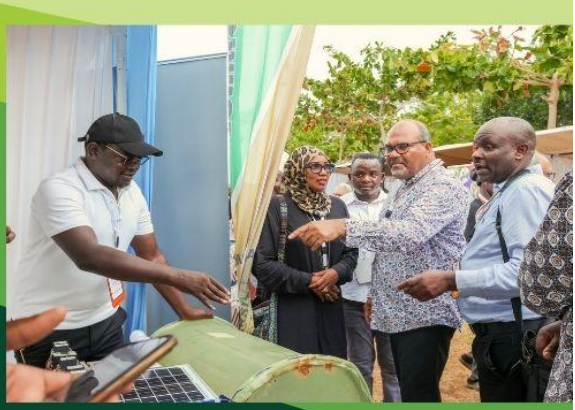
Technical University of Mombasa

BOOK OF ABSTRACTS

Transforming Lives through Research, Innovation, and Sustainable Partnerships



7TH MULTIDISCIPLINARY CONFERENCE & INNOVATION WEEK – 2026

13th to 16th April 2026 Mombasa Kenya

7TH TECHNICAL UNIVERSITY OF MOMBASA MULTIDISCIPLINARY CONFERENCE & INNOVATION WEEK

Venue: Technical University of Mombasa (TUM)
Date: 13th - 16th April 2026

FOREWORD

It is my pleasure to welcome you to the 7th Multidisciplinary Conference and Innovation Week at the Technical University of Mombasa. This conference comes at a significant time in the University's growth. The establishment of the School of Medicine marks a major milestone in strengthening our capacity in health sciences, while our expanding and diverse research portfolio continues to address pressing societal and global challenges across multiple disciplines.

The abstracts presented reflect the strength and diversity of research at TUM. They highlight advancements in digital transformation and artificial intelligence, contributions to health and wellness, innovations in industry and manufacturing, and strong focus areas in sustainability, the blue economy, and climate resilience. They also offer important insights across education, policy, business, and the humanities, demonstrating the value of multidisciplinary approaches to solving complex challenges.

This conference is particularly timely as Mombasa prepares to host the Our Ocean Conference (OOC11) in 2026, positioning our region as a key player in global ocean and climate discourse. The work presented here reflects the University's growing contribution to these global priorities.

I commend all contributors, reviewers, and organisers for their dedication and encourage participants to engage actively and build meaningful collaborations.

I wish you a productive and enriching conference.

Prof. Laila Abubakar
Vice Chancellor
Technical University of Mombasa

ACKNOWLEDGEMENTS

The Organising Committee of the 7th Multidisciplinary Conference and Innovation Week at the Technical University of Mombasa expresses profound gratitude to all who contributed to the success of this milestone event.

We extend our heartfelt thanks to our sponsors for their generous financial and logistical support, which made this conference possible. Your commitment to fostering innovation and research is truly appreciated.

We also acknowledge our esteemed partners and collaborators for their invaluable contributions to the conference program, which has enriched the dialogue and collaboration across disciplines. Your dedication to advancing knowledge is commendable.

A special mention goes to the various ad hoc Committees whose tireless efforts ensured the conference's quality and seamless execution. Your attention to detail and hard work did not go unnoticed.

Lastly, we would like to thank all the participants, presenters, and attendees. Your engagement and enthusiasm are what make this conference a vibrant platform for interdisciplinary collaboration and innovation. Together, we are shaping the future through knowledge and creativity.

CONFERENCE EXECUTIVE COMMITTEE

Prof. Laila Abubakar	Vice Chancellor
Prof. Peter Gichangi	DVC, Academics, Research and Innovation
Prof. Joseph Rasowo	DVC, Administration, Finance and Planning
Prof. Rahma Udu	Registrar, Partnerships, Research and Innovation

