KABARAK UNIVERSITY

Education in Biblical Perspective

SCHOOL OF SCIENCE, ENGINEERING AND TECHNOLOGY

THE 15TH INTERNATIONAL RESEARCH CONFERENCE FOR SCHOOL OF SCIENCE, ENGINEERING & TECHNOLOGY

PROGRAM AND BOOK OF ABSTRACTS

CONFERENCE DATES:

10TH - 11TH JULY 2025

Kabarak University is ISO 9001:2015 certified.

KABARAK UNIVERSITY | Education in Biblical Perspective

About Us

Kabarak University is a Chartered institution of higher learning that provides holistic Christian-based quality education, training, research and outreach activities for the service of God and humanity. The University was established in the year 2000 by the 2nd President of Kenya, H.E. the Late Hon. Daniel T. Arap Moi, who was also the founding Chancellor. This was as a result of his visionary idea of setting up a Christian University that would meet the demand for higher education in Kenya and offer quality education based on strong moral principles.

Location

Kabarak University Main Campus is located 20 kilometers north of Nakuru City, along the Nakuru-Eldama Ravine highway in a serene, spacious and beautiful environment that makes it ideal for learning. The University has state-of-the art facilities for teaching, learning, research, accommodation, catering, and sports. The facilities are purpose-built to enhance intellectual, physical, and spiritual growth. Nakuru City Campus is located one kilometer from Nakuru CBD, along Prison Road, off Nakuru-Kabarnet Road.

Vision

To become a centre of Academic Excellence founded on Biblical Christian values.

Mission

To provide holistic quality education, research and community outreach based on Biblical Christian values.

Philosophy

To provide quality education in Biblical perspective that transforms lives.

Core Values

- Integrity
- Professionalism
- Patriotism
- Innovativeness
- Being Mindful of Others

KABARAK UNIVERSITY

SCHOOL OF SCIENCE, ENGINEERING AND TECHNOLOGY

THE 15TH INTERNATIONAL RESEARCH CONFERENCE FOR SCHOOL OF SCIENCE, ENGINEERING & TECHNOLOGY

ON:

- *Data Science and Artificial Intelligence*
- *Pure and Applied Sciences*
- *Environment and Energy*

PROGRAM
AND
BOOK OF ABSTRACTS

JULY 2025

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Prof. Henry Kiplangat, PhD, MBS, OGW

VICE CHANCELLOR, KABARAK UNIVERSITY

Good morning

I am greatly honored to welcome you to Kabarak University and to our **15th International Research Conference**. It is the turn of the School of Science, Engineering and Technology to host the two-day conference starting today and ending tomorrow. I note with great satisfaction the three areas of focus for this Conference, namely:

1. Data Science and Artificial Intelligence;
2. Pure and Applied Sciences; and
3. Environment and Energy.

The focus on **Data Science and Artificial Intellignece**, under the theme *Development, Deployment and Adoption of Data Science and Artificial Intelligence Solutions,* will certainly inspire passionate engagements and explorations on how deeply data and AI are reshaping the world we live in, especially in the following four (4) areas:

1) In **agriculture**, where AI drives precision farming, optimizing inputs and protecting crops against disease and climate risks;
2) In **healthcare**, where AI is transforming diagnostics, drug development, and personalized care, analyzing massive datasets beyond human capability;
3) In **environmental science**, where AI detects trends and anomalies in complex climate data, helping predict extreme weather events and guide conservation efforts; and
4) In **governance**, where data analytics fosters evidence-based policymaking and enhances public services.

Ladies and gentlemen, as you interrogate these advances and as scholars of integrity, strive to explore the critical questions of ethics, fairness, and transparency responsibilities that we, as scientists and educators, must embrace.

At Kabarak University, we support research at the frontiers of AI and data science. Our research teams comprised of students guided by experienced researchers are continually developing solutions with real-world impact, as evidenced by our participation and success in the national and international technology competitions. For instance, in February this year, Dr. Philip Nyawere, Director RIO, and Dr. Andrew Kipkebut, Lecturer IT, attended *AI Everything Global 2025 Exhibition* held in Abu Dhabi and Dubai, United Arab Emirates. Together with our IT students Mercy Jemeli and Felix Masigwa, the team showcased Kabarak University AI-driven projects. One of the AI-driven innovations presented is **GasGuard:** An AI-enabled safety system designed for real-time detection of gas leaks in residential, commercial, and industrial settings. The solution leverages smart sensors and AI analytics to monitor gas levels, issue early warnings, and automatically trigger safety protocols to prevent accidents and environmental hazards. The University has successfully steered the registration of **GasGuard** with the Kenya Copyright Board as a copyright work in the name of **Mercy Jemeli, Felix Masigwa,** and **Kabarak University.** This achievement, among others, underscores our commitment to research and innovation.

Regarding our **conference on Pure and Applied Sciences**, the theme *Recent Advances in Research in Physics, Chemistry, Biological Sciences, and Applications* underscores our conviction that science is the foundation upon which transformative applications are built. Breakthroughs in theoretical physics, power quantum computing, semiconductors, and materials science are unlocking next-generation energy storage solutions essential for renewable energy systems. In the field of Chemistry, research on natural products drive the discovery of new pharmaceuticals and sustainable industrial applications while advances in biological sciences drive innovation in biotechnology, agriculture, and environmental sustainability.

Ladies and gentlemen, our third forum, the **Conference on Environment and Energy**, focusing on *Enhancing Environmental Resilience for Food Production and Energy Sustainability,* is more relevant than ever. We are honored that this conference is done in partnership with TEAMEnvironment KENYA and the Kenya Forest Research Institute (KEFRI)**,** whose partnership and expertise are invaluable. The world today faces a stark reality. Resources are finite, and energy remains scarce and unevenly distributed. As populations grow and economies develop, pressures on natural resources, food systems, and energy supplies intensify. At the same time, climate change threatens ecosystems, agriculture, and human livelihoods with increasing severity. The latest reports warn that urgent action is needed to avoid irreversible damage.

Ladies and gentlemen, at Kabarak University, we recognize that the scarcity of resources and energy is not merely an economic challenge, it is a scientific and ethical imperative. It demands research, innovation, and collaborative solutions that balance human development with environmental stewardship. Our commitment to sustainability is reflected not only in our research but in our daily operations, green campus initiatives, and community engagement. We believe universities must lead by example

in creating a sustainable future. For this reason, Kabarak University is not just an institution of learning:

- We are a beacon of innovation and social responsibility. We support research and innovation through funding, modern facilities, mentorship, and interdisciplinary collaboration;
- We build partnerships with other universities, research institutes, industry, government, and communities. These collaborations have led to significant innovations and impactful solutions; and;
- We are deeply committed to corporate social responsibility (CSR). Our faculty and students actively participate in community health initiatives, environmental conservation, and educational outreach.

Ladies and gentlemen, just to emphasize, although we gather under three distinct conference themes, our mission is unified: to harness knowledge, science, and technology to improve lives and secure the future of our planet. In a nutshell, data science gives us tools to navigate complexity and extract transformative insights, pure sciences drive fundamental discoveries that shape new industries and technologies, and environmental sciences ensure our progress is sustainable, equitable, and resilient. Therefore, as you can see, this conference is more than an academic event—it is a forum where disciplines converge, collaborations form, and new solutions emerge for the challenges of our time. I wish you a productive engagement.

Prof. Peter Rugiri

DEAN, SCHOOL OF SCIENCE, ENGINEERING & TECHNOLOGY

Distinguished guests, faculty colleagues, dear students, and friends of Kabarak University, I extend my warm greetings to you all.

On behalf of the School of Science, Engineering, and Technology (SSET), it is my honor to welcome you to this year's conference. Today, we are launching three significant international conferences: The Kabarak University International Conference on Data Science and Artificial Intelligence, The Kabarak University International Conference on Pure and Applied Sciences, and The Kabarak University International Conference on Environment and Energy. This coming together of guest speakers, faculty, conference participants, and students, shows how dedicated we are to a smarter, greener future informed by data.

Grounded in Biblical Christian values and academic excellence, we take pride in shaping Kenya's future through Science, Engineering, and Technology. We gather at a pivotal moment when Artificial Intelligence is not just a future concept; it is a transformative force in our present, changing how we live, learn, work, and tackle society's most pressing challenges. This is reinforced by our foundational work in Natural, Pure and Applied Sciences, which broadens our understanding of the universe and supports all technological advancement. Our emphasis on Environment and Energy addresses the urgent need to protect our planet's future and fosters innovations in sustainable solutions.

From healthcare and agriculture enhanced by advanced data analytics to the development of new materials through applied sciences, and the pursuit of renewable energy sources and climate resilience, these fields are reshaping our world. At the School of Science Engineering and Technology, we view this as a call to action: To prepare a generation of innovators, thinkers, engineers, and scientists who will lead Africa's scientific and technological revolution with integrity, creativity, and responsibility.

These conferences urge us to move beyond mere curiosity and engage with science and technology purposefully. They challenge our students to deeply delve, our researchers to boldly explore, and our industry partners to meaningfully collaborate. They also compel us to confront difficult questions about ethics, inclusion, sustainability, and humanity's role in an increasingly technology-driven world.

To our students: seize every opportunity, ask bold questions, and never stop learning. You will determine how science and technology serve humanity and our planet. Learn from the experts, build your networks, and share your ideas to address significant challenges.

Thank you, and once again, welcome to the School of Science, Engineering, and Technology at Kabarak University where Biblical Christian faith, knowledge, and technology converge to transform lives.

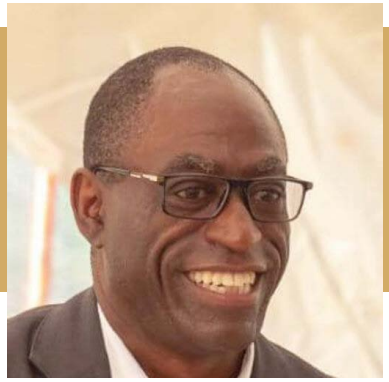
Prof Ciira Maina
KEYNOTE SPEAKER

Prof Ciira is Associate Professor at Dedan Kimathi University of Technology in Nyeri, Kenya where he teaches electrical engineering and also conduct research in a number of areas including bioacoustics, IoT, machine learning and data science. Since September 2019 he has led the Centre for Data Science and Artificial Intelligence (DSAIL). He also serves as the board chair of Data Science Africa.

Prior to joining DeKUT in 2013, Prof Ciira was a postdoctoral researcher at the University of Sheffield between 2011 and 2013, a PhD student at Drexel University in Philadelphia, USA between 2007 and 2011 and a BSc Student at the University of Nairobi between 2002 and 2007.

Prof. Wilkister N. Moturi
GUEST SPEAKER

Prof Wilkister N. Moturi (PhD) is a professor of Environmental Health at Egerton University, Department of Environmental Science. She holds a Ph.D. in Environmental Science and has professional training in Epidemiology and Medical Statistics from University of California, Davis. Her research interests are in the areas of ecosystem health and human wellbeing; occupational and industrial Health; water, sanitation and health; and disaster risk reduction. She has been a collaborator with the Family Planning and Environmental Sustainability Assessment (FPESA), and the Kenyan coordinator of myClimate, a Swiss NGO dealing with climate protection initiatives; external reviewer of Swedish Research Council for Sustainability proposals; PI and member of several collaborative projects with international and national outlook and facilitator of various national and international programs. She has undertaken consultancies in her field and supervised and mentored students in USA, Netherlands, South Sudan, Uganda and Kenya. Currently, she is a Global Burden of Disease (GBD) collaborator and an external examiner for postgraduate theses for national and regional universities. She has conducted research and published widely. She is a member of the Environment Institute of Kenya (EIK) and patron of the Egerton University Environmental Association (EUEA).



Dr. Onesmus Munyati

GUEST SPEAKER

Trained as a polymer chemist at the University of Manchester Institute of Science and Technology (UMIST), Onesmus Munyati has built a distinguished career spanning over three decades, dedicated to translating fundamental materials research into practical solutions for pressing development challenges. His journey began with a strong foundation in chemistry from the University of Zambia, where he graduated with merit, setting the stage for his impactful contributions to science and technology in Africa.

