze. Research findings will be presented in figures and tables. All ethical consideration will be observed by seeking ethical clearance from Meru University of Science and Technology (MUST) Institutional Research Ethics Review Committee (MIRERC) and a permit will be obtained from National Commission of Science and Technology and Innovation (NACOSTI). Informed consent will be sought from the study participants before administering the questionnaire.

**Keywords**: *Pain management, Pain management strategies*

# 137. Determinants of health outcomes of traumatic brain injury patients at Meru Teaching and Referral Hospital, Kenya

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**Subtheme:** Harnessing Nursing and Health Systems to mitigate the effects of climate change.

## Abstract

Traumatic brain injury is a disruption of the brain structure with its function caused by the application of an external source which is manifest as confusion, loss of consciousness, coma, or seizure. TBI is among the leading causes of admissions in hospitals globally and has been attributed to significant morbidity, mortality and disability. The objective of this study is to assess the determinants of health outcomes of patients with traumatic head injury seeking treatment at Meru teaching and Referral Hospital. Methods: A retrospective cross sectional design, will be used to conduct this study at Meru Teaching and Referral Hospital. The study population will be adult patients who have a diagnosis of traumatic head injury, seeking care and treatment at Meru teaching and referral hospital and health care workers managing patients at Accident and emergency department, adult surgical wards and critical care unit. A sample size of 84 patients will be the study participants. Data will be collected using a check list to collect primary data from patient's files and questionnaires will be administered to health care workers to assess their level of knowledge on management of traumatic brain injury patient. Data collected will be entered into Statistical Package for Social Sciences (SPSS) version 24 and descriptive statistics used for analysis. Research findings will be presented in figures and tables. All ethical consideration will be observed by seeking ethical clearance from Meru University of Science and Technology (MUST) Institutional Research Ethics Review Committee MIRERC and a permit will be obtained from National Commission of Science and Technology and Innovation (NACOSTI). Informed consent will be sought from the study participants.

**Keywords**: *Brain injury, Health Care Outcomes*

# 138. Determinants of high blood pressure management among patients with a complication of stroke: a case of Meru Teaching and Referral Hospital (METRH).

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**Subtheme:** Harnessing Nursing and Health Systems to mitigate the effects of climate change.

## Abstract

Non-communicable diseases (NCDs) are the current leading cause of global morbidity and mortality contributing an estimated 71% (41 million) of the all-cause mortality in 2016 (WHO, 2018). Factors like high blood pressure, smoking, diabetes, high cholesterol, obesity and atrial fibrillation causes stroke. Stroke deaths accounted for 6% of total deaths in Kenya in 2020. The main objective of this study is to explore determinants influencing the management of high blood pressure among patients diagnosed with stroke preceding a period of treatment for hypertension visiting MeTRH. Methodology: Mixed method research approach will be used where explanatory sequential study will be carried out. Quantitative study will use simple random sampling and qualitative study purposive sampling. The study population are patients with stroke seeking care at Meru Teaching and Referral Hospital, healthcare workers in NCD clinic and medical records for stroke patients. A sample size of 72 medical records, 7 healthcare workers and data saturation for patients will be used. To collect Quantitative data, semi structured interviews and structured surveys from healthcare workers and for medical records using pre-designed semi structured questionnaire. To collect Qualitative data, individual open ended surveys questions and unstructured interviews to patients with stroke will be used. Quantitative data will be entered into Statistical Package for Social Sciences (SPSS) version 24 and descriptive statistics used for analysis then presented using frequency tables and graphs. Reading and re-reading data will be done qualitative design and presented as a report. Test and retest reliability method and cronbach's Alpha of 0.8 will be used to ascertain reliability and WHO Stroke Steps questionnaire for validity. Ethical clearance will be sought from Meru University of Science and Technology (MUST) Institutional Research Ethics Review Committee (MIRERC) and obtain permit from National Commission of Science and Technology and Innovation (NACOSTI). Informed consent will be sought from the study participants.

**Keywords**: *High Blood Pressure, Patient Management, Stroke*

CONFERENCE PAPERS

# 139. Assessment of self-care practices among hypertensive patients at Meru Teaching and Referral Hospital, Kenya.

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**Subtheme:** Harnessing Nursing and Health Systems to mitigate the effects of climate change.

## Abstract

Globally hypertension has been on the rise among the adult population with countries in sub-Saharan Africa (SSA) carrying the highest burden. Self-care practices have been proven to improve the risk factors and reduce severity of hypertension. The aim of this study was to investigate the adherence of self-care practices among hypertensive patients at the Meru Teaching and Referral Hospital. A cross-sectional survey was conducted among 75 hypertensive patients attending the Medical Outpatient Clinic at the Meru Teaching and Referral Hospital. Data was analyzed using descriptive statistics and inferential statistics. The average mean age of the participants was 58.53 years and the majority were females (n=39, 52%). Of the participants who had consumed alcohol before hypertension diagnosis (26.7%, n=20), a quarter of them (25%, n= 5) had used alcohol in the last one month prior to the study. A small percentage (9.33%, n=7) of the participants reported to be currently smoking. Majority of the participants, 93.3% (n= 70) used liquid vegetable oil for cooking. More than half of the participants (64%, n= 48) reported that they added raw salt to their food. Only 40% (n=30) of the participants consumed fruits daily. This varied with vegetable intake where majority of the participants (69.3%, n=52) reported daily intake. Almost all of the participants 98.7% (74) consumed less than 5 servings of fruits and vegetables in a day, with a mean serving of 1.41(±0.90). Majority of the participants (85.4%, n=64) performed moderate to vigorous activity. Of the six self-practices that were assessed among hypertensive patients, two were not well adhered to by the majority of the participants. Health care workers to continuously educate the patients on self-care strategies that will help improve adherence of all the recommended self-care practices

***Keywords:*** *Self-care practices, Hypertensive patients, Meru, Blood Pressure Control*

# 140. Characteristics and experiences of nurse mentors towards nursing clinical mentorship: a case of Meru county

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**Subtheme:** Harnessing Nursing and Health Systems to mitigate the effects of climate change.