Organizing Committee

Prof. Rahma Udu
Dr. Shivan Patel
Dr. Cromwell Kibiti
Dr. Wanyenda Chilimo
Prof. Huxley Makonde
Dr. Samson Kitheka
Dr. Madiha Salim
Dr. Sameer Bachani
Dr. Fullgence Mwakondo
Dr. Sylvia Mutua
Dr. Mathew Egessa
Dr. Michael Munywoki
Dr. Kevin Tole
Ms. Susan Wanjiru
Prof. Cosmas Munga
Prof. Anwar Hood
Dr. Mariam Swaleh
Dr. Victor Jeza
Dr. Mvurya Mgala
Dr. Aly Tadudi
Dr. Umulkulthum Yeya
Dr. Mohammed Swaleh
Mr. Aggrey Shitsukane
Ms. Muzny Muses
Mr. Salim Chiro
Mr. Swaleh Abubakar
Ms. Bibiye M. Juma
Mr. Kassim Ziro
Mr. Douglas Ananda
Mr. David Kariuki
Mr. Victor Kambi
Ms. Lubna Abdulhalim
Ms. Emily Miano
Ms. Ruth Dama

Table of Contents

CONFERENCE INFORMATION

Background

The 7th Multidisciplinary Conference and Innovation Week at the Technical University of Mombasa takes place at a pivotal moment, as global challenges such as climate change, public health crises, and technological advancements demand collaborative solutions. By bringing together diverse fields of expertise, this conference embodies the spirit of innovation and collective problem-solving essential to addressing today's complex societal issues.

Objectives

- Showcase cutting-edge research and innovations across key thematic areas.
- Promote interdisciplinary collaboration among academia, industry, and policymakers.
- Strengthen partnerships that address pressing global challenges.
- Support early-career researchers and students in their professional development.

Theme

Transforming Lives Through Research, Innovation and Sustainable Partnerships

Sub-Themes

i. Digital Transformation, Automation and Emerging Technologies
ii. Sustainable Environment, Blue Economy and Climate Resilience
iii. Health, Wellness and Society in the 21st Century
iv. Research and Innovation in Industry and Manufacturing
v. Business, Economics and Entrepreneurship
vi. Humanities, Culture, Arts and Society
vii. Education, Policy and Global Collaboration

CHIEF GUEST

Prof. Shaukat Abdulrazak

Principal Secretary for Science, Research and Innovation, State Department for Science, Research and Innovation, Office of the Prime Cabinet Secretary, Republic of Kenya.

Biography

Prof. Shaukat Abdulrazak is the Principal Secretary for Science, Research and Innovation at the State Department for Science, Research and Innovation, Office of the Prime Cabinet Secretary, Republic of Kenya. Before his appointment to the State Office, Prof. Shaukat Abdulrazak was the Director of the Division for Africa at the International Atomic Energy Agency (IAEA) Technical Cooperation. In this capacity, he facilitated IAEA technical cooperation support to 50 countries in Africa in the peaceful use of nuclear technology (including Human health, Agriculture, industry, and energy). Before joining the IAEA, Prof. Shaukat worked as CEO at the Kenya National Commission for Science, Technology and Innovation (NACOSTI). He has more than 30 years working experience at various leadership positions including Professor and DVC (Research and Extension) at Egerton University and VC at Umma University, Chairman and Member of National and International boards, including the Chair of Kenya Marine and Fisheries Research institute, African Technology Policy Studies, member of the Kenya National Economic Social Council, Commissioner at the African Commission on Nuclear Energy and the International Centre for Genetic Engineering and Biotechnology. Member of the Kenya Medical Research Institute and the National Cancer Institute.

Prof. Shaukat is a Fellow of the International Science Council, The World Academy of Sciences, and the African Academy of Sciences. He is decorated with the Presidential award, MBS, and EBS. He has published widely in international journals, scientific conferences, and symposia proceedings. His undergraduate studies were at Egerton University, Kenya. Abdulrazak obtained his Master of Science and PhD degrees from the University of Aberdeen, UK; a Postgraduate Diploma in Innovation and Change from York University, UK; and a Postdoctoral Fellowship from Shimane University, Japan.

KEYNOTE SPEAKERS

HE Maj (Rtd) Dr. Dhadho Gaddae Godhana

Is the governor of Tana River County. He entered active politics in 2007 and was first elected to public office as a member of the 10th parliament for the Galole Constituency. During his tenure, he served as Assistant Minister in the Department of Livestock Production and in the Ministry of Information and Communication. His first order of service was in the Department of Defence in the armed forces of the Republic of Kenya, where he served to the rank of Major and, as head of Human Resources, at his retirement. During his time in the Army, he served as Major (Battalion Environment Officer) and Major (Battalion HIV/AIDS Coordinator). He is also a holder of several diplomas in military leadership, command, and management courses. He has served successfully in the Kenyan military, rising to the rank of Major, and has also served in the United Nations Peace Mission, the UN Protection Force in the former Yugoslavia.