Upon returning to his alma mater, Dr. Munyati established the University of Zambia's pioneering nanomaterials research program. He currently leads an interdisciplinary team of researchers and students who are actively investigating the potential of conducting polymers and hybrid nanomaterials across a range of critical applications. Their innovative work includes the development of advanced sensor materials for environmental monitoring, polymer nanocomposites for enhanced energy storage, high-performance water purification membranes to address water scarcity, and cutting-edge nanodrug delivery systems. At the heart of their research is a fundamental inquiry: how can the unique properties of nanomaterials and the nanoscale provide tangible solutions to large-scale problems in health, energy, and environmental sustainability?

Recognizing the importance of diverse sustainable energy solutions for Zambia's future, Dr. Munyati serves as the Chair of the National Expert Group on Biogas Technology. Appointed in this crucial role, he guides the evaluation and strategic implementation of biogas technologies, contributing to cleaner energy alternatives and more effective waste management practices within the nation.

Dr. Munyati's influence extends beyond academia and into the realm of science policy across Eastern and Southern Africa. His active participation as a governing board member of the African Materials and Solar Energy Society (AMSEESA) and his leadership as the chair of the Research, Development and Innovation Subcommittee of Zambia's National Institute of Scientific and Industrial Research play a vital role in shaping the region's scientific agenda. He remains committed to fostering regional, locally relevant research initiatives that can address the unique challenges and opportunities within the African context.

Ultimately, Onesmus Munyati's multifaceted career underscores the profound potential of nanomaterials and sustainable energy technologies to drive meaningful and lasting development. His vision extends from both fundamental research in nanomaterials and the practical deployment of innovative solutions, such as biogas technology, serving as a powerful example of how research conducted within a university setting can ripple outward to create positive transformations in communities and contribute to a more sustainable future for Zambia and the wider region.

KABARAK UNIVERSITY

THE 15TH INTERNATIONAL RESEARCH CONFERENCES FOR THE SCHOOL OF SCIENCE, ENGINEERING & TECHNOLOGY

DAY ONE PLANERY PROGRAM
10TH JULY 2025

TIME	ACTIVITY	PRESENTER
0800 - 0900 am	Registration	Ms. Immaculate Ezekiel
	PROGRAMME MODERATOR:	Dr. Sellah Kebenei
0900 - 0910 am	Opening Prayer and Devotional Thought	Prof. John Jackson Kitetu
0910 - 0915 am	Welcoming Remarks Dean, School of SSET	Prof. Peter Rugiri
0915 - 0945 am	**Guest Speaker's Address** **Topic: Circular Economy Models for Conversion of Agricultural Waste to Sustainable Bioenergy**	Prof. Wilkister N. Moturi
0945-1000 am	**PLENARY: Q&A Session**	Dr. Sellah Kebenei
10.00-10.10 am	Kenya National Anthem, East Africa Community Anthem, Kabarak University Anthem	School of Music and Media
1010 -1020 am	Opening Prayer and Devotional Thought	Rev. Justus Mutuku – University Provost
1020 - 1025 am	Welcoming Remarks and invite DVC (A & R)	Prof. Peter Rugiri – Dean School of Science, Engineering & Technology
1025 - 1030 am	DVC (A & R) to make his remarks and invite the Vice-Chancellor	Prof. John Ochola, DVC (A & R)
1030 - 1100 am	**Vice-Chancellor makes his remarks, officially opens the Conference and invites the Key Note Speaker**	**Prof. Henry Kiplangat, Vice-Chancellor**
1100 - 1130 am	**Keynote Speaker** **"Development, Deployment and Adoption of Data Science and Artificial Intelligence Solutions,"**	**Prof. Ciira Maina,** **Centre for Data Science & Artificial Intelligence (DSAIL)**
1130 - 1145 am	**PLENARY: Q & A Session**	Dr. Sellah Kenei
1145 - 1155 am	Awards	Dr. Laura Limo

TIME	ACTIVITY	PRESENTER
1155 - 1200	Vote of Thanks	Dr. Phillip Nyawere, Director – RIO
1200	Closing Prayer	Rev. Justus Mutuku – University Provost
	LUNCH BREAK	

PROGRAM & BOOK OF ABSTRACTS FOR DATA SCIENCE & ARTIFICIAL INTELLIGENCE CONFERENCE 2025

Conference Theme: ***"Data Science and Artificial Intelligence for Digital Transformation in Different Sectors."***

Link: https://kabarak-ac-ke.zoom.us/j/86809747798?pwd=6eVTuPHOIAWuDyPgsvM7CT6mx3YsiL.1

Meeting ID: 868 0974 7798 Passcode: 659026

Kabarak University on **10th July to 11th July 2025**

SCHEDULE

AFTERNOON SESSION

PAPER PRESENTATION

MODERATOR: MS. MERCY GACHOKA

TIME	ACTIVITY	PRESENTER
2:00 – 2:20 pm	A blockchain based model for provision of incentives to rare blood group donors	Leah Chebet Bunei , Prof. Simon Maina Karume, Dr. Ruth Oginga Kabarak University
2:20 – 2:40 PM	Effects of two modes of virtual reality on students' learning outcomes in biology among secondary schools in minna Niger state, Nigeria	Gambari A. I., Shuaibu, H. Y., Saliman, K., & Umahaba, R. E.
2:40 – 3:00 PM	An Intelligent Curriculum Alignment Model for Digital Skills in Academic Programs	Duncan Nyale, Simon Karume, Andrew Kipkebut, Fidelis Mukudi and Abrar Sharafat

11TH JULY 2025

MORNING SESSION PAPER PRESENTATION

MODERATOR: MR. JOSHUA MUTAI

TIME	ACTIVITY	PRESENTER
8:00 – 8:30 am	Registration	Mr. Joshua Mutai
8:40 – 9.00 am	Devotion & Opening Prayers	Pst Alukwe
9:00 – 10:00 am	Guest Speaker	Dr Adolpus Wagala
10:00 – 11:00 am	TEA BREAK	CATERING DEPT
11:00 – 11:20 am	Readiness Of Tvet Educators For Ai-Enhanced Teaching And Learning: A Case Study Of Kaimosi Friends National Polytechnic Kenya	Odhiambo J Okumu, Mary Oyungu
11:20 – 11:40 am	Effect Of Effective Ai-Driven Training And Learning Systems On Trainee Academic Engagement And Performance (Case Of Tvet Institutions In Kenya)	Stephen Musilngómbe Wafula
11:40 – 12:00 pm	Ai-Driven Validation Of Blockchain-Based Smart Contracts For Real Estate Records Management	Saina Jonathan
12:00 – 12:20 pm	Balancing Progress And Privacy: Ethical Consideration For Data-Driven Urban Planning In Nairobi- Learning From Singapore's Onemap Case Study	Peter K. Gathoni, Ian D. Njuguna
12:20 – 2:00 pm	LUNCH BREAK	CATERING BREAK
2:00 – 5:00 pm	Data Science student Colloquium	
5:00 – 5:10 pm	Closing Remarks	Dean SSET

ABSTRACTS FOR DATA SCIENCE & ARTIFICIAL INTELLIGENCE

A BLOCKCHAIN BASED MODEL FOR PROVISION OF INCENTIVES TO RARE BLOOD GROUP DONORS

Leah Chebet Bunei [1], Prof. Simon Maina Karume [2], Dr. Ruth Oginga [3]
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ABSTRACT

A critical necessity towards provision of universal healthcare by the Kenyan government is to ensure constant blood supply in the countries blood bank. Rare blood donors always play a critical role in healthcare sector by provision of life saving support to patients with specific medical needs to live longer and with higher quality of life. However, the scarcity of these rare blood types which are which are AB negative, A negative, B negative and O negative leads to a great challenge especially in emergency or high demand situations. Despite the crucial need for blood donations, donors may be less motivated to donate blood regularly due to lack of effective incentives. Traditional blood donation management systems are often not transparent, inadequate donor identification and delayed incentives to rare blood group donors. This demoralize them from donating blood again particularly those individuals with rare blood types. To address these challenges, this research aims to develop a blockchain based model for provision of incentives to rare blood donors that offers trust, transparency and security tailored to increase blood donation. The study focuses on designing, developing, and evaluating a blockchain based model for provision of incentives to rare blood group donors. For the purpose of regulatory hurdles, data protection measures are used to safeguard donor information which includes encryption, access controls and also ensuring compliance with data privacy regulations. The objective of the research is achieved by use of systematic literature review as a research methodology to explore the existing models and design thinking methodology is adopted to guide the research process. The possible conclusion of a blockchain based model for provision of incentives to rare blood donors presents an approach to address the challenges encountered by the blood donation systems, particularly when it comes to rare blood types.

Keywords: Blockchain, model, smart contact, confidentiality, donors

AN INTELLIGENT CURRICULUM ALIGNMENT MODEL FOR DIGITAL SKILLS IN ACADEMIC PROGRAMS

Duncan Nyale[1], Simon Karume[1], Andrew Kipkebut[2], Fidelis Mukudi[1] and Abrar Sharafat[3]

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[2]Department of Computer Science, Kabarak University, Nakuru, Kenya.

[3]Department of Information and Communication Technology, Kenya School of Government, Mombasa, Kenya.

ABSTRACT

The rapid evolution of digital technologies has created significant misalignment between academic curricula and labor market demands for digital skills. This study presents the development and validation of an intelligent curriculum alignment model that systematically analyzes university curricula, identifies digital competencies, and maps them to labor market requirements. The research employed a hybrid artificial intelligence approach combining web scraping, Natural Language Processing (NLP), and Decision Tree machine learning algorithms to create a comprehensive solution. The model achieved an accuracy of 88% in classifying digital skills relevance, demonstrating strong performance with high precision (0.99) for low-frequency skills and exceptional recall (0.99) for high-frequency skills. The study utilized data from 46,514 job postings across 27 occupations, resulting in a skillset database of 9,077 unique digital skills categorized by market demand. The intelligent model generates three key outputs: a Curriculum Analysis Report, a Digital Skills Index (DSI) scoring curriculum alignment on a 0-100 scale, and a Prescriptive Analytics Report providing data-driven recommendations for curriculum improvement. This research addresses critical gaps in educational responsiveness to technological change and provides a scalable framework for continuous curriculum optimization in the digital era.

Keywords: Digital skills, curriculum alignment, artificial intelligence, natural language processing, higher education, workforce development, educational technology, machine learning

EFFECTS OF TWO MODES OF VIRTUAL REALITY ON STUDENTS' LEARNING OUTCOMES IN BIOLOGY AMONG SECONDARY SCHOOLS IN MINNA NIGER STATE, NIGERIA

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ABSTRACT

This study investigated the effects of two modes of Virtual Reality (VR) instruction on students' learning outcomes in Biology among senior secondary school students in Minna, Nigeria. Six research objectives with corresponding research questions and null hypotheses were tested at the 0.05 level of significance. The study adopted a quasi-experimental design involving a non-randomized, non-equivalent pretest-posttest control group framework. A purposive and random sampling techniques were adopted to select 125 students from intact classes. Four researchers' developed instruments, validated by experts in relevant fields were used for data collection. The reliability of the instruments

was determined using the Split-Half method, yielding coefficients of 0.77, 0.85, and 0.80 respectively. Data collected were analyzed using Mean and Standard Deviation for answering the research questions, while ANCOVA and Mann-Whitney U test was used to analyze hypotheses. The findings revealed that students exposed to the Non-Immersive VR Instructional Package outperformed those in the Immersive VR and Control groups in learning Genetics. The study concludes that Virtual Reality-based instructional approaches, particularly Non-Immersive VR, are effective in enhancing students' academic achievement and knowledge retention in Biology. It is recommended that VR technologies be integrated into regular classroom instruction to improve learning Biology in senior secondary schools.