## Abstract

Clinical mentorship education enhances learning, retention, acquisition of skills and clinical competencies of nursing students. Clinical mentorship programs play a critical role for clinical education of nursing students. Shortage of nurses in Kenya hinders optimal healthcare services and student mentorship. The nurse-patient ratio is 8.3: 10,000 population compared to 25: 10,000 WHO recommendations. The Nursing Council of Kenya (NCK) requires that one instructor mentors ten students. Kenya has committed to increasing the healthcare workforce leading to growth of nursing schools and student enrolment yet, formalised nursing mentorship is lacking. Qualified nurses in hospitals are expected to play a dual role of serving their employer and mentorship/preceptorship of students yet the university does not compensate them sufficiently. Most universities utilise government and faith-based hospitals for training meaning that they do not own the hospitals. The nursing school has no control on what and how clinical mentorship is done. Currently, there are no national or NCK guidelines and standards on mentor qualifications though they play a major role in nursing education. It is also unclear how qualified nurses who act as mentors experience the clinical mentoring of student nurses in resource-limited settings. This study evaluated characteristics and experiences of nurse mentors in selected health facilities in Meru County. Baseline data was collected using a structured questionnaire. Qualitative content analysis was utilized to develop themes and categories emerging from the data. Baseline survey results indicate that 53.5% (n=38) of the nurse mentors had a diploma in nursing qualification with 28.2% (n=20) having worked as nurses for 11-15 years. Majority [78.9% (n=56)] of the nurses had mentored students for 1-5 years in the current unit/ward. However, 59.2% (n=42) of the nurse rated their experience mentoring students as neutral. Most [69.0% (n=49)] of the nurse mentors indicated that there no guidelines/policies in the hospitals to guide the mentorship process with 95.8% (n=68) stating that there is need for clinical mentorship training. Majority of the nurse mentors [32.4% (n=23)] stated that their motivation to mentor is a result of moral duty, job responsibility and competency improvement. The study concluded that nurses are generally motivated to mentor student nurses and there is an urgent need for formal training of clinical nurse mentors in order to improve clinical teaching and learning.

**Keywords:** *clinical mentorship, mentors, student nurses, mentorship program*

# 141. Knowledge and practice of breast self-examination among women of reproductive age at Meru Teaching and Referral Hospital- Meru County, Kenya.

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**Subtheme:** Harnessing Nursing and Health Systems to mitigate the effects of climate change.

## Abstract

Breast cancer is a progressive illness with a bad prognosis when discovered late. Globally, during the year 2020, more than 2.3 million women of reproductive age were diagnosed with breast cancer and over 685 000 deaths occurred due to the disease making it the world's most prevalent cancer. To control breast cancer incidence and reduce deaths, there is need for an early detection strategy such as breast self- examination (BSE). World Health Organization (WHO) recommends that women should start practicing breast self-examination from the age of 20 years for early detection of breast cancer. In Kenya, breast cancer screening rate is under 5% and 86 percent of women have never had a breast cancer screening making early diagnosis difficult for most of Kenyan women.Breast cancer screening is crucial because the disease has a preclinical stage during which the disease is localized and asymptomatic, where there are greater chances of cure and survival. The aim of this study was to assess the knowledge and practice of BSE among women of reproductive age at Meru teaching and referral hospital (MeTRH).This study used a descriptive cross-sectional study design to assess BSE knowledge and practice among 423 women of reproductive age who attended the Meru Teaching and Referral Hospital. Data was analyzed using descriptive statistics and regression analysis.Majority of the respondents 58.9% (n=249) were aged between 18-28 years. Majority of the respondents (57%, n=241) had poor knowledge of BSE while 43% (n=182) had moderate knowledge of BSE. The mean score for correct breast self-examination practice was 44.4% and the standard deviation was 30. Thirty percent of the respondents (n=127) had good BSE practice, while the majority 70% (n=296) had poor BSE practice. The main determinants of BSE practice were use of teaching aids in BSE education sessions ($t=9.012$, $p<0.001$), followed by level of education ($t=6.833$, $p<0.001$), then guidance in BSE performance ($t=4.87$, $p<0.001$) and lastly the religions where the participants belonged ($t=2.583$, $p=0.01$). Both the level of knowledge and practice of breast self-examination was poor. Both social cultural factors and institutional factors influenced BSE practice. Health care providers to provide regular health education and demonstrations on BSE using appropriate teaching aids. The hospital management to regularly organize outreach programs on breast cancer screening.

**Keywords:** *Breast cancer, breast self-examination, early detection, knowledge, practice, women of reproductive age,*

# 142. Assessment of knowledge and attitudes of diabetes mellitus amongst patients attending the Non-communicable Diseases Clinic at Meru Teaching and Refferal Hospital

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**Subtheme:** Harnessing Nursing and Health Systems to mitigate the effects of climate change.

## Abstract

Background: Diabetes mellitus is a global health problem that affects individuals of all age groups. The disease is associated with complications that cause morbidity, mortality and huge economic burdens on the health care system. The main problem in the management of diabetes mellitus is non-compliance of patients to the management plan. Although cure is not expected with follow up, complications can be alleviated by achieving glycemic controls. The aim of the study was to assess the knowledge that diabetic patient attending the outpatient clinic have on DM and its complications, benefits of compliance to scheduled clinic visits and impacts of missed appointments at MeTRH. Methods: A cross-sectional survey was conducted among 100 diabetic patients attending the diabetic Outpatient Clinic at the Meru Teaching and Referral Hospital. Data was analyzed using percentages, frequencies and standard deviation for descriptive statistics Results: The mean age of the participants was 39.83 years and the majority, (n=44, 59.5%) were females. The mean knowledge score was 46% with a standard deviation of ±29.3. Majority (49, 66.2%) of the respondents had poor general knowledge of diabetes, while (25, 33.8%) mentioned at least one correct aspect about diabetes mellitus. As for knowledge of diabetic complications, majority (45, 60.8%) knew at least one complication of diabetes mellitus, while (29, 39.2%) did not know of any complication. As for benefits of scheduled visits of care, (46, 62.2%) mentioned relevant benefits while (28, 37.8%) mentioned irrelevant benefits. Conclusions: Of the three areas assessed on knowledge diabetic patients had, there was generally poor knowledge by the participants. Recommendations: There is need to hold more sessions of routine health education to patients probably in the morning before normal clinic operations begin about diabetes, the importance of scheduled visits and the risks involved when one fails to comply.