He holds two bachelor's degrees: one in Security Management from San Juan University in Mexico and one in Development Studies from the Kimmage Development Study Centre in Ireland. He holds a Master of Arts Degree in Corporate Leadership and Governance from San Juan De La Cruz University in Mexico and a Master of Arts Degree in Development Studies from Mexico State Du Vale University. He also holds two Doctorate Degrees (Honoris Causa) in Public Administration (PDA) from the London Graduate School and in Leadership and Management from the London Bridge School of Business Studies.

In His Excellency's administration as Governor, he brings with him a long-standing leadership and exemplary discernment on the disconnect between the government actions, the people's participation as key development actors, and the absence of coordinated exploitation of natural resource potential by the two actors (Government and the people) Dr. Godhana is a paragon of transformational cutting edge purpose driven leadership and a beacon of the Pan-African vision. He embodies the Spirit of Africa and carries deep, rare knowledge, with a vast range of local and international governance experience.

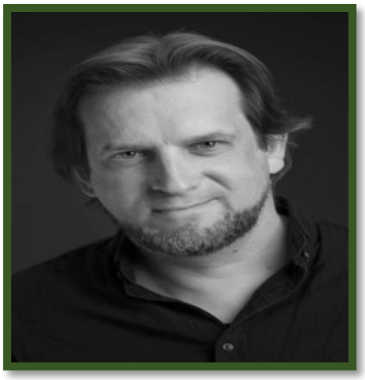
He is a leader in human development, peacebuilding, and cohesion, and has led the county of Tana River in adopting unique human development and transformative programs that, over the last decade, have laid a foundation for economic development and growth for the people of Tana and the country at large. He is the Author of the book, **The Fundamental Principles of Nation Building, and founder of The Chronicles of Tana River County's Rich Heritage,** now **The Heritage Magazine**. He is also the founder and CEO of the Green Village Initiative/ The Green Village Empowerment Foundation (GVEF).

Dr. Emmanuel Kombe Nzai

Emmanuel Kombe Nzai is the Chairman of the Kenya Vision 2030 Board, charged with guiding and coordinating the strategic implementation of Kenya's long-term national transformation agenda (Kenya Vision 2030) - www.vision 2030.go.ke. Currently, at its final Medium-Term Plan (MTP4, 2023 2027), a Presidential appointee, Mr Nzai, is guiding the countdown actions of the President's Manifesto – Bottom Economic Transformation Agenda within the Kenya Vision 2030 successive national plan – Kenya Vision 2063 (Kenya@100). He is a seasoned Economic Development and Policy professional, bringing in over 20 years of executive management
experience in both the public and private sectors in Kenya and the USA.

Nzai is the founding CEO of the Jumuiya Economic Development Secretariat, a regional economic development agency representing Kenya's six coastal counties (www.jumuiya.org). He also played a pivotal role as the initiator and advisor of the EUR 25 million Go Blue Project, which focuses on advancing the blue economy in Kenya - www.goblue.co.ke

His previous leadership positions include serving as the first Executive Officer of the Kenya Vision 2030 Delivery Secretariat and founding Linkagepoint LLC, a strategic advisory firm based in Washington, D.C. Nzai is respected national political leader who vied for Deputy President in Kenya (Ekuru-Nzai 2017). He holds an MBA in Information Technology and Public Administration from Shenandoah University, Virginia, and an Honorary Doctorate in Development Economics from London Bridge University, UK.



Dr. Andrzej Cichocki (PhD)

Director, screenwriter, cinematographer, camera operator, producer

Andrzej Cichocki (PhD) is an accomplished filmmaker, director, screenwriter, cinematographer, camera operator, and producer whose work has received international recognition and critical acclaim.

His films have earned over 40 awards and been recognised at prestigious festivals worldwide, including the Krakow Film Festival, the Rhode Island International Film Festival (Oscar-accredited), Camerimage, the Warsaw Jewish Film Festival, and many others. His documentary "*A Little Bit of Paradise*" premiered in competition at IDFA in Amsterdam, one of the world's most renowned documentary film festivals.