Keywords: Virtual Reality VR, Immersive VR, Non-Immersive VR, Learning Outcome, Gender

READINESS OF TVET EDUCATORS FOR AI-ENHANCED TEACHING AND LEARNING: A CASE STUDY OF KAIMOSI FRIENDS NATIONAL POLYTECHNIC KENYA

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ABSTRACT

Integrating Artificial Intelligence (AI) into Technical and Vocational Education and Training (TVET) is of utmost potential to enhance teaching and learning. However, the readiness of TVET teachers to accept AI is of great concern. This study assessed the readiness of educators at Kaimosi Friends National Polytechnic, Kenya, focusing on their awareness of AI, institutional support, and challenges faced in integrating AI into instructional practices. Descriptive survey design was employed, and data were collected from 40 educators through structured questionnaires and semi-structured interviews. Results indicated that 35% of educators were highly aware of AI, 50% were moderately aware, and 15% had low awareness. Institutional support was low, with 60% of educators lacking access to AI-related resources and training. The significant challenges included inadequate training of AI (70%), lack of infrastructure (55%), and resistance to change (30%). The research concluded that low awareness of AI, institutional inadequacy, and technology barriers hinder AI adoption in TVET. It recommends the introduction of structured AI training programs, investment in AI infrastructure, and policy development to facilitate AI integration. Addressing these gaps will improve the digital skills of teachers and enable AI-driven pedagogy in Technical and Vocational Education and Training institutions, ultimately fostering technical education innovation.

Keywords: AI Readiness in TVET, AI Integration in Education, TVET Educators

EFFECT OF EFFECTIVE AI-DRIVEN TRAINING AND LEARNING SYSTEMS ON TRAINEE ACADEMIC ENGAGEMENT AND PERFORMANCE (CASE OF TVET INSTITUTIONS IN KENYA)

Stephen Musilngómbe Wafula
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The Kitale National Polytechnic

ABSTRACT

The incorporation of Artificial Intelligence (AI) in education and training has revolutionized traditional training and learning approaches. The trainers as well as trainees are applying AI in most of their teaching and learning activities mostly in institutions of higher learning. The study examined the effect of effective AI-driven training and learning systems on trainee academic engagement and performance in Technical and Vocational Education and Training (TVET) institutions in Kenya. The study was guided by three specific objectives: To determine how AI algorithms can adjust learning content based on individual student progress and preferences, to assess the impact of adaptive learning systems on trainees with different learning styles and abilities, and to investigate the role of AI in real-time feedback and personalized recommendations for trainers and trainees. The research employd a mixed-methods approach, incorporating both qualitative and quantitative data from TVET institutions implementing different learning systems. Findings highlighted the role of AI in personalizing learning, improving engagement, and enhancing academic performance among trainees. The findings indicated that AI algorithms play a crucial role in personalizing learning experiences by adjusting educational content based on individual student progress and preferences. Adaptive learning systems have proven to be effective in accommodating diverse learning styles and abilities, ensuring that trainees receive tailored support that enhances their comprehension and retention of knowledge. Additionally, AI-powered real-time feedback mechanisms and personalized recommendations enable both trainers and trainees to make informed decisions, ultimately improving learning outcomes. Through the study, it was recommended that AI should be integrated in TVET Institutions in Kenya, improve digital literacy by training trainers and trainees on effective use of AI tools, enhance data privacy by adopting strict information security measures and regulations and increase accessibility to AI driven infrastructure and connectivity.

Keywords: Artificial Intelligence, training, learning, Algorithms, Educational content

AI-DRIVEN VALIDATION OF BLOCKCHAIN-BASED SMART CONTRACTS FOR REAL ESTATE RECORDS MANAGEMENT

Saina Jonathan, David Muchangi Mugo (PhD), Faith Mueni
School of Pure and Applied Sciences,
University of Embu
Email: sainajonathan@gmail.com

ABSTRACT

Blockchain technology has the potential to transform real estate records management by enhancing transparency, security, and efficiency. However, its adoption faces challenges, particularly in validating smart contracts to ensure reliability and legal compliance. This study presents an AI-driven framework

for validating blockchain-based smart contracts in real estate. Using machine learning and natural language processing techniques, the framework evaluates smart contracts for security vulnerabilities, compliance with regulatory requirements, and functional correctness. The research employs a mixed-methods approach, including empirical case studies and algorithmic validation, to assess effectiveness. The findings contribute to the broader discussion on integrating AI in blockchain for secure and efficient real estate transactions.

Keywords: Blockchain, Smart Contracts, AI Validation, Real Estate Records, Machine Learning, Compliance, Security, Transparency

BALANCING PROGRESS AND PRIVACY: ETHICAL CONSIDERATION FOR DATA-DRIVEN URBAN PLANNING IN NAIROBI- LEARNING FROM SINGAPORE'S ONEMAP CASE STUDY

Peter K. Gathoni* 1, Ian D. Njuguna[2]
[1]Spatial and Environmental Planning, Kenyatta University, Nairobi, Kenya, [2]School of Public Affairs & Administration, The University of Kansas, Kansas, United States

ABSTRACT

Rapid urbanization in Nairobi necessitates a data-driven approach to sustainable urban planning, with the proposed Nairobi Urban Resource and Information System (URIS) poised to be a pivotal instrument. However, ethical considerations regarding data privacy, equity, security, and transparency must be paramount. This paper explores URIS's potential while critically examining these concerns, drawing insights from Singapore's OneMap platform. Geographic information is inherently political, as it reflects power dynamics, collection methods, and distribution of benefits. In African cities like Nairobi, historical legacies and socioeconomic inequalities can exacerbate biases in geospatial data utilization. The research delves into these complexities, advocating for equitable and ethical data practices that empower marginalized communities' Open data initiatives present opportunities for transparency and public engagement but raise concerns about privacy, misuse, and surveillance. This paper examines these complexities, emphasizing the need to balance openness with robust safeguards for vulnerable populations. To ensure ethical data practices, we recommend a multi-faceted approach. Robust legal frameworks must protect privacy, while international collaboration can provide expertise and resources. Anonymization techniques, coupled with digital literacy programs, can empower citizens to understand and control their data. Transparency, informed consent, and community engagement are essential to build trust and ensure the URIS benefits all residents. By addressing these ethical concerns, Nairobi can leverage the URIS to foster inclusive and privacy-conscious urban planning, positioning itself as a leader in ethical data-driven development in Africa and beyond. This research contributes to the growing body of knowledge on responsible data governance and offers practical recommendations for policymakers and stakeholders involved in urban planning in Nairobi and other developing cities.

Keywords: Data Privacy, Ethical planning, Ethical Urban Planning, Nairobi Urban Resource and Information System (URIS), Singapore OneMap

PROGRAM AND BOOK OF ABSTRACTS FOR CONFERENCE ON ENVIRONMENT AND ENERGY TECHNOLOGY, 2025

Conference Theme: ***Enhancing Environmental Resilience for Food Production and Energy Sustainability***

CHAIR: Danice Awinda

Rapporteur: Dr. Mary Kuria

PROGRAM

DAY 1: 10th July 2025

Link: https://kabarak-ac-ke.zoom.us/j/89344316011?pwd=vgws8H5OfsuLzKEGYPfAlxTMbzF63q.1

TIME	TITLE OF THE PAPER	NAME OF THE PRESENTER
2.00 – 2.20 pm	**Abstract 1**: Evaluating the existing ecosystem-based adaptation strategies implemented among smallholder maize farmers in Moiben sub-county	Kibet Abigael Jepkorir Kabarak University
2.20 – 2.40 pm	**Abastract 2**: Health Risks Assessment of Selected Trace Elements in Mt. Suswa's Fumarolic Condensates: Informing Participatory Natural Resource Management	Gideon Yator Kabarak University
2.40 – 3.00 pm	**Abstract 3**: Assessment of the Impacts of Sisal Processing Industries on Water Resources in Rongai Sub-County, Kenya.	Jackline. C. Kiptui Kabarak University
3.00 – 3.20 pm	**Abstract 4:** Redemptive Innovation and Climate Preparedness: A Qualitative Exegetical Study of Proverbs 6:6–8 in Bungoma County, Kenya	Samuel Tembu Kenya Assemblies of God East University
3.20 – 3.40 pm	**Abstract 5:** Repellent Properties of *Lippia javanica* Oil against *Anopheles gambiae* Mosquitoes	Bii Kiprono Gideon Kabarak University
3.40 – 4.00 pm	**Abstract 6:** A Faith-Inspired Call to Environmental Policy for Future Generations in Kenya	Ernest Okello Kenya Assemblies of God East University

DAY TWO: 11th July 2025

CHAIR: Dr. Sellah Kebenei

Rapporteur: Dr. Rose Sagwe

Link: https://kabarak-ac-ke.zoom.us/j/86763751362?pwd=ATcP2hwolORVsG8YlaCya9Ap18F0mO.1

8.30 am	Devotion and opening prayer: Dr. Eliud Michura
9.00 am	Opening remarks from the Dean School of Science Engineering and Technology

TIME	TITLE OF THE PAPER	NAME OF THE PRESENTER
9.00 – 9.20 Am	**Abstract 7:** Anthropogenic Forest Fires in Ngboko, Western Equatoria State, South Sudan: Linking Traditional Land Use Practices to Ecosystem Decline and Livelihood Vulnerability	Mwalo Abel Kabarak University
9.20 – 9.40 Am	**Abstract 8:** Joseph's Food Security Strategy in Genesis 41: A Biblical Prototype for Climate-Smart Agriculture	Esther Wavinya Kenya Assemblies of God East University
9.40 – 10.00 Am	**Abstract 9:** Evaluating the Impact of Blue Economy Initiatives on Living Standards in the Coastal Kenya.	Sharon Jerop Kemboi Kabarak University
10.00 – 10.20 Am	**BREAK**	
10.20 – 10.40 Am	**Abstract 10:** Harnessing *Warburgia ugandensis* Extract for Eco-friendly Cockroach Control	Mugao Doglas Muthuuri, Kabarak University
10.40 – 11.00 Am	**Abstract 11:** Strategies for Climate Resilience, Food and Energy Systems: Exegetical Analysis of Genesis 2:1–15 – Stewardship and Sustainability	Kellen Njokah Kenya Assemblies of God East University
11.00 – 11.20 Am	**Abstract 12:** Economic Constraint as a factor Influencing Women's Low Adaptability to Clean Energy in Rural Kenya	Faith Wangu Karanja Kabarak University

TIME	TITLE OF THE PAPER	NAME OF THE PRESENTER
11.20 – 11.40 pm	**Abstract 13:** Addressing Food Waste Challenges in Hospitality: Implications for Environmental Sustainability in Kenya	Shadrack Korir Sot Technical Training Institute
11.40 – 12.00 pm	**Abstract 14:** Optimizing the Adoption of |Sugarcane Bagasse Briquettes in Kenyan Secondary Schools using Artificial Intelligence.	James Owek Ochieng; Jaramogi University of Science and Technology
12.00 – 12.20 pm	**Absract 15:** Antimicrobial Activities of *Tithonia diversisifolia* Leaf Extracts (Mexican Sunflower) Against *Salmonella typhi* And *Escherichia coli*.	Kevin Koli Maende, Kabarak University
12.20 – 12.40 pm	**Abstract 16:** Faith and Forests: Community Stewardship and the Theological Call to Environmental Responsibility – An Exegetical Analysis of Psalms 24:1–2	Moses Munyi Kenya Assemblies of God East University
12.40 – 1.00 pm	**Abstract 17**: Enhancing maternity services through provision of infection prevention essentials in maternity health care: A case of Busia county health facilities".	Nicodemus Onunga Omwancha Kabarak University
1.00 – 2.00 pm	**BREAK**	
2.00 – 2.20 pm	**Abstract 18:** Tragedy of the Commons in Kenya's Forest Resources: A Call for Sustainable Management	Atibo Joan Nandako Kabarak University
2.20 -2.40 pm	**Abstract 19:** Utilizing Waste as a Resource for Energy Sustainability: An Exegetical Analysis of Matthew 25:14–30 through Socio-Scientific Hermeneutics	Yudah Ayoo Kenya Assemblies of God East University
2.40 – 3.00 pm	**Abstract 20:** Interconnectedness of natural systems.	Sharon Chepkoech Kabarak University

BOOK OF ABSTRACTS FOR CONFERENCE ON ENVIRONMENT AND ENERGY TECHNOLOGY, 2025

EVALUATING THE EXISTING ECOSYSTEM-BASED ADAPTATION STRATEGIES IMPLEMENTED AMONG SMALLHOLDER MAIZE FARMERS IN MOIBEN SUB-COUNTY