Key words: knowledge on diabetes mellitus and complications, missed visit impacts, compliance to scheduled visits

***Keywords:*** *Diabetes mellitus, Clinic visit Compliance, non-communicable diseases*

# 143. Social-cultural factors that influence utilization of Antenatal care at Saku sub-county, Kenya.

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**Subtheme:** Harnessing Nursing and Health Systems to mitigate the effects of climate change.

## Abstract

Antenatal care (ANC) is the continuous care that is accorded to women in the course of pregnancy. Notably, antenatal care is an efficient health intervention aimed at inhibiting maternal mortality and morbidity majorly in areas where women have poor health. This study therefore assessed the Social-cultural factors that influence utilization of ANC at Saku sub-county, Kenya.This research applied descriptive cross sectional study design. The study was carried out in Saku Sub County in the following randomly selected health facilities: Marsabit County Referral Hospital, Dakabaricha Dispensary and Jirime Dispensary. The study population comprised of post-natal mothers aged between 15-49 years seeking services at maternal and child health clinic (MCH) in Saku Sub County. The Cochran's Sample Size Formula was used to calculate a sample size of 154 respondents. The study employed a researcher- administered semi-structured questionnaire and use of focused group discusions. Descriptive statistics, chi-square tests and logistic regression were used in the analysis. Tertially/University education was significantly associated with utilization of ANC Services (OR=0.377, P value =0.012, 0.177-0.806). There was a significant association between. The age between 15-19 years with the utilization of ANC services (O.R =2.470, P value =0.044, 1.024-5.955).There was a significant association between utilization of Antenatal careFNYA and receiving support from family members (P value= 0.035). Mothers are likely to utilize ANC services more often if they receive family support. Therefore, family support exerts a positive impact on a pregnant woman's psychological well-being, as well as on the health of her newborn. Sensitizing men about antenatal services and their benefits health-care providers is important.

**Keywords:** *Antenatal care, utilization of Antenatal care, Social-cultural factors influencing utilization of Antenatal care.*

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**SUBTHEME 8: Pure and Applied Sciences for Climate Action**

PRE-CONFERENCE PAPERS

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## 145. Light-dependent chloroplast relocation in wild strawberry (*Fragaria vesca*)

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**Subtheme:** Pure and Applied Sciences for Climate Action

### Abstract

Chloroplast photorelocation is a vital organellar response that optimizes photosynthesis in plants amid fluctuating environmental conditions. Chloroplasts exhibit an accumulation response, moving toward weak light to enhance photoreception, and an avoidance response, moving away from strong light to avoid photodamage. Although chloroplast photorelocation has been extensively studied in model plants such as *Arabidopsis thaliana*, little is known about this process in the economically important crop strawberry. Here, we investigated chloroplast photorelocation in leaf mesophyll cells of wild strawberry (*Fragaria vesca*), a diploid relative of commercially cultivated octoploid strawberry (*F. xananassa*). Microscopy observation revealed that the periclinal area of leaf mesophyll cells in *F. vesca* is considerably smaller than that of *A. thaliana*. Given this small cell size, we investigated chloroplast photorelocation in *F. vesca* by measuring light transmittance in leaves. Weak blue light induced the accumulation response, whereas strong blue light-induced the avoidance response. Unexpectedly, strong red light also induced the accumulation response in *F. vesca*. These findings shed light on chloroplast photorelocation as an intracellular response, laying the foundation for enhancing photosynthesis and productivity in *Fragaria.*

**Keywords:** *Chloroplast photorelocation, Wild Strawberry, Fragaria vesca*

# 146. Development of a viable laboratory colony rearing procedure for *Anopheles arabiensis* infected with *Microsporidia mb*

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Malaria continues to be a significant global health challenge causing millions of infections and deaths each year. The human population in Africa bears the highest malaria disease burden which is approximately 95% of the total number of cases and deaths. Various vector control strategies have been implemented to control transmission which includes; use of Insecticide-Treated bed Nets (ITNs), Indoor Residual Spraying (IRS) and Larval Source Management but resistance to insecticides still poses challenges. There is need to explore alternative methods to overcome the limitations posed by insecticide resistance. Recent studies indicates that a symbiont of Anopheles mosquitoes, Microsporidia MB exhibits a significant ability to block malaria transmission particularly in Anopheles arabiensis, which is the predominant member of the Anopheles gambiae species complex in many active transmission areas of Eastern Africa. Microsporidia MB is transmitted horizontally through mating and vertically from mother to the offspring. Microsporidia MB infection has been shown to improve Anopheles fitness. These characteristics make Microsporidia MB a promising candidate for developing a symbiont-based strategy to block malaria transmission. Currently, research relies on field collected mosquitoes. The study aim is to develop a viable laboratory colony- rearing procedure for Anopheles arabiensis infected with Microsporidia MB. The specific objectives are (i) to determine the prevalence and density of Microsporidia MB in successive generations of mosquitoes collected in the field and reared in laboratory (ii) to determine the fitness trends of Microsporidia MB infected mosquitoes in successive generations reared in laboratory and (iii) to evaluate the effects of different adult/sugar diets on the fitness of Microsporidia MB positive mosquitoes reared in laboratory. The experiment is being ICIPE iTOC-Mbita. By integrating Microsporidia MB infected mosquitoes with other strategies such as bed nets, insecticide residual spraying and larval source management, we can maximize the impact of vector control on malaria transmission thus leading to a malaria free nation.