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ABSTRACT

In Moiben Sub-County, climate change poses significant challenges, particularly impacting the agricultural community. As a major agricultural hub in Kenya, Uasin Gishu County experiences shifting precipitation patterns, prolonged droughts, and erratic rainfall, adversely affecting crop yields and livestock. Smallholder maize farmers, who heavily depend on rain-fed agriculture, face reduced productivity, increased vulnerability to pests and diseases, and heightened water scarcity. The study's main objective is to evaluate existing ecosystem-based adaptation strategies implemented among smallholder maize farmers in Moiben Sub-County. Resilience Theory guided the study. The study used a mixed-methods research design. The target population is 7536 respondents, including Smallholder maize farmers, local government officials and community leaders. The sample size of 390 respondents was determined using the Krejcie and Morgan formulae. The study used systematic random sampling to select smallholder maize farmers (residents) and a purposive sampling technique to select the key informants. This study used a questionnaire for farmers to collect quantitative data and interviews for government officials to collect qualitative data. Quantitative data from filled questionnaires were entered into SPSS version 24 for descriptive statistical analysis. Qualitative data from interviews were analyzed using thematic analysis to gain insights into respondents' perspectives and perceptions. Quantitative data was analyzed using descriptive statistics in the form of means, standard deviation, and percentages and presented in tables and figures. Inferential statistics, including correlation and linear regression, were conducted at a 0.05 significance level to determine the relationships and predictive power of the study variables. The analyzed data was presented in the form of tables and charts. Study findings indicate that there was a positive and statistically significant relationship between ecosystem-based adaptation strategies implemented and climate change vulnerabilities (β_1=.227, p=.001). The study concludes that smallholder maize farmers in Moiben Sub-County have embraced positively a number of ecosystem-based adaptation (EbA) practices that include soil conservation, agroforestry, rainwater harvesting, as well as crop diversification practices, which have led to positive agricultural sustainability and decreased climate change risks. The research suggests that agricultural stakeholders and county agricultural departments can improve the adoption of EbA by improving extension services, providing helpful training, and creating favourable policies such as subsidies and access to credit to encourage sustainable land management.

Keywords: evaluate, existing, ecosystem-based adaptation, strategies, implemented, smallholder, maize farmers, Moiben Sub-County

HEALTH RISKS ASSESSMENT OF SELECTED TRACE ELEMENTS IN MT. SUSWA'S FUMAROLIC CONDENSATES: INFORMING PARTICIPATORY NATURAL RESOURCE MANAGEMENT

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ABSTRACT

Access to safe and clean water remains a critical challenge in semi-arid geothermal regions such as Mt. Suswa, Kenya, where communities often depend on fumarolic condensates as alternative water sources. While geothermal emissions can contain trace elements of concern, their health implications are not well documented in this region. This study evaluated the concentrations and potential health risks of selected trace elements in fumarolic condensates collected from key vents within the Mt. Suswa area during the dry (January–February 2025) and wet (March–April 2025) seasons. A total of 19 samples were analyzed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Sampling sites were chosen based on accessibility and relevance to local usage. Results indicated spatial and seasonal variations in trace element concentrations; however, all measured levels—including arsenic (ranging from 3–8 ppb) and cadmium (1–2.4 ppb)—remained below the maximum allowable limits set by the World Health Organization (WHO) and Kenya's National Environment Management Authority (NEMA). Health risk assessments conducted according to U.S. EPA guidelines showed non-carcinogenic hazard index (HI) values ranging from 0.2 to 0.6, remaining well within the acceptable safety threshold of 1.0. Similarly, the calculated carcinogenic risk (CR) from arsenic exposure ranged from 1.0×10^{-5} to 9.0×10^{-5}, below the WHO's recommended upper limit of 1×10^{-4}, indicating minimal public health concern under current exposure conditions. These findings indicate that, under prevailing conditions, fumarolic condensates in Mt. Suswa pose a low health risk relative to national and international drinking water standards. Nonetheless, the study advocates for participatory natural resource management approaches that integrate scientific monitoring with indigenous knowledge to support effective risk communication and sustainable resource use. Strengthening community-based conservation and embedding traditional water governance practices can help safeguard long-term water quality and environmental health in geothermal landscapes such as Mt. Suswa.

Keywords: Fumarolic condensates, trace elements, health risk assessment, participatory management.

ASSESSMENT OF THE IMPACTS OF SISAL PROCESSING INDUSTRIES ON WATER RESOURCES IN RONGAI SUB-COUNTY, KENYA

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ABSTRACT

Sisal farming is a vital large-scale cash crop activity in Rongai Sub-County, Kenya, with over 1,000 hectares of land dedicated to its cultivation. As a primary economic activity, it provides income and employment opportunities for the local population. However, sisal processing industries are significant consumers of water, which has led to their establishment near natural water sources, including streams and rivers. This study was conducted to assess the impact of sisal processing industries on water resources in Rongai Sub-County, Kenya. The research focused on determining the effects of waste

on water quality in the Molo River, Rongai River, MajaniMingi River, and surrounding boreholes. Data collection involved collecting water samples from the three rivers and adjacent boreholes. Laboratory analyses were performed to evaluate water quality parameters such as pH, dissolved oxygen (DO), temperature, conductivity, and total dissolved solids (TDS). Quantitative data from the laboratory results were compared with World Health Organization (WHO) and Kenyan water quality standards. The findings revealed that sisal processing activities impact local water resources. Water quality tests indicated notable alterations in pH, reduced DO levels, and slightly elevated TDS and conductivity in water bodies adjacent to processing facilities. There were no notable effects on water turbidity. These changes suggest increased pollution, potentially affecting aquatic life and human health. This study recommends a sustainable approach that involves integrating advanced waste treatment, community education, and innovative waste repurposing strategies which can reduce water pollution and health risks while enhancing environmental sustainability and regional economic resilience.

Keywords: Boreholes, PH, Rivers, Rongai subcounty, Sisal industries, Sisal waste, water quality.

REDEMPTIVE INNOVATION AND CLIMATE PREPAREDNESS: A QUALITATIVE EXEGETICAL STUDY OF PROVERBS 6:6–8 IN BUNGOMA COUNTY, KENYA

Samuel Tembu[1], Sila Simiyu[1], Matthew Ochanda[2], Jacob Kipchilis[3], Isaack Kasili[3]
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ABSTRACT

Redemptive innovation aims to restore broken systems in ways that reflect God's justice, wisdom, and care for creation. In Bungoma County, Kenya, climate change has worsened food insecurity and land degradation, particularly for communities reliant on rain-fed agriculture. This qualitative, library-based study conducts an exegetical analysis of Proverbs 6:6–8, which highlights the ant's foresight and diligence, and applies it to the context of climate preparedness. The biblical text is examined alongside development literature and environmental policy documents to construct a redemptive framework for technological adaptation. Reports from the Kenya Climate Smart Agriculture Strategy (2017–2026) and the National Drought Management Authority (2023) show that although Bungoma receives reliable rainfall, more than 60% of smallholder farmers experience yield losses due to deforestation, soil erosion, and limited access to adaptation tools. These issues are compounded by low awareness and uptake of available innovations. The study finds that Proverbs 6:6–8 offers not just a moral lesson but a call to strategic planning and stewardship. When rooted in biblical teaching, redemptive technologies such as rainwater harvesting, early warning systems, and organic soil practices can be embraced more fully by communities of faith. Churches, already trusted centers of influence, can play a key role in promoting climate preparedness by integrating creation care into sermons, supporting local innovations, and partnering with development actors. By aligning practical climate strategies with biblical wisdom, communities can prepare more effectively for environmental challenges, while embodying a theology of restoration.

Keywords: Redemptive Innovation, Climate Preparedness, Proverbs 6:6–8, Sustainable Agriculture, Bungoma County

REPELLENT PROPERTIES OF *LIPPIA JAVANICA* OIL AGAINST *ANOPHELES GAMBIAE* MOSQUITOES

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ABSTRACT

Malaria remains a pressing public health challenge in sub-Saharan Africa, with Kenya bearing a substantial burden of the disease. As insecticide resistance among malaria vectors escalates due to prolonged use of synthetic chemicals, there is growing interest in alternative, environmentally friendly vector control strategies. This study evaluated the repellent efficacy of *Lippia javanica* essential oil against *Anopheles gambiae* mosquitoes, a primary malaria vector. Plant material was collected from Nyalilbuch village in Soin Ward, Kericho County, Kenya. Essential oil was extracted from the air-dried leaves using Hydro-distillation method. Repellency tests were conducted using the Arm-in-Cage (AIC) method with laboratory-reared *A. gambiae* mosquitoes from ICIPE. Human volunteers exposed forearms treated with varying concentrations (1–6 mg/mL) of *L. javanica* oil, with untreated arms serving as controls. Mosquito landings were recorded at 30-minute intervals up to 180 minutes post-application. The oil demonstrated strong immediate repellency, with peak efficacy (>70%) observed within the first 60 minutes. Protection declined gradually thereafter, with repellency dropping below 50% after 150 minutes. The mean effective protection time ranged between 120 and 150 minutes. These findings highlight the potential of *L. javanica* oil as a promising short-term botanical repellent. To enhance field utility and duration of protection, further formulation development or increased dosages may be required. The study supports ongoing efforts to integrate natural repellents into sustainable vector management strategies.

Keywords: malaria, *Lippia javanica*, mosquito repellency, *Anopheles gambiae*, botanical insecticide

A FAITH-INSPIRED CALL TO ENVIRONMENTAL POLICY FOR FUTURE GENERATIONS IN KENYA

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ABSTRACT

Environmental degradation in Kenya, characterized by deforestation, soil erosion, water pollution, and land degradation, poses a severe threat to food security, biodiversity, and the well-being of future generations. Despite national efforts, environmental governance remains weak, and community participation is limited. This paper examines eco-justice through the lens of Christian eschatology, proposing a faith-based framework for environmental sustainability and intergenerational justice in Kenya. Anchored in Revelation 11:18, which warns of divine judgment against those who destroy the earth, the study calls for a biblically grounded response to ecological crises that integrates Christian hope with moral responsibility. This study aims to explore theological foundations for environmental stewardship, analyze Kenya's ecological challenges as moral and spiritual issues, and propose faith-driven strategies for policy advocacy and participatory resource management. The study uses a library-based qualitative methodology. Findings show that Kenya loses an estimated 12,000 hectares

of forest annually, with more than 40% of its land degraded, affecting over 10 million people. Despite the Church's moral influence and extensive grassroots networks, its role in environmental policy and advocacy remains minimal. This paper recommends that faith communities integrate environmental ethics into theological education, support community-based sustainability initiatives, and actively engage in policy frameworks. By aligning eschatological hope with present ecological responsibility, the Church in Kenya can promote a redemptive vision of creation care. This theological approach to eco-justice calls Christians to active environmental stewardship, advancing sustainability, justice, and God's restorative purpose for the earth.

Keywords: Environmental Stewardship, Sustainable development, Eco-justice, Biodiversity, Participatory resource management

ANTHROPOGENIC FOREST FIRES IN NGBOKO, WESTERN EQUATORIA STATE, SOUTH SUDAN: LINKING TRADITIONAL LAND USE PRACTICES TO ECOSYSTEM DECLINE AND LIVELIHOOD VULNERABILITY

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ABSTRACT

Forest fires are an escalating environmental concern in South Sudan, particularly in Ngboko, Western Equatorial State, where traditional land use practices such as shifting cultivation, hunting, and land preparation frequently involve the use of fire. Although culturally embedded, these practices are increasingly linked to deforestation, biodiversity loss, soil degradation, and ecosystem disruption. The loss of forest cover not only weakens local ecosystem services but also contributes to greenhouse gas emissions, intensifying regional vulnerabilities to climate change, including erratic rainfall and prolonged droughts. Socio-economically, recurring fire outbreaks threaten the livelihoods of forest-dependent communities, particularly among low-income and largely illiterate households with limited access to environmental education. This study investigates the human-driven causes, environmental impacts, and socio-economic consequences of forest fires in Ngboko. Using a mixed-methods case study approach, it combines household surveys, key informant interviews, focus group discussions, and ecological field assessments. Expected findings, based on existing literature and anecdotal evidence from local residents, suggest that most forest fires occur during the dry season and result in reduced vegetation cover, declining soil fertility, and lower agricultural productivity. Community members also report increased food insecurity and the loss of forest-based resources due to uncontrolled fires. The study aims to propose sustainable, community-based land management and education strategies to mitigate fire outbreaks and build resilience. Its findings will support evidence-based policies and grassroots interventions in fragile, post-conflict landscapes.