**Keywords:** *Microsporidia MB, Malaria, successive generations, Vector control measures, Transmission*

# 147. Drivers of water pollution in Kuuru River a tributary of Tana River, Meru County

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**Subtheme:** Pure and Applied Sciences for Climate Action



## Abstract

Water pollution is a significant concern because it affects the quality and availability of water resources essential for various purposes. Kuuru River is a tributary of the Tana River that serves as a source of drinking water, irrigation, and other domestic uses in Meru County. This study aimed to assess the drivers of water pollution in tributaries of the upper Tana River catchment within the Kuuru River. The study determined the water quality, land use, and environmental conservation activities in the riparian zone of the Kuuru River from the source to the Kathita River, a tributary of the Tana River, and evaluated the contribution of institutions provided by the legislative framework to the conservation of the Kuuru River. Standard methods were used to analyze turbidity, total dissolved solids (TDS), pH, temperature, electrical conductivity (EC), nitrates, and nitrites from 18 water samples collected along the Kuuru River. A descriptive survey using semi-structured questionnaires was administered to 384 household heads to obtain data on land use and environmental conservation practices. Key informants from relevant institutions were also interviewed using semi-structured questionnaires to gather insights into their interventions and oversight of river protection activities. The water quality of the Kuuru River met the standards set by the World Health Organization (WHO), the National Environmental Management Authority (NEMA), and the Kenya Bureau of Standards (KEBS) for drinking water. However, levels of EC and turbidity were elevated, indicating the presence of pollutants. Anthropogenic activities in Maskani, Kanthiari, and Kimachia markets were identified as the main drivers of pollution. A lack of awareness regarding riparian conservation was noted and was attributed to insufficient stakeholder involvement and inadequate technical and financial support for conservation efforts. A periodic assessment of the water quality in the Kuuru River is recommended to determine the overall impact of the anthropogenic activities in the study area. Effective stakeholder involvement to raise awareness of riparian conservation is essential.

**Keywords:** *Water Pollution, anthropogenic activities, pollutants*

# 148. Modelling the trends and forecast of prostate cancer incidences using ARIMAX models (a case of Meru County).

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Globally, the prevalence of cancer is increasing, placing a heavy burden on communities and health systems at all income levels. The objective was to model the trends and forecast the prostate cancer incidences using ARIMA and ARIMAX Models (Case of Meru County) compare model accuracy between ARIMA and ARIMAX using AIC (Akaike Information Criterion), and draw conclusions. There is limited information in literature on how prostate cancer time trends could change according to specific demographic subgroups. Prostate cancer incidences were predicted using the ARIMA and ARIMAX models, and the relative forecast accuracy was be assessed using the AIC and MAPE. The ARIMAX model was fitted using the Box-Jenkins methodology. Data on the prevalence of prostate cancer was obtained from Meru Cancer Registry. R programming (Version 4.3.3) software was used in the analysis. The best models for the Prostate cancer incidences is ARIMA(0,0,1) and ARIMAX (0,0,1). The study shows that there is correlation between age and prostate cancer incidences in Meru County. Nevertheless when viewed from ARIMAX and ARIMA models based on the AIC value, ARIMAX value was lower than the ARIMA value. Inclusion of other external variables besides age can further improve the model. Health care institutions and practitioners are able to make more informed judgments with the help of the forecasted results and their corresponding forecast intervals and make informed decisions on whether the number of observed prostate cancer cases in a given time-frame represents a potential incidence or is a function of random variation.

**Keywords:** ARIMA, ARIMAX, MAPE and AIC

# 149. A mathematical model of Typhoid Fever disease dynamics with drug resistant aspect

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Typhoid fever continues to be a major global health challenge in the developing countries. The emergence of drug-resistant Typhoid strain currently is major problem in tackling this scourge. A dynamical transmission of Typhoid fever in human populations with antibiotic-resistant was proposed and used to analyze the treatment using antibiotics. The model consists of human population and pathogen population. The human population is grouped into six compartments namely; susceptible, exposed, infected with drug sensitive strain, infected with drug resistant strain, recovered and bacterial population. We formulated a non-linear ODEs and modelled interactions among these populations. The control reproduction number $R_c$, was derived using next-generation matrix approach and was used to analyze dynamical behavour of the disease. If $R_c < 1$ the disease is contained and if $R_c > 1$, it persists leading to endemic state. The local and global stability analysis at DFE points were determined using Routh-Hurwitz conditions and Lyapunov functions respectively. The DFE and endemic equilibrium were determined using theories of ODEs. Sensitivity analysis was done using normalized forward sensitivity index in order identify the most important model parameters. Using MATLAB, numerical simulation was done and graphs plotted. The findings indicated that effective treatment and strict hygiene practices especially when one is handling food, drinking water and beverages, is adequate to eradicate the disease in the community.

**Keywords**: *Typhoid Fever, Drug resistant strain, Stability analysis, Endemic*

# 150. Extension of the Pythagorean theorem from R^2 to R^3 and R^1

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Pythagorean theorem has been and remains a fundamental pillar in many spheres of mathematics, physics and engineering and many other fields such as carbon dating and oceanography. The present study will theoretically study the transition of the Pythagorean theorem from $\mathbb{R}^2$ to $\mathbb{R}^3$(three dimensional space) and thereafter from $\mathbb{R}^3$ to $\mathbb{R}^1$(one dimensional space). Initially We shall then expand from $\mathbb{R}^2$ to $\mathbb{R}^3$ where we shall show that for any Pythagorean triples a, b and c then $a^3 + b^3 + c^3 = d^3$. We shall then highlight the interplay between volumes of three geometrical constructs. In other words volume $a^3$ plus volume $b^3$ plus volume $c^3$equals volume$d^3$. Finally, we shall transition from $\mathbb{R}^3$ to $\mathbb{R}^1$ where we shall show that $\frac{a^2}{d} + \frac{b^2}{d} = \frac{c^2}{d}$. Both of the above transitions are not taken care of by the classical Pythagorean theorem in $\mathbb{R}^2$. in so doing we will investigate valuable insights into the challenges and considerations posed by the 3 dimensional scope. Additionally, we shall engage the Pythagorean Theorem to a rigorous test involving integers and decimals. We shall then cast our eyes onto the various practical applications in the realm of mathematics, Physics, engineering and architecture unveiling the theorems potential to optimize design and construction processes. Finally, the study will make recommendation and prospects for further generalizations to higher dimensions and the various generalizations to higher dimensions. This investigation will contribute to the enrichment of spatial mathematics and the broad spectrum of practical implications in diverse disciplines.