Keywords: Anthropogenic forest fires, shifting cultivation, ecosystem degradation, climate change, community vulnerability, traditional land use, South Sudan, sustainable land management

JOSEPH'S FOOD SECURITY STRATEGY IN GENESIS 41: A BIBLICAL PROTOTYPE FOR CLIMATE-SMART AGRICULTURE

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ABSTRACT

This paper examines the food security strategy implemented by Joseph in Genesis 41 as a biblical prototype for climate-smart agriculture (CSA) in the contemporary context of environmental resilience and food sustainability. This study identifies and analyzes key elements of Joseph's strategy; early warning signs, proactive planning, surplus storage, strategic distribution, centralized governance, and regional collaboration as foundational components of climate-smart agricultural practices. The study illustrates how faith informed wisdom can contribute to present-day efforts to mitigate the impact of climate change on agriculture and food systems. His emphasis on collecting and storing grain during years of plenty reflects the modern practice of creating strategic food reserves and investing in infrastructure to cushion against climate-induced crop failures aligns with modern CSA pillars. The paper also draws theological and ethical implications from Joseph's leadership, emphasizing stewardship, justice, and foresight as biblical values that can shape climate action. This approach encourages interdisciplinary dialogue between theology, environmental science, and agricultural policy, contributing to the development of faith-integrated climate solutions, especially in Africa where faith-based communities play a critical role. In conclusion, Joseph's food security strategy presents a valuable, contextually relevant model for enhancing climate resilience in agriculture. It invites policymakers, theologians, and agricultural practitioners to embrace biblically grounded, innovative, and sustainable solutions for food security amid the global climate crisis.

Keywords: Food security, Climate-smart agriculture, Biblical model, Sustainable development, Early warning signs

EVALUATING THE IMPACT OF BLUE ECONOMY INITIATIVES ON LIVING STANDARDS IN THE COASTAL KENYA

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ABSTRACT

This study assesses the influence of Blue Economy initiatives on the living standards of communities in Coastal Kenya. The coastal region of Kenya possesses significant potential for economic transformation through the sustainable exploitation of ocean resources, particularly through investments in fisheries, aquaculture, marine renewable energy, and coastal tourism. Currently, scant empirical evidence is available concerning the socioeconomic outcomes of these programs, despite the growing policy interest in them. This study analyzed investment strategies in sustainable fisheries, aquaculture production, marine renewable energy infrastructure, and coastal tourism development, by the Sustainable Livelihoods Framework and the Blue Economy Model, assessing their effects on local welfare. The study employs a descriptive research approach with structured questionnaires distributed to people of coastal communities, policymakers, and players in the Blue Economy sector. Descriptive statistics and multiple regression analysis are utilized to assess the strength and significance of the

correlation between four independent variables and key indicators of living standards: income level, accessibility to basic services, employment, and household welfare. Preliminary research indicates that investments in sustainable fishing and coastal tourism development have a modestly good and considerable impact on living standards. Aquaculture production and marine renewable energy also yield positive consequences, but in a more localized manner, influencing the scale and context of their implementation. The study significantly enhances the current understanding of the Blue Economy by providing evidence-based recommendations for the implementation of sector-specific initiatives aimed at improving community well-being. It also proposes policies to maximize the social and economic benefits of coastal resource development while ensuring environmental sustainability and community representation.

Keywords: Sustainable Fisheries, Aquaculture Production, Marine Renewable Energy, Coastal Tourism Development.

HARNESSING *WARBURGIA UGANDENSIS* EXTRACT FOR ECO-FRIENDLY COCKROACH CONTROL

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ABSTRACT

Cockroaches, particularly *Periplaneta americana* and *Blattella germanica*, are among the most resilient urban pests, posing serious public health risks due to their role in disease transmission and food contamination. The widespread use of synthetic insecticides to manage these pests has led to resistance development, environmental pollution, and adverse human health effects. This study evaluates the insecticidal potential of *Warburgia ugandensis*, a medicinal tree native to East and Southern Africa, as a botanical alternative for sustainable cockroach control. Plant materials (bark and leaves) were collected from Nakuru County, Kenya, and processed using ethanol and aqueous extraction methods. Laboratory bioassays including topical application, contact toxicity, and feeding deterrence tests were conducted on adult cockroaches under controlled conditions. The results demonstrated that mortality rates increased with extract concentration and exposure time, with bark extracts in distilled water achieving 100% mortality at 20g/100ml within 24 hours. Statistical analysis using one-way ANOVA confirmed significant differences between treatments. The findings highlight the potential of *Warburgia ugandensis* extracts as a natural, biodegradable, and effective insecticide, providing a promising direction for integrated pest management and reduction in synthetic pesticide dependency.

Keywords: *Warburgia ugandensis*, cockroach control, botanical insecticide, eco-friendly pest management, insecticidal plant extract

STRATEGIES FOR CLIMATE RESILIENCE, FOOD AND ENERGY SYSTEMS: EXEGETICAL ANALYSIS OF GENESIS 2:1–15 – STEWARDSHIP AND SUSTAINABILITY

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ABSTRACT

Climate change poses a significant threat to global food security, energy sustainability, and ecological balance, with especially severe impacts in Kenya. This study explores biblical foundations for environmental stewardship through an exegetical analysis of Genesis 2:1–15, which offers a theological model for creation care - "to work and keep" the Garden stressing the balance between productivity and ecological responsibility. A qualitative, library-based approach is used, drawing from theological, scientific, and policy literature. Since 1970s, average temperatures have risen by 1.5°C, and rainfall has become increasingly erratic, resulting in reduced agricultural productivity and heightened pressure on natural resources. Agriculture contributes over 20% to Kenya's GDP and employs more than 40% of the population, with 98% relying on rain-fed farming. In 2022, drought led to a 6.5% decline in maize production, a 5.9% decrease in milk output, and left 4.3 million people food-insecure. While 91% of electricity is from renewables, only 31% of households use clean cooking energy. This study aims to examine the biblical basis for environmental responsibility, evaluate its relevance to Kenya's climate crisis and recommend faith-integrated strategies to strengthen climate resilience. The findings align with Kenya's National Climate Change Response Strategy (2010) and National Climate Change Action Plan (2018–2022), which emphasize inclusive, ethical, and sustainable action. Proposed strategies include agroecology, reforestation, water harvesting, renewable energy, ethical consumption, and climate advocacy. The study recommends embedding biblical stewardship into national policy and fostering partnerships among churches, scientists, and policymakers for grassroots resilience.

Keywords: Environmental resilience, food security, energy sustainability, climate change, biblical stewardship

ECONOMIC CONSTRAINT AS A FACTOR INFLUENCING WOMEN'S LOW ADAPTABILITY TO CLEAN ENERGY IN RURAL KENYA

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ABSTRACT

Over the past 200 years, global economic growth has been largely driven by advancements in energy generation and storage. Energy access is recognized as a key driver of social and economic development. In rural Kenya, however, clean and affordable energy remains elusive, particularly for women who are the primary users and managers of household energy. Despite government investments and policy frameworks promoting renewable energy, uptake among rural women remains disproportionately low. A key factor influencing this trend is economic constraint, which limits women's ability to shift

from traditional fuels to cleaner alternatives such as solar, biogas, and improved cookstoves. This study is premised on the understanding that economic barriers such as low income and limited credit access when intersected with gender inequality, restricts women's capacity to adopt and sustain clean energy solutions. This problem persists despite Kenya's commitment to vision 2030 and the global Sustainable Development Goals. Furthermore, these women face health risks and often lack time to engage in other income generating activities. Without targeted economic empowerment and financial inclusion to rural women, clean energy transitions in Kenya will remain unattainable. The objective of this research is to examine how economic constraints specifically income levels, affordability, credit access, and cost perceptions affect rural women's adaptability to clean energy technologies in Nyeri County. A mixed-methods approach will be employed: structured household surveys will generate quantitative data, while interviews and focus group discussions will provide qualitative insights. The study will be conducted in Kieni, Tetu, and Othaya sub counties, selected purposively due to their distinct energy access levels, economic diversity, and geographic characteristics. Stratified random sampling will then be used to identify households based on income, education, and energy use. Women are the study's focus because of their central role in household energy management and the disproportionate burdens they face, including health risks and lost economic opportunities. Findings from this research will be vital to policymakers, NGOs, and development stakeholders. It will inform gender-sensitive energy policies, promote inclusive financial strategies, and contribute to national and global development goals (SDGs 5 and 7). The study aims to close a critical knowledge gap and guide implementation of clean energy solutions that are both equitable and sustainable.

Keywords: Clean energy, rural, women, economic constraints, Kenya, gender and development

ADDRESSING FOOD WASTE CHALLENGES IN HOSPITALITY: IMPLICATIONS FOR ENVIRONMENTAL SUSTAINABILITY IN KENYA

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Sot Technical Training Institute

ABSTRACT

In Kenya's dynamic hospitality sector, the persistent challenge of food waste poses a significant threat to environmental sustainability. This study delves into the complexities of this issue, exploring the specific food waste problems encountered by hotels, restaurants, catering services, and other establishments. We sought to understand the underlying causes and processes of food waste generation, moving beyond mere quantification to uncover the human dimensions – from kitchen management practices and food preparation techniques to consumer dining behaviours and plate waste. Through a mixed-methods approach, combining in-depth interviews with hospitality professionals, including chefs, managers, and staff, alongside on-site observations of food handling and disposal practices, we gained first-hand insights into the daily challenges and innovative efforts aimed at minimizing waste. Our research highlights the far-reaching environmental consequences of this waste, linking it to the inefficient use of resources, increased greenhouse gas emissions from landfills, and the strain on local waste management and disposal systems. The study also examines the economic implications of food waste for hospitality businesses, including the costs associated with procurement, storage, and disposal. Furthermore, this paper underscores the urgent need for context-specific and tailored interventions to address food waste in Kenya's hospitality industry. It champions a range of practical solutions, emphasizing the potential of proactive waste reduction strategies, such as improved inventory management and portion control, composting initiatives for

organic waste diversion, and food redistribution programs to connect surplus food with communities in need. Ultimately, this research aims to contribute to a more sustainable and responsible hospitality sector in Kenya, one that not only minimizes its environmental footprint but also fosters a culture of resourcefulness and social responsibility.

Keywords: Food waste, Hospitality, Environmental sustainability, Kenya, Waste reduction

OPTIMIZING THE ADOPTION OF SUGARCANE BAGASSE BRIQUETTES IN KENYAN SECONDARY SCHOOLS USING ARTIFICIAL INTELLIGENCE

James Owek Ochieng; Jaramogi University of Science and Technology

ABSTRACT

The reliance on firewood and charcoal as primary cooking fuels in Kenyan secondary schools has contributed to deforestation, increased carbon emissions and rising energy costs. Although sugarcane bagasse briquettes present a viable and sustainable alternative adoption remains low due to supply chain inefficiencies, high production costs and limited policy support. The study introduces an intelligent framework that leverages machine learning, predictive analytics and optimization algorithms to enhance the production and policy effectiveness of briquette adoption. To address logistical challenges data driven models such as XGBoost and LSTM neural networks predict school energy demand by analyzing historical consumption, geographical factors and transport logistics. Graph Neural Networks (GNNs) optimize distribution routes significantly reducing transport costs by dynamically adjusting to road networks and fuel prices. Reinforcement learning based adaptive supply chain management ensures stable, cost-effective deliveries to institutions. On the production side, computational optimization techniques like Genetic Algorithms (GA) and Particle Swarm Optimization (PSO) enhance briquette composition improving calorific value while maintaining affordability. Computer vision tools and Internet of Things (IoT) enabled sensors oversee real time quality control, monitoring raw material consistency and combustion efficiency. These process refinements result in 20% improvement in fuel performance and ensure standardization of briquettes quality. From policy perspective, multi-agent simulations and Monte Carlo modelling evaluate how government subsidies, carbon credits and tax incentives influence market adoption. Findings indicate that an optimized policy framework could increase uptake by 40%, making bagasse briquettes a financially attractive option for schools. Economic modelling and pricing elasticity analysis help policymakers establish effective cost structures to encourage transition from firewood. Results suggest that incorporating computational intelligence in logistics reduces transport costs by 30%, while optimized production enhances both efficiency and affordability. By integrating smart analytics with energy policy, this research proposes a scalable, data-driven approach that aligns with SDG 7 (Clean energy), SDG 13 (Climate Action), and SDG 15 (Sustainable forest management.) the study demonstrates how advanced computational methods can accelerate renewable energy adoption providing cost effective and sustainable solution for educational institutions in Kenya and internationally.