**Keywords:** *Pythagorean theorem, Three dimensional space, One dimensional space*

# 151. The disturbed outer Milky Way disc for stars with measured line-of-sight velocity.

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

The Milky Way's disc has been disturbed in the outer parts affecting the movements of stars. Using the position and proper motion measurements for 33 million stars in line-of-sight from Gaia DR3 we estimated a relationship between their vertical velocity and angular momentum around the galactic center. From the density distribution, the vertical velocity for stars in the disc at a galactic radius between ~10 to 14 kpc is strongly dependent on the angular momentum. However, a break or bimodality is visible in the vertical velocity distribution, particularly around ~ 11.5 kpc (~ 2700 kpc km/s). This bimodality has a downturn in vertical velocity at ~ 10 kpc (~ 2400 kpc km/s) to a minima at ~ 11.5 kpc (~ 2700 kpc km/s) followed by an abrupt break rising to a positive value. Main sequence stars are strongly affected by the disturbances in their vertical velocities. N-body simulations simulated that the passage of a Sagittarius-like dwarf galaxy can generate similar disturbances in the Galactic disc.

**Keywords:** *Numerical – Galaxy, Evolution – Galaxy, Kinematics and dynamics – Galaxy, structure.*

# 152. Relativistic dynamics in a Friedmann Universe

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

The Friedmann-Lemaître-Robertson-Walker (FLRW) model stands as a cornerstone among cosmological frameworks, effectively describing the formation and evolution of cosmic structures consistent with most empirical observations. The backbone of the FLRW is the cosmological principle according to which the universe is homogeneous and isotropic on large scales. However, current three-dimensional catalogues reveal a contrasting view of the universe as non-homogeneous and non-isotropic up to the furthest observational limits, challenging the accuracy of the FLRW model.

In this paper, we derive new redshift-light intensity and redshift-number density relations using Einstein Field Equations (EFE) based on the number count of galaxies method, detailing the dynamics and evolution of the universe within the FLRW paradigm. Our findings show that these novel relations can precisely characterize galaxy formation and evolution, enhancing our understanding of the cosmos. Specifically, the relations replicate the initial burst of galaxies at the beginning of the universe, consistent with other models, and provide more general and accurate results for structure formation and evolution, aligning with observational data. This makes them a promising tool for future cosmological studies.

**Keywords:** *Structure formation- evolution – redshift - number density - light intensity – Einstein field equations*

# 153. A logical proof of the Polignac's conjecture based on partitions of an even number of a new formulation

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**Subtheme:** Pure and Applied Sciences for Climate Action



## Abstract

Polignac's Conjecture, proposed by Alphonse de Polignac in the 19th century, is a captivating hypothesis that extends the notion of twin primes to a broader context. It posits that for any even positive integer 2k, there exist infinitely many pairs of consecutive prime numbers whose difference is 2k. This conjecture is a natural generalization of the Twin Prime Conjecture, which focuses solely on pairs of primes differing by two. The conjecture has significant implications for our understanding of the distribution of prime numbers and the nature of their gaps and its exploration serves as a testament to the enduring fascination and mystery surrounding prime numbers and their properties. However, despite extensive efforts by mathematicians over the years, Polignac's Conjecture remains unproven, standing as one of the many unsolved problems in number theory. This study utilizes a set of all odd partitions generated from an even number of a new formulation and we show that, from this set of all pairs of odd numbers there exist proper subsets containing infinitely many pairs of prime numbers whose differences is a fixed even gap. Finally, using these results and the facts that the difference of any two prime numbers is even and there exist infinitely many prime numbers, a logical proof of the Polignac's Conjecture is provided.

**Key words:** *Polignac's Conjecture, Twin Prime Conjecture, Even numbers, Odd numbers, Prime numbers,*

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# 154. Development of Machine Learning model for estimation of spatial distribution of particulate matter pollutant in air

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**Subtheme:** Pure and Applied Sciences for Climate Action



## Abstract

Creating accurate air pollution maps is crucial for environmental health monitoring. However, traditional sensor systems provide limited information, offering only single-point, instantaneous readings. This research investigates a novel approach to address this limitation. We propose a machine learning-based system to predict the spatial distribution of particulate matter (PM) across a region using data from a sparse network of sensors. The system collects data on various factors, including PM concentrations (PM1.0, PM2.5, PM10), weather parameters (wind speed, temperature, humidity), and spatial information (longitude, latitude). We explore the effectiveness of Long Short-Term Memory, Artificial Neural Networks (ANNs), Support Vector Regression, and Random Forest models. Our findings reveal that ANNs outperform other models in terms of accuracy and consistency across all feature combinations surpassing 75% threshold, particularly within a 160-meter radius of a central sensor. Furthermore, the inclusion of weather parameters and feature engineering significantly improve model performance, leading to enhanced generalization and lower error rates for all PM types. This study paves the way for a new paradigm in particulate matter sensor design, one that overcomes the limitations of single-point measurements. Additionally, it underscores the importance of incorporating weather data into machine learning models for accurate spatial distribution prediction of air pollutants.