Keywords: AI for renewable energy, biomass briquettes, machine learning, supply chain optimization, sugarcane bagasse.

ANTIMICROBIAL ACTIVITIES OF *TITHONIA DIVERSISIFOLIA* LEAF EXTRACTS (MEXICAN SUNFLOWER) AGAINST *SALMONELLA TYPHI* AND *ESCHERICHIA COLI*

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ABSTRACT

Invasive plant species are often associated with negative ecological impacts, yet some also hold untapped potential in pharmacological research due to their unique bioactive compounds. *Tithonia diversifolia* (Mexican sunflower), native to Central America but now widespread in tropical and subtropical regions, is one such plant. Traditionally used in folk medicine for treating wounds, gastrointestinal disturbances, and infections, it has attracted scientific interest due to its rich phytochemical profile, including flavonoids, alkaloids, tannins, and terpenes. This study evaluates the antibacterial activity of *Tithonia diversifolia* leaf extract (TDLE) against pathogenic strains of *Escherichia coli* and *Salmonella typhi*, including multi-drug resistant (MDR) isolates. The antibacterial assay was conducted using the disc diffusion method. Sterile discs impregnated with varying concentrations of TDLE (20, 40, 60, and 80 mg/mL) were tested against bacterial cultures on Mueller-Hinton agar. The zone of inhibition (ZOI) increased with extract concentration. For *E. coli*, inhibition zones ranged from 15.0–17.0 mm at 20 mg/mL to 23.0–25.5 mm at 80 mg/mL. In contrast, *S. typhi* showed lower sensitivity, with ZOIs from 8.0–10.5 mm at 20 mg/mL to 12.5–13.5 mm at 80 mg/mL. Notably, TDLE exhibited activity against both antibiotic-sensitive and MDR *S. typhi*, indicating broad-spectrum antibacterial potential. The study also investigated the interactions between TDLE and standard antimicrobial drugs, revealing possible additive or synergistic effects, particularly against *E. coli*. These findings support the therapeutic potential of *T. diversifolia*, not only as a source of novel antibacterial agents but also as a valuable complementary treatment in the context of rising antibiotic resistance. Further studies are recommended to isolate specific active constituents and elucidate their mechanisms of action.

Keywords: *Tithonia diversifolia*, invasive species, Mexican sunflower, antibacterial activity, *Escherichia coli*, *Salmonella typhi*, multidrug resistance, phytochemicals, zone of inhibition

FAITH AND FORESTS: COMMUNITY STEWARDSHIP AND THE THEOLOGICAL CALL TO ENVIRONMENTAL RESPONSIBILITY – AN EXEGETICAL ANALYSIS OF PSALMS 24:1–2

Moses Munyi[1], Earnest Okello[1], Mathew Ochanda[2], Jacob Kipchilis[3], Isaack Kasili[3]
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ABSTRACT

Kenya and East Africa at large is grappling with accelerated deforestation, land degradation, and declining biodiversity, posing critical threats to environmental stability and human livelihoods. This study examines how faith-based community stewardship contributes to environmental resilience, particularly through forest restoration in Kenya and Uganda. Utilizing a library-based methodology and an exegetical analysis of Psalms 24:1–2, it highlights the theological foundation for environmental care rooted in the belief that the Earth belongs to God and that humans are stewards of His creation.

The paper reviews recent interventions by faith communities, including tree planting, forest adoption, and environmental education initiatives. The results reveal significant ecological and social outcomes: reforestation of degraded lands, revival of biodiversity, and heightened environmental consciousness within local congregations. Projects such as those led by the Anglican Church of Kenya and the Bethany Land Institute demonstrate the effectiveness of integrating spiritual motivation with sustainable land practices. Recommendations from this study include enhancing partnerships between faith groups and policy institutions, incorporating ecological stewardship in theological education, and promoting sustainable livelihoods like agroforestry. These strategies align ecological action with moral and cultural values. In conclusion, the paper affirms that faith-based communities play a transformative role in ecosystem restoration and sustainability. Their spiritual authority and grassroots reach make them vital actors in addressing environmental challenges while promoting food security and clean energy.

Keywords: Faith-based stewardship, Environmental resilience, Forest restoration, Ecotheology, Community engagement, Sustainable development.

ENHANCING MATERNITY SERVICES THROUGH PROVISION OF INFECTION PREVENTION ESSENTIALS IN MATERNITY HEALTH CARE: A CASE OF BUSIA COUNTY HEALTH FACILITIES"

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ABSTRACT

Hospital-acquired infections (HAIs) affect 5% to 30% of patients during hospital stays. In developed countries, rates range between 5% and 15%, and may exceed 50% in intensive care units. A CDC analysis estimates acute-care hospital HAI rates around 5%, with some institutions reporting up to 10%. Legionellosis, a serious HAI, has a fatality rate between 28% and 50% in healthcare settings. Sepsis remains a leading cause of newborn deaths globally. In response, the World Health Organization (WHO) advocates for the "six cleans" in newborn care: clean hands, perineum, delivery surface, and clean practices in cord cutting, tying, and care. To promote health-seeking behavior and ensure safe deliveries, maternity units must be hygienic and trusted. To support this, Save the Children assessed 35 health facilities in Busia County, Kenya, aiming to create infection-free delivery environments by improving access to water, sanitation, and hygiene (WASH) services. Fifteen facilities received structural improvements including ventilation, painting, ceiling repairs, toilet renovation, drainage construction, and tiled floors for easy cleaning. Additionally, roof water harvesting and gravity-fed water systems were installed in 22 maternity units, while all 35 facilities were fitted with solar lighting to support night deliveries. These interventions improved the appeal and safety of delivery rooms. Health workers now operate in clean, ventilated environments with access to water for hand hygiene. Indoor toilets also reduced delivery risks during rapid labor. Overall, improved infrastructure, essential supplies, and demand-creation efforts are expected to increase skilled delivery uptake and reduce neonatal infections. Further research could explore the impact of the improvements in infection prevention for delivery spaces in Busia County after Save the Children interventions.

Key words: Hospital-acquired infections (HAI), Legionellosis, Sepsis, Infection prevention, Hygienic environment, Hand hygiene, Neonatal infection prevention.

TRAGEDY OF THE COMMONS IN KENYA'S FOREST RESOURCES: A CALL FOR SUSTAINABLE MANAGEMENT

Atibo Joan Nandako; Kabarak University; Eliud Garry Michura; Kabarak University

ABSTRACT

This paper discusses tragedy of the commons as an ecological challenge within Kenya's heterogenous forest systems (natural, plantation, dryland, coastal and mangrove forests). It's based in the research ideas of Garrett Hardin's "Tragedy of the Commons", which argues that when individuals look out for short-term self-interest, shared resources are over-exploited, to the disadvantage of everyone. Key symptoms of the tragedy across all forest types including illegal logging, overgrazing, charcoal burning, and encroachment are revealed, and connected to weak forest governance, unclear land tenure, and policy implementation gaps. Based on a desktop review of policy papers, environmental reports and local environmental case studies such as Arabuko-Sokoke and Mt Elgon, the paper displays failures in participatory forest management and enforcement of the Forest Conservation and Management Act, 2016. It ends with recommendations on how to act, these include building stronger Community Forest Associations (CFAs), implementing Payment for Ecosystem Services, real time monitoring and strengthening laws and regulations on punishments of illegal activities. The latter actions intend to result in enhanced governance for a more inclusive, sustainable and ecologically based forest management in Kenya.

Keywords: Tragedy of the commons, Forest Resources, Community Forest Associations (CFAs),

UTILIZING WASTE AS A RESOURCE FOR ENERGY SUSTAINABILITY: AN EXEGETICAL ANALYSIS OF MATTHEW 25:14–30 THROUGH SOCIO-SCIENTIFIC HERMENEUTICS

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ABSTRACT

This interdisciplinary study explores the ethical imperative of transforming waste into energy through a theological reading of the Parable of the Talents (Matthew 25:14–30), employing socio-scientific hermeneutics. The Greek term for waste is re-examined in light of biblical stewardship, productivity, and accountability, offering a faith-informed rationale for responsible environmental innovation. Anchored in the theological concept of stewardship, this paper argues that neglecting to utilize discarded resources is a violation of divine expectations for ethical resource management. The study aims to exegete Matthew 25:14–30 for ethical insights on resource use, to assess waste-to-energy (WTE) technologies through biblical ethics, and to propose a community-based WTE model guided by scriptural values. Using a qualitative approach, the research integrates Greek exegetical analysis with socio-historical interpretation. It also reviews existing WTE technologies and contextual case studies, evaluated through a theological-ethical lens. Findings demonstrate a strong ethical alignment between responsible WTE practices and biblical stewardship, highlighting justice, productivity, and care for creation. However, tensions remain regarding equitable access and implementation, particularly for marginalized communities. A conceptual model is proposed for local application, linking faith,

sustainability, and social equity. The study concludes that theology and technology are not isolated domains. Instead, biblical ethics can inform innovative waste management policies that promote both environmental sustainability and social justice. Faith communities, especially in Africa, are called to reclaim their prophetic role by advocating for waste utilization as a moral and ecological responsibility grounded in Scripture.

Keywords: Waste, Energy Sustainability, Matthew 25:14–30, Socio-Scientific Hermeneutics, Stewardship, Waste-to-Energy, Environmental Ethics

INTERCONNECTEDNESS OF NATURAL SYSTEMS

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ABSTRACT

The complex and delicate network of relationships between living and non-living things is how nature works. The concept of ecological interconnectedness is examined in this work, with a focus on the interactions between living things and their surroundings that preserve ecosystem resilience and balance. These connections are essential to the processes that keep life on Earth going, including food chains, energy transmission, and nutrient cycling.

The main idea of the study is interdependence, which emphasizes how species live through parasitic, competing, or mutualistic connections. This interdependence is best illustrated by coral reefs, where fish, corals, algae, and invertebrates rely on one another for reproduction, food, and shelter.

The specific objectives of the study is to examine how the equilibrium of natural ecosystems is affected by human-caused disturbances including pollution and climate change; to examine how keystone species contribute to the stability of ecosystems; to evaluate the effects of invasive plant species on biodiversity, ecological services, and local livelihoods, with a focus on water hyacinth in Lake Victoria; to analyze the role of mutual ecological relationships such as food webs and energy flow play in maintaining life and to investigate how ecological interdependence between living and non-living components maintains ecosystem stability.

It also demonstrates how human activity affects ecological equilibrium through case studies. Elk numbers, flora, and riverbank stability were all significantly impacted by the removal and subsequent reintroduction of wolves in Yellowstone National Park, demonstrating the power of a keystone species to impact an entire ecosystem. The invasive water hyacinth, on the other hand, ruined fisheries, blocked water systems, and disturbed biodiversity when it was introduced to Lake Victoria.

The significance of Traditional Ecological Knowledge which sees people as a part of nature is also emphasized in the study. These traditional traditions promote peaceful and sustainable cohabitation and provide insightful information for contemporary conservation.

In the end, the study emphasizes how important it is to preserve ecosystem services and biodiversity. It advocates policies that restore environmental integrity, encourage ecological education, and protect natural habitats. Understanding how nature is interrelated is crucial for ecological health as well as for guaranteeing a sustainable future for all life on Earth.

Key words: Keystone species, sustainability, migratory routes, carbon sinks and ecosystem resilience

PROGRAM & BOOK OF ABSTRACTS FOR PURE & APPLIED SCIENCES CONFERENCE 2025

Conference Theme: ***"Recent Advances in Research on Physics, Chemistry and Biological Sciences and Applications"***

PROGRAM

Session Chair: Prof. Christopher Maghanga

Link: https://kabarak-ac-ke.zoom.us/j/89001663319?pwd=AJepY4fXPpJ02SDVRqG9AGqJ440aai.1

PAPER PRESENTATIONS

10TH JULY 2025

TIME	TITLE	PRESENTER
14:00 – 15:00 pm	*Functional Nanomaterials and Device Engineering: Interdisciplinary Pathways to Sustainable development in Africa and beyond*	Dr. Onesmus Munyati
15:00 – 15:20 pm	Assessment of Environmental Impacts of Geothermal Power Operation in Tiaty East Sub-County, Baringo County	Anne Sapan and Edwin Akumu Kabarak University
15:20 – 15:40 pm	Investigation of the Effectiveness of an Adsorbent from Eggshell in Removal of Lead from Water	Timothy Kibet Kiptala Kabarak University
15:40 – 16:00 pm	Antifungal Potential of Solanum nigrum Extracts of Ethanol and Methanol against *Candida albicans*	James Nyamache Rioba*, Mary W. Kuria, Rose N. Sagwe Kabarak University
16:00 – 16:20 pm	Chemical Analysis of Organophosphate and Pyrethroid Residues in *Brassica oleracea var. acephala* and *Citrus sinensis* and Their Impact on Food Safety	Wafula Elly Musungu*, Mary Wahu Kuria, Rose Nyakemiso Sagwe Kabarak University
16:20 – 16:40 pm	Synergistic Effect of Photocatalysis and Photo-Fenton Processes in Sol-Gel Fabricated CO-SnO_2Thin Films for Water Treatment	Sharon Chemtai[1], Sellah Kebenei[1], Mwamburi Mghendi[3], Margaret Samiji[2] and Christopher Maghanga[1] [1]Kabarak University, [2]Department of Physics, University of Dar es Salaam [3]Department of Physics, University of Eldoret,
16:20-16:25 pm	Closing Prayer- Dr. Carolyne Chepkurui	

11TH JULY 2025

SESSION CHAIR: PROF. PETER RUGIRI

PAPER PRESENTATIONS		
TIME	**PRESENTATION**	**PRESENTER**
08:00 – 08:10 am	*Devotion- Dr. Edwin Akumu*	
08:10 – 08:30 am	Performance Evaluation of a Photovoltaic System with Lithium-Iron-Phosphate Storage: Modeling Using Local Irradiance, Wind Speed, Humidity, and Temperature DataMasinde Muliro University of Science & Technology,	Cornelius Masheti Lideli*, Francis Gaitho, Patrick Tonui,and James Owuor
08:30 – 08:50 am	Advanced Synthesis and Multimodal Characterization Of Methylammonium Lead Iodide Perovskite Thin Film For High-Efficiency Solar Cell Applications	Silas Abok*, Celine Omondi, Francis M. Gaitho and Maxwell J. Mageto Masinde Muliro University of Science and Technology,
08:50 – 09:10 am	A comparison investigation of an *ab initio* GGA+U and experimental study of the wurtzite structure of ZnO for dye-sensitized solar cells application	Kiprotich Sharon[1*], Irungu M. Kahura[1] and Jatani Ungula[2] [1]Murang'a University of Technology [2]Kenya Methodist University,
09:10 – 09:30 am	Assessment of Ambient Air Concentration of Ammonia at Major Refuse Waste Dump in Ebhoiyi Village along New Agbor Road Uromi, Edo State	Ugah Chukwuemeka Stanley*& Anyira-Fasanmi Mary Ifeoma National Institute of Construction Technology and Management Uromi, Edo State
09:30 – 09:50 am	A Generalization formula for a set of floor series, quadratic sequences, novel sequences and arithmetic sequences	Richard K. Kareri* and Peter Rugiri Kabarak University
09:50:10:10 am	Probable decay modes of superheavy nuclei and cluster radioactivity	Hezekiah CHEROP[1], Peter TANUI[2], Kenneth SIRMA[3], Dismas KIBOI[4] 1. Pwani University, 2. Kabarak University, 3. Maasai Mara University, 4. University of Eldoret
09:50 – 10:30	**TEA/COFFEE BREAK**	
10:30 – 12:30	Research Concepts & Proposals - Postgraduate Students	

ABSTRACTS FOR CONFERENCE ON PURE & APPLIED SCIENCES

ASSESSMENT OF ENVIRONMENTAL IMPACTS OF GEOTHERMAL POWER OPERATION IN TIATY EAST SUB-COUNTY, BARINGO COUNTY

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ABSTRACT

This study assessed the environmental and health impacts of geothermal power operations in Tiaty East Sub-county, Baringo County, Kenya, using statistically validated community perceptions. Mixed-methods involving structured questionnaires and key informant interviews with leaders and professionals were administered. Data were analyzed using SPSS Version 21.0, applying descriptive statistics and Chi-square tests of independence to determine associations between geothermal activities and reported outcomes. Statistical significance was evaluated at a 95% confidence level. Chi-square analysis revealed a statistically significant association between geothermal operations and perceived negative effects on vegetation, 69% of respondents reporting degradation. Mitigation efforts by stakeholders were largely deemed ineffective, 74% reporting no visible action and only 26% acknowledging partial efforts such as afforestation and soil restoration. A significant relationship was found between geothermal activities and compromised water quality and availability. Key concerns included water shortages, temperature rise, and contamination-related diseases. While 33% cited mitigation measures like water delivery and treatment, 64% reported these efforts had not yielded meaningful improvements. Health effects were similarly significant with 65% of respondents attributing increased illness to geothermal operations. The most reported conditions included respiratory diseases, malaria and cardiac illnesses. Although 34% mentioned interventions such as waste treatment and provision of mosquito nets, two-thirds (66%) found these efforts insufficient. These results indicate communities awareness of the specific environmental and health challenges posed by geothermal operations, the response by stakeholders remains inadequate. The high prevalence of vegetation loss, water scarcity, and illness underscores a gap between policy intentions and real impact. The statistical insignificance of mitigation strategies points to the need for better-resourced participatory and interventions. The study concludes, operations significantly affect vegetation, water resources and public health. Despite mitigation efforts, statistical insignificance underscores need for, community-led environmental and health interventions. The findings call for policy revision, stakeholder accountability and comparative studies in geothermal regions.

INVESTIGATION OF THE EFFECTIVENESS OF AN ADSORBENT FROM EGGSHELL IN REMOVAL OF LEAD FROM WATER

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ABSTRACT

Water plays a crucial role in the survival of living organisms. Unlike other substances, heavy metals cannot be easily degraded. Lead pollution in water brings about health problems and affects the food chain due to its bioaccumulation. To address this issue, there is need to find environmentally friendly, sustainable, and cost-effective methods to remove lead from water. One such method is through adsorption method of lead, which is both economical and effective. This study examined eggshell waste as an economical and environmentally friendly method for developing an adsorbent that adsorbs lead from polluted water. The focus is on optimizing various variables, including pH, contact time, and initial and final lead concentrations. Experiments were conducted to evaluate the effects of these factors. Lead concentrations were measured using a UV spectrometer following Beer-Lambert's law. The percentage of lead removal provided a quantitative measure of the eggshell's adsorption capacity. High-efficiency eggshell extracts are a promising, low-cost, and sustainable solution for water treatment, highlighting their significance. The eggshell waste was collected and cleaned using deionized water, then dried, crushed, and burned to obtain calcium oxide, which was then hydrolyzed to obtain calcium hydroxide. The addition of phosphoric acid yielded hydroxyapatite, and the further addition of carbon dioxide resulted in carbonated hydroxyapatite, which is responsible for the adsorption of lead ions from the solution. FTIR analysis was done on the eggshell powder to confirm the functional groups. A constant initial concentration of 10 mg/l was used for the whole experiment and the final concentration showed different positive results of a decrease in concentration with effects of time of contact and pH. With a pH of 5, it showed a high adsorption efficiency of 90% hence an optimum pH to work with. A pH of 7 and 10 showed adsorption efficiency of 75% and 50% respectively which is less effective as compared to a pH of 5. A decrease in concentration is observed as the time of contact increases. A time of 120 minutes showed the least concentration of 1.5 ppm and an adsorption efficiency of 85%. This suggests that the more time of contact, the more adsorption takes place. Adsorption isotherm was also studied using the data obtained between Langmuir and Freundlich models. The Langmuir model showed a better linear curve as compared with the Freundlich model.

ANTIFUNGAL POTENTIAL OF SOLANUM NIGRUM EXTRACTS OF ETHANOL AND METHANOL AGAINST *CANDIDA ALBICANS*

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ABSTRACT

The rise of antifungal resistance, particularly among opportunistic pathogens like *Candida albicans*, presents a significant global health concern, necessitating the exploration of alternative, natural therapeutic agents. Medicinal plants have historically served as a rich source of bioactive compounds

with antimicrobial properties. *Solanum nigrum* (black nightshade), a plant extensively used in traditional medicine, has been reported to contain a variety of phytochemicals with potential pharmacological activities. This study aimed to evaluate the antifungal efficacy of ethanol and methanol extracts of *S. nigrum* leaves against *C. albicans*, and to assess the phytochemical composition of the plant. Fresh leaves of *S. nigrum* were collected, thoroughly cleaned, shade-dried to preserve sensitive compounds, and ground into a fine powder. Soxhlet extraction was employed using ethanol and methanol as solvents to obtain concentrated leaf extracts. The antifungal activity of each extract was tested using the disc diffusion method on Sabouraud Dextrose Agar inoculated with *C. albicans*. Zones of inhibition were measured in millimeters to quantify antifungal activity. Additionally, qualitative phytochemical screening was performed to identify the presence of key secondary metabolites. The results demonstrated that both ethanol and methanol extracts of *S. nigrum* exhibited antifungal activity against *C. albicans*, with the methanol extract producing a significantly larger zone of inhibition. Phytochemical screening revealed the presence of alkaloids, flavonoids, tannins, saponins, and glycosides compounds known for their antimicrobial properties. The greater efficacy of the methanol extract suggests that solvent polarity influences the extraction of active antifungal constituents. These findings support the potential use of *S. nigrum* as a natural source of antifungal agents and reinforce the value of traditional medicinal plants in addressing the challenge of antifungal resistance. Further research is recommended to isolate, purify, and characterize the specific bioactive compounds responsible for the observed antifungal activity, and to evaluate their safety and efficacy through in-vivo studies and clinical trials.

Concentration	Ethanol Extract (mm)	Methanol Extract (mm)	Positive Control - Fluconazole (mm)
0.02 mg/ml	7.50 – 11.47 (Median = 9.49)	11.42 – 13.98 (Median = 12.70)	34.2 – 37.34 (Median = 35.77)
0.04 mg/ml	11.48 – 15.35 (Median = 13.42)	16.95	35.77
0.06 mg/ml	16.91 – 20.45 (Median = 18.68)	18.96	35.77
0.08 mg/ml	21.33 – 25.93 (Median = 23.63)	26.17	35.77

CHEMICAL ANALYSIS OF ORGANOPHOSPHATE AND PYRETHROID RESIDUES IN *BRASSICA OLERACEA VAR. ACEPHALA* AND *CITRUS SINENSIS* AND THEIR IMPACT ON FOOD SAFETY

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ABSTRACT

The growing concerns over food safety and security have highlighted the need for comprehensive studies on pesticide residues in agricultural produce. This study aimed to analyze pesticide residue levels in collard greens and oranges collected from local markets in Rafiki and Nakuru Wakulima market. The primary focus was on detecting carbamates, pyrethroids, and organophosphates using

a UV-VIS spectrophotometer. The study followed an experimental design, involving laboratory-based extraction and analysis procedures. Fresh samples of collard greens and oranges were meticulously collected, labeled, and processed to ensure the elimination of contaminants. The samples were chopped, dried, and blended into powder, and subjected to maceration extraction using ethanol. The extracts were concentrated via rotary evaporation and subsequently analyzed for pesticide residues. Beer-Lambert's law was applied to quantify the pesticide concentrations in the samples. Descriptive statistics was used to summarize the data, furthermore, t-tests and ANOVA were used to identify significant differences in pesticide residue levels across the two locations and sample types. This study aims to provide valuable information into the presence and concentration of pesticide residues in commonly consumed vegetables and fruits, thereby contributing to food safety and public health initiatives. These findings are expected to inform agricultural practices to ensure safer food supply chains.