**Keywords**: *Air pollution, Particulate matter (PM), Air quality sensors, Environmental parameters, Spatial distribution*

# 155. A study on physico-mechanical properties of blended cement with laterite soil

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**Subtheme:** Pure and Applied Sciences for Climate Action



## Abstract

The adoption of Supplementary Cementitious Materials (SCMs) has gained traction globally as a solution for reducing the anthropogenic Carbon dioxide (CO2) emissions associated with cement production. Previous studies have extensively tested the mechanical and durability properties of cement blends containing various SCMs. However, there is a notable gap in the literature regarding the use of laterite soil as an SCM, particularly in cement blends. Existing research primarily focuses on laterite as an aggregate rather than a binder component. This study aimed to investigate the potential of laterite soil as supplementary material in blended cement, especially in regions where kaolinite clay soil is scarce but laterite is abundant. The research specifically explores the physicomechanical properties of a ternary blended cement comprising 50% clinker, 15% limestone, 30% laterite soil, and 5% gypsum. The blend was formulated by partially replacing the Ordinary Portland Cement (OPC) with limestone and laterite in a 1:2 ratio, maintaining a 45% replacement level. The experimental investigation involved evaluating the influence of laterite soil on the physical and mechanical properties of the blended cement using the Vicat apparatus and compressive strength tests. The results demonstrate a synergistic effect between laterite and limestone, achieving a compressive strength of 38 MPa after 28 days. The physical properties of the blended cement were comparable to those of limestone and calcined clay blends, indicating that laterite soil can effectively substitute clay as an SCM. This study contributes to the limited body of knowledge on laterite soil as a component in cement blends and suggests avenues for further research. Future studies could explore the compatibility of the laterite-limestone blend with chemical admixtures such as set retarders and investigate the long-term durability of the blend under various environmental conditions.

**Keywords**: *Laterite soil, Supplementary Cementitious Materials (SCMs), Compressive strength, Physical Properties, Limestone Calcined Clay Cement (LC3)*

# 156. Assessment of fecal coliforms in *catha edulis* (khat) leaves along the value chain in Igembe Ssouth sub-county, Meru, Kenya.

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Background: Catha edulis leaves have been found to contain high levels of fecal coliforms, exceeding recommended limits for safe consumption, therefore posing a high risk of spreading bacterial diseases. The presence of fecal coliforms in these leaves is a concern for consumers and those involved in their production and transportation. Therefore, this study assessed the fecal coliform contamination rate of Catha edulis (Khat) leaves at different stages of the value chain in Igembe South Sub-County, Meru, Kenya. Materials and Methods: This study was conducted and it involved 328 respondents from 25 locations within the Sub-County, and it adopted a cross-sectional descriptive study design involving one-time sampling of Khat leaves during farming, handling, vending, and consumption. Khat leaves were collected in aerated bags, processed, and evaluated for the presence of fecal coliforms at the Meru University of Science and Technology Laboratory. Data collected were analyzed using descriptive statistics such as mean, standard deviation, minimum, and maximum and inferential statistics such as Tukey HSD with the aid of Statistical Package of Social Sciences (SPSS) version 23.0. Results: Study findings from Tukey HSD revealed that handlers had significantly higher fecal coliform contamination with mean difference=0.1162; p=.000 than vendors (mean difference=0.0994; p=.002), customers (mean difference=0.1096; p=.001) and farmers having the lowest with mean difference=0.0169; p=.000. Conclusion: The study concluded that handling was the most contributing factor to fecal coliform contamination. The study recommends the need for reduce fecal coliform contamination among handlers as well as vendors, customers and farmers by improving sanitation hygiene practices such as handwashing, proper use of sanitation facilities, sanitation of surfaces and equipment and proper storage of khat leaves.

**Keywords:** *Fecal coliforms contamination, assessment, sanitation practices and value chain.*

CONFERENCE PAPERS

# 157. Stochastic Modelling, Analysis and Simulation of HIV-HBV Co-infection Using SDEs and Euler-Maruyama numerical Scheme

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Human Immunodeficiency Virus and Hepatitis B co-infections complicates population dynamics and brings forth a wide range of clinical outcomes which makes it a difficult situation for public health. In particular designing treatment plans for the co-infection. In this study, we develop a stochastic mathematical model derived from deterministic model to examine the dynamic behavior of co-infection between HIV and hepatitis B virus. SDEs are deduced from the stochastic flowchart incorporating random white noise transmission. The Euler-Maruyama numerical scheme is used to obtain the numerical results of the stochastic model. To represent the interaction between these two viruses, the model combines epidemiological insights with current developments in mathematical modelling approaches. Basic statistics of the sample paths showed that the variability of infection outcomes oscillates around the deterministic trajectory. These results provide new insights into the dynamics of co-infection through in-depth research and simulation, which helps to understand the inherent nature of deterministic model by incorporating the stochastic effects. These understanding will further help the policer makers in health sector to take care of the variability and uncertainty in designing treatment and management strategies.

**Keywords**: *Stochastic Differential Equations (SDEs), HIV-HBV co-infection, Euler-Maruyama numerical scheme, Ito formula, Weiner process*

# 158. A model for the propagation and control of pulmonary tuberculosis disease in Kenya

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Pulmonary tuberculosis is among the leading infectious diseases causing mortality worldwide. Therefore, scaling up intervention strategies to reduce the spread of infections in the population is imperative. In this paper, a population-based compartmental approach has been employed to formulate a mathematical model of pulmonary tuberculosis that incorporates an asymptomatic infectious population. The model includes asymptomatic infectious individuals since they spread infections incessantly to susceptible populations without being noticed, thus contributing to the high rate of infection transmission. Qualitative and numerical analysis were performed to determine the impact of various intervention strategies on controlling infection transmission in the population. Sensitivity and numerical results indicate that increasing screening of latently infected and asymptomatic infectious individuals reduces infection transmission to the susceptible population. Numerical results demonstrate that the combination of vaccination, screening, and treatment of all forms of pulmonary tuberculosis is the most effective intervention in decreasing infection transmission. Furthermore, a combination of screening and treatment of all forms of pulmonary tuberculosis proves more effective than a combination of vaccination and treatment of symptomatic infectious individuals alone. Treating the symptomatic infectious population alone is identified as the least effective intervention for curtailing infection transmission in the susceptible population. These study findings will guide healthcare officials in making decisions regarding the screening of latently infected and asymptomatic infectious pulmonary tuberculosis patients, thereby aiding in the fight against epidemics of this disease.