Keywords: Pesticide Residues, the health impact of pesticides, pesticides analysis, collard greens, oranges

SYNERGISTIC EFFECT OF PHOTOCATALYSIS AND PHOTO-FENTON PROCESSES IN SOL-GEL FABRICATED CO-SNO$_2$ THIN FILMS FOR WATER TREATMENT

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ABSTRACT

Urbanization and global population growth have led to an increase in water pollution, posing significant threats to both ecological systems and public health. The rising demand for effective water treatment technologies has driven the exploration of innovative materials and hybrid techniques. Among these, photocatalysis stands out as a cost-effective and sustainable approach due to its utilization of abundant photon energy. Tin(IV) oxide (SnO_2) has garnered considerable attention in the field of photocatalysis due to its chemical stability and non-toxic nature. However, its wide band gap and rapid electron–hole recombination limit its photocatalytic efficiency. To overcome these limitations, strategies such as cobalt (Co) doping and the integration of Photo-Fenton processes have been employed. In this study, nanocrystalline SnO_2 thin films both undoped and Co-doped at varying concentrations (1%, 3%, 5%, 7%, and 10%) were successfully synthesized using the sol-gel method. Optical properties of the fabricated films were studied using a UV-Vis spectrophotometer in the 300–2500 nm range. Results showed that the band gap of pure SnO_2 was effectively narrowed to approximately 3.1 eV upon Co doping. The photocatalytic degradation of Methylene Blue dye was systematically evaluated using Co–SnO_2 catalysts, both independently and in combination with Fe^2 /H_2O_2 under UV irradiation. The results indicated that Co-doped SnO_2 integrated with the Photo-Fenton process exhibited the highest photocatalytic efficiency compared to undoped SnO_2.

Keywords: Photocatalysis, Photo Fenton, Sol gel, Tin iv oxide, doping, optical properties.

PERFORMANCE EVALUATION OF A PHOTOVOLTAIC SYSTEM WITH LITHIUM-IRON-PHOSPHATE STORAGE: MODELING USING LOCAL IRRADIANCE, WIND SPEED, HUMIDITY, AND TEMPERATURE DATA

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ABSTRACT

Solar energy is the most abundant source on earth but transforming it to electrical energy more efficiently has remained the subject of research to date. Photovoltaic (PV) modules that do this task depend on the amount of irradiance received, which varies from one region to another. Other factors, majorly, environmental, affect the power the PV modules produce. These factors simultaneously influence the module efficiency but the number being studied in a given geographical region varies significantly in literature. This research gap informs the need to study the combined effect of these factors in least explored regions. The intermittent nature of solar energy necessitates a storage device like a Lithium-ion battery to supply energy when the irradiance drops significantly. This research aims to examine the effect environmental factors, particularly irradiance, humidity, wind speed, and ambient temperature, have on the efficiency of a PV system with Lithium-Iron Phosphate storage. The research specifically modeled a PV system in Simulink with the stated factors as inputs and PV array, inverter, and battery as the major blocks for calculating the system's efficiency. This research used historical data of the four factors as inputs of the model to obtain the system's power for its efficiency calculation. Here, their interrelation was considered to determine the two variables of a Simulink's PV array block using Matrix Laboratory (MATLAB)'s ridge regression. The research also used the performance of a selected PV system over the data collection period to validate the model. The system's efficiency from the field data was found to be 22.06% against 22.26% from the manufacturer's specifications. Simulink's efficiency was 21.55%. The System's data gave an efficiency of 96.82% for the battery and 77.92% for the inverter. There is a minimal difference between the theoretical and experimental data for the PV system.

Keywords: Irradiance, Cell temperature, Humidity, Wind speed, MATLAB, PV system, Efficiency

ADVANCED SYNTHESIS AND MULTIMODAL CHARACTERIZATION OF METHYLAMMONIUM LEAD IODIDE PEROVSKITE THIN FILM FOR HIGH-EFFICIENCY SOLAR CELL APPLICATIONS

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ABSTRACT

Methylammonium lead iodide ($MAPbI_3$) perovskites have emerged as a transformative class of materials for next-generation photovoltaic technologies, owing to their exceptional optoelectronic properties, including a high absorption coefficient (>10^4 cm^{-1}), tunable direct bandgap (~1.52 eV), and compatibility with low-temperature, solution-based fabrication methods. Despite their remarkable

potential, the widespread commercialization of perovskite solar cells (PSCs) remains hindered by intrinsic instability under environmental stressors (e.g., moisture, heat, and light) and suboptimal power conversion efficiencies (PCEs) arising from defects in polycrystalline films. This study systematically addresses these challenges by optimizing the synthesis and post-deposition processing of $MAPbI_3$ thin films fabricated via a one-step spin-coating technique. Key innovations include anti-solvent engineering with chlorobenzene to enhance crystallinity as it improves solvent extraction kinetics, leading to a denser and more homogenous film with fewer defects and a two-stage annealing protocol (60°C for 10 min, followed by 100°C for 30 min) to allow for the gradual solvent evaporation and controlled crystal growth thereby minimizing pinhole defects and improve charge carrier mobility. Structural characterization via X-ray diffraction (XRD) confirmed the formation of phase-pure tetragonal perovskite crystals with preferential (110) orientation, UV-Vis spectroscopy demonstrated strong broadband absorption across the visible spectrum (400–800 nm), corroborating the material's suitability for sunlight harvesting and SEM unveiled the morphological properties of the film while JV scan analysis depicted the electrical performance of the device. Fabricated device exhibited a champion PCE of 13.9%, an open-circuit voltage (Voc) of 1.02 V, and a fill factor (FF) of 63.8%, representing a 22% improvement over non-optimized counterparts. Critically, stability assessments under controlled ambient conditions (25°C, 30% relative humidity) revealed that treated devices retained >80% of their initial efficiency after 500 hours, underscoring the efficacy of the proposed processing strategies. This work explicates the interplay between anti-solvent selection, annealing kinetics, and film morphology, providing actionable insights for scalable, high-performance PSC production.

Keywords: Perovskite solar cells, $MAPbI_3$, Spin coating, Characterization Techniques, Python

A COMPARISON INVESTIGATION OF AN *AB INITIO* GGA+U AND EXPERIMENTAL STUDY OF THE WURTZITE STRUCTURE OF ZNO FOR DYE-SENSITIZED SOLAR CELLS APPLICATION

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ABSTRACT

Zinc oxide (ZnO) is an extensively utilized, versatile compound implemented in a diverse scope of technological applications. In dye-sensitized solar cells (DSSCs), the attainable nanostructures, inherent transparency and tunable electronic properties of ZnO can be integrated to confer high level device properties. ZnO is a complex compound with substantial and intricate defect chemistry and its properties are exceptionally sensitive to the functional utilized in the computing and experimental processes. Consequently, engineering of the band edges in Wurtzite ZnO (W-ZnO) for DSSCs application has not yet been exhausted. The W-ZnO was synthesized using sol-gel method while the computations were performed using density functional theory (DFT) as implemented in the Quantum ESPRESSO code. The generalized gradient approximation with Perdew-Burke-Ernzerhof was utilized as the exchange correlation functional. Investigations of the structural, electronic and optical properties of W-ZnO were carried out using both computational and experimental techniques. The structural

properties of the materials have been found to be consistent with previous observations in literature with a slight decrease in lattice parameters in the DFT+U calculations. W-ZnO was observed to display a direct band gap at gamma. The energy band gaps of, 0.79 eV, 1.45 eV, 3.19 and 3.33 eV in the standard DFT, DFT + U_d , DFT+U_d +U_p calculations and experimental values were obtained respectively. Generally, W-ZnO was found to have low absorption ability and high transmittance in the visible spectrum which were in close correlation with the experimental values obtained which therefore make them suitable candidates for DSSCs application.

ASSESSMENT OF AMBIENT AIR CONCENTRATION OF AMMONIA AT MAJOR REFUSE WASTE DUMP IN EBHOIYI VILLAGE ALONG NEW AGBOR ROAD UROMI, EDO STATE

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ABSTRACT

The study monitored the presence of ammonia level in the ambient air at major refuse waste dump in Ebhoiyi along New Agbor road Uromi Edo State, Nigeria. From the analysis, the ammonia ambient air concentration was monitored during morning hours for a period of two week at the onset of wet and dry season. The ammonia air concentration was measured using a portable monitor equipped with an electrochemical sensor for the data collection. The result obtained after the two weeks analysis showed that dry season had a relatively high mean ammonia concentration of 0. 18 ± 0.002 (ppm) as against 0.13 ± 0.002 (ppm) for wet season, while the corresponding minimum value were 0.09 ± 0.001 and 0.04 ± 0.002 (ppm) for dry and wet season respectively. This high concentration of ambient air ammonia recorded during the dry season may be attributed to high dumped refuse waste at the site during dry season unlike wet season, because 60 – 75% of Uromi resident majorly dumped their refuse waste in the water – ways during raining season. Although, despite the high concentration of ammonia during dry season, the result obtained did not exceed the Nigeria Federal Government of National Environmental Standards and Regulation Enforcement Agency (NESREA) of ammonia, since there is no international guideline for ammonia as at today.

Keywords: Uromi, Air, Ammonia (NH_3), Refuse dumpsite, Portable Gas-monitor

A GENERALIZATION FORMULA FOR A SET OF FLOOR SERIES, QUADRATIC SEQUENCES, NOVEL SEQUENCES AND ARITHMETIC SEQUENCES

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ABSTRACT

In this paper we explore generalized arithmetic sequences; we first begin by algebraically describing the sequences, then proceed to extend these results to describe particular set of floor series, some novel sequences and quadratic sequences. Using the floor function, we demonstrate that it can be used to create a formula for basically any linear generalized arithmetic sequence. Additionally, we show that the derived formula in its simplest form, elegantly boils down to an arithmetic sequence. These results provide new insights in the understanding of generalized arithmetic sequences; this will enable a broader and more intuitive modeling for applications in combinatorics, number theory (sum of divisors and prime number distribution), cryptography and computer science.

PROBABLE DECAY MODES OF SUPERHEAVY NUCLEI AND CLUSTER RADIOACTIVITY

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ABSTRACT

Cluster radioactivity is a very rare phenomenon. Among the various parameters that may determine the cluster radioactivity or cluster decay, the most important parameters are the binding energy B(A,Z) of the parent nucleus and the binding energies of the nuclei that constitute the decay products. These parameters are crucial in determining the nuclear reaction energies (Q-values). Calculations for Q-values for even-even super heavy nuclei whose atomic numbers (Z) range from Z=100 to Z=124 were computed and the sign of the quantity of Q-values were used to determine whether the super heavy nuclei could undergo cluster radioactivity. The modified Bethe-Weizsäcker formula was used to calculate the binding energy of the nuclei involved in the cluster radioactivity, and the Coulomb energy was calculated using the modified Coulomb energy formula. It was found that nuclei whose Q-values are positive but relatively small fall under the category of super heavy nuclei which undergo cluster radioactivity while those nuclei whose Q-values are very high are significantly unstable, thus, they release energy that is sufficient to cause spontaneous fission. It is also noted that all the parent nuclei whose atomic numbers lie between Z=100 to Z=124 satisfy the conditions for spontaneous

fission, however, for Z>124 the possibility for spontaneous fission diminishes. Based on our results, we conclude that nuclei with very high Q-values are significantly unstable, and the energy released is sufficient to cause spontaneous fission. Additionally, the boundary between cluster radioactivity and spontaneous fission remains elusive and an open question.

Keywords: Cluster radioactivity, Binding energy, Modified Coulomb interaction, Nuclear reaction energy, Super heavy nuclei.

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Moral Code As members of Kabarak University family, we purpose at all times and in all places, to set apart in one's heart, Jesus Christ as Lord. (1 Peter 3:15)