**Keywords**: *Pulmonary tuberculosis, Latent infected, Asymptomatic infectious, Symptomatic infectious, Control reproduction number, Numerical Simulation*

# 159. Modelling approaches to support Kenya's sustainable development

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Neither the first round of Nationally Determined Contributions (NDCs) nor currently implemented climate policies are on track to meeting the Paris Agreement's objectives. Net-zero targets embedded within aggregated long-term intended strategies can arguably deliver on the temperature goal of 1.5°C, but they still feature considerable feasibility concerns, regarding their implementation. Countries are urged by UNFCC to increase their ambition and produce new NDCs covering the post-2030 period, aiming to bridge the triple gap of climate action (implementation, ratcheting, ambition). The design of a multi-dimensional set of policy measures that comprise countries' climate policy agendas is supported by equally diverse integrated assessment modelling (IAM) activities. Notwithstanding the recent progress in the IAM literature and scenario space, the modelling world has fallen short of its promise to include non-scientists in its process, to account for individual choices and lifestyle changes that are indirectly narrated as assumptions not interacting with the vividly modelled technology-economy-environment-policy flows, and to place climate action as a cross-cutting theme in the sustainability spectrum. In the light of these requirements, IAM COMPACT, an EU-funded research project under the Horizon Europe framework programme, aimed at effectively supporting the assessment of global climate goals, progress, and feasibility space, as well as the design of the next round of NDCs and policy planning beyond 2030 for major emitters and non-high-income countries. As part of the support provided for NDC and policy planning beyond 2030, IAM COMPACT also offered capacity development in the use of modelling tools to aid policy in four extra-EU countries: Ukraine, Sri Lanka, Ethiopia and Kenya. The Renewable Energy & Climate Change Research Center of the Technical University of Mombasa, with the participation and contribution of trainers from Politecnico di Milano, KTH Royal Institute of Technology and the National Technical University of Athens, Strathmore University organized the Kenyan NDC support workshop.

**Keywords:** *Paris Agreement's objectives, Net-zero targets, NDCs, integrated assessment modelling*

# 160. European Union (EU) – Africa bio-energy roadmap: Kenya bio energy review

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

23 partners from the EU, Kenya and the UK have formed a consortium to launch the FUELPHORIA project, funded by the EU research and innovation programme Horizon Europe (GA 101118286), which aims to establish sustainable, competitive and secure value chains for advanced bio-fuels and renewable non-biological fuels. The project contributes to the objectives of the European Commission's 2022 Re-power EU Plan "to scale-up renewables, achieve electrification, and replace fossil-based heat and fuel in industry, buildings, and the transport sector". Project partners will demonstrate that sustainable value chains for advanced bio-fuels and non-biological renewable fuels can be established in real environment, offering an alternative to fossil fuels. A range of chemical, electrochemical, biological, thermochemical, and photobiological processes will be used to convert different feed-stocks into an array of renewable fuels. The fuels will be developed to meet quality specifications defined by end-users in the transport sector (aviation, maritime and road) and in the power production sector (gas or oil-fired thermal plants). The participation of the Renewable Energy and Climate Change Research Center of the Technical University of Mombasa (Kenya) will play an important role in exploring the possibilities of exporting renewable fuels and bio-fuels from Africa. At the end of the project, a set of policy recommendations for EU policymakers will be developed with the objective of showcasing how the results of the project can contribute to a sustainable transition of the EU energy systems. The project will run for the period of four years, from October 2023 until September 2027.

**Key words:** *FUELPHORIA, advanced bio-fuels and renewable non-biological fuels*

# 161. Assessment of Particulate Matter (PM) Levels in Urban Centers in Kenya: A Case Study of Meru Town, Kisumu, and Nairobi

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Particulate Matter (PM) is a significant contributor to air pollution, posing serious public health risks. Urban centers in Kenya, particularly Meru Town, Kisumu, and Nairobi, face heightened risks due to industrial and motor vehicle emissions, compounded by rapid urbanization and weak environmental regulations. This study aims to assess PM levels in these urban centers to evaluate their suitability for human habitation. To achieve this, Internet of Things (IoT)-enabled Optical Particle Counters (OPCs) were deployed at various strategic locations in the three towns to collect PM data. The data, spanning from 2020 to 2023, was transmitted to a central server for analysis using Python and archived on the sensors.AFRICA Sensor Africa portal. The PM levels were compared against the World Health Organization's (WHO) recommended thresholds to determine pollution severity.The study revealed elevated PM levels in all three towns, exceeding WHO's guidelines. Specifically, Nairobi recorded PM2.5 levels of 25 $\mu g/m^3$ and PM10 levels of 25 $\mu g/m^3$. Meru had PM2.5 levels of 30 $\mu g/m^3$ and PM10 levels of 22 $\mu g/m^3$, while Kisumu recorded PM1.0 levels of 25 $\mu g/m^3$ and PM2.5 levels of 25 $\mu g/m^3$. For context, WHO recommends an annual mean of 5 $\mu g/m^3$ for PM2.5 and 15 $\mu g/m^3$ for PM10, and a 24-hour mean of 15 $\mu g/m^3$ for PM2.5 and 45 $\mu g/m^3$ for PM10. The high PM levels across these urban centers can be attributed to industrial emissions, vehicular exhaust, and rapid urban growth, with each city exhibiting unique pollution sources. Nairobi's pollution is primarily driven by vehicular emissions, Meru's by a combination of industrial activities and urbanization, and Kisumu's by both industrial emissions and biomass burning.These findings underscore an urgent need for policymakers to commission comprehensive PM monitoring studies across all urban centers in Kenya. Moreover, stringent regulatory measures must be formulated and enforced to mitigate escalating PM levels, ensuring safer living conditions for urban residents.

**Keywords:** *Particulate Matter, PM 1.0, PM 2.5, PM 10, WHO, PM annual threshold, PM daily threshold, Optical Particle Counters*

# 162. Modelling the effects of drought on predator-prey population dynamics

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Drought has severe ecological effects and it's of paramount importance to broaden our knowledge on how it affects not only specific species but also multi-trophic interaction at large. In this study, a three-dimensional continuous predator-prey system that incorporates the concept of drought is proposed and analyzed. Focus have been on the impact of drought due to the challenges it presents to the predator prey populations ranging from resources variability to cascading effects in food webs. The model utilizes the logistic equation with both Holling type I and type II functional response to represent the dynamics of the system. Drought has been modelled as an exogenous driver influencing the prey's growth rate and the predators responds through changes in prey density. The existence, boundedness, and uniqueness of the model's solution are investigated. The feasibility and stability conditions of the fixed points within the system are examined by employment of linearization, eigenvalue method and Routh Hurwitz criterion. Numerical Simulation of the developed model was utilized to gain insights into the dynamics and behavior of the species population dynamics. A major observation deduced was that the healthy prey population decreased consequently increasing the predators' population. As drought intensified, the weakened prey population continuously increased accelerating the increase of the predators' species. Predator population increases since it consumes both gazelles though with different response. Due to the weak body condition of the gazelle, they become the favorite, but since predators spend most of their time in searching and handling then the weakened prey populations continues to increase rather than decrease despite being predators favorite. Prey population later declines due to intra specific competition and natural deaths. Without drought, it's seen that the prey population is regulated by the carrying capacity which in-turn takes care of the predators' population. Further research can be carried out to improve the model by incorporating factors such as migration, refuge, disease and inter- specific competition in order to depict the earth's natural phenomenon and look into working with experimental data for validation.

**Keywords:** *Drought, Routh-Hurwitz, Jacobian, Predator-Prey, Stability Analysis*

# 163. The weakly sign symmetric po-matrix completion problems for patterns of digraphs of order 5 with upton 5 Arcs: performing wss po matrix completion on partial matrices obtained from non-isomorphic digraphs of order 5 with upton 5 arcs

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Matrix completion problem involves determining whether or not a completion of a partial matrix exists for a certain class of matrices. As such a description of circumstances is sought in which choices for the unspecified entries may be made so that the resulting matrix is of the desired class. Matrix completion problems are applied in fields where some data is known and some other data entries are not known, but it is known that the full data matrix must have certain characteristics. Examples include Network analysis, System modelling by aiding in decision making processes and optimization strategies such as transportation, film industry and gaming. Graph theory has played an important role in the study of matrix completion problems. Positionally symmetric patterns have been studied by use of graphs while positionally asymmetric patterns have been studied by use of digraphs. A Wss Po-matrix is a matrix where if the off-diagonal elements have the property that if the entry in row i and column j is non-zero then the entry in row j and column i must have same sign or be zero and all its principal minors are non-negative. Our research aimed at studying the matrix completion of digraphs of order 5 with up to 5 arcs with a view of determining the digraphs whose partial matrices have zero completion into Wss Po-matrix. and those that do not have. Digraphs were utilized to create partial Wss Po- matrices, from which all principal minors were obtained. All principal minors obtained from the partial matrices were found to be non-negative indicating that all the partial matrices had zero completion into Wss Po-matrix. and therefore, none of the digraphs was found to have non-completion. Digraphs of order 5 with up to 5 arcs that could be completed and those that could not were analyzed.

**Keywords:** *Symmetric Po-Matrix, Non-Isomorphic Digraphs, Graph theory*

# 164. Analytic investigation of the imprints of charge on Reissner Nordström black hole photon ring

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**Subtheme:** Pure and Applied Sciences for Climate Action

## Abstract

Exquisite precision has been demonstrated in testing General Relativity (GR) in weak-field regimes; however, substantial absence of precise tests persists in strong-field regimes. Black holes serve as laboratories to scrutinize GR in strong-gravity regimes. Observations from a variety of cosmological probes consistently point to the existence of dark energy which is responsible for the universe's accelerating expansion. The cosmological constant provides an elegant explanation for this observed acceleration. Furthermore, it is possible to assume that black holes have charge making it vital to investigate how this affects their observational properties. The Reissner–Nordström black holes solution is the black hole metric that incorporates both charge and the cosmological constant. This research is dedicated to probing the nature of strong gravity for black holes in Reissner–Nordström space time through the photon ring and other observables. The foundational part of our study begins with an exploration of the fundamental concept of photon orbits, serving as the basis for constructing the photon ring. Precise computations of time delays, Lyapunov exponents, and changes in azimuthal angle parameters will follow, providing insight into how they shape the structure of the photon ring. The expected outcomes point out that an increase in charge will have influence on the photon ring structure and the critical parameters. Astrophysically relevant values of the cosmological constant will have no noticeable effect as compared to the Schwarzschild black hole. The findings of this work will aid in imposing constraints on the amount of charge that can exist in Reissner–Nordström spacetime. Additionally, they will contribute significantly to the validation or exclusion of this solution, particularly in the context of future Event Horizon Telescope observations.

**Keywords:** *general relativity, charge, black holes, time delays, Lyapunov exponents,changes in azimuthal angle*

# 165. On Class (BD) Operators of order (n+k+m)

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**Subtheme:** Pure and Applied Sciences for Climate Action



## Abstract

In this paper, we introduce the class of (BD) of order (n+k+m) operators acting on the classical Hilbert space H. This new class of operators contribute to solving solving differential equations ,studying spectral properties and analyzing linear transformations in function spaces .An operator if T ∈ B(H) is said to belong to class (BD) of order (n+k+ m) if T *2(n+k+m) (TD)2 commutes with (T *(n+k+m)TD)2 equivalently [T *2(n+k+m) (TD)2, (T *(n+k+m)TD)2] = 0. We investigate the properties of this class and we also analyze the relation of this class to (n+k+m)-power D-operator. The methodology involved the use of adjoint properties of these operators which majorly relies on the commutation relation. Results show that the product of two doubly commuting operators is in the class of (BD) order (n+k+m) operators. This study is limited in the classical Hilbert space and we therefore encourage exploration in the semi-Hilbertian space .

**Keywords:** *D-operator, Normal, N Quasi D-operator, complex symmetric operators, n-power D-operator, (BD) operators*

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