Throughout his career, he has collaborated with renowned artists and award-winning filmmakers, including Sławomir Idziak, Jolanta Dylewska, Detlev Buck, Jerzy Hoffman, Krystyna Janda, Marek Żebrowski, and Andrzej Jakimowski.

He is a graduate of the Krzysztof Kieslowski Film School, where he completed both his master's thesis titled "*Freedom and Rigor of Narration. Creative Aspects of the Cinematographer's Workshop in the Film Story*" and his doctoral thesis "*The Art of Film as Symbolic Form. Cassirerian Influences*". He also studied photography at the Association of Polish Art Photographers and pursued studies in management, marketing, and vocal performance.

In addition to his filmmaking work, he is a lecturer in directing and cinematography at the Krzysztof Kieslowski Film School and has served as a guest lecturer at Staffordshire University and the Warsaw Film School. He promotes interdisciplinary teaching approaches that embrace new technologies and modern educational models.

Beyond film, he is active in music as a songwriter, lyricist, and performer, and is also engaged in artistic photography. He runs his own film production company, serves on film festival juries, and writes on art-related topics. He is a member of the Polish Filmmakers Association.

"*Cinema is not the audience, festivals, reviews, interviews. It's waking up at six in the morning every day. It's cold, rain, mud and heavy lamps. It's a nervous job, to which everything has to be subordinated at some point*" – Krzysztof Kieślowski

"*I'd rather people feel a movie before understanding it*" – Robert Bresson

"*To shoot a film is to organize an entire universe*" – Ingmar Bergman

Prof. Jones Fairfax AGWATA, PhD

Environmental Scientist and Policy professional

Prof. Jones Fairfax AGWATA, PhD, is a career Environmental Scientist and Policy professional with over thirty years' experience as a University Lecturer, Trainer, Researcher and Consultant. He is an Associate Professor in the Department of Environmental Sciences at Machakos University, Kenya and has recently completed his tour of duty as the Director for Research, Innovation and Technology Transfer in the University.

Prof. Agwata holds a Doctor of Philosophy, PhD (PhD) in Environmental Science, a Master of Philosophy (MPhil) in Environmental Studies, and a Bachelor of Science (BSc) from Kenyatta University, MOI University, and the University of Nairobi, respectively.

His broad areas of academic, professional and research interests are in Disaster Management, Climate Change, Environmental Assessment, Water Resources Management, Project Management and Natural Resources Use Conflicts. He holds a Research Fellowship at the American Biographical Institute, USA and a Fellowship at the African Scientific Institute. He is also a Life Member of the Kenya Meteorological Society, besides holding memberships at the Kenya National Academy of Sciences, Scientists of Kenya Association, International Society for Development and Sustainability, Japan; International Association of Hydrological Sciences, UK; Kenya DAAD Scholars Association and the Environment Institute of Kenya.

Prof. Agwata serves on the Kenya Bureau of Standards' Disaster Management, Environmental Management and Higher Education Services Technical Committees and is the immediate former Chair of the Board of Management at State House Girls High School, Nairobi. He has attended several courses and presented papers at various international and national conferences and workshops. In addition to several Book chapters and Articles in refereed Journals to his credit, Prof. Agwata is a Lead Expert with the National Environment Management Authority, Kenya, and a qualified Quality Management Systems Auditor.

He has travelled widely to various countries, including South Sudan, the United Arab Emirates, China, Uganda, Tanzania, Ethiopia, Zambia, Malawi, Zimbabwe, Namibia, Germany and Switzerland, for various consultancy and professional engagements.

Prof. Michael J. Saulo, PhD

Associate Professor & Renewable Energy Researcher

Prof. Michael J. Saulo holds a PhD in Electrical Power and Energy Systems from the University of Cape Town, South Africa (2014). He is a former Registrar in charge of Partnership, Research and Innovation at the Technical University of Mombasa (TUM). Prof. Saulo is a career researcher and Associate Professor who has supervised and graduated numerous postgraduate students at both MSc and PhD levels.

With over 80 publications in peer-reviewed journals and more than 1,000 citations, Prof. Saulo has made significant scholarly contributions to renewable energy. He coordinates the Renewable Energy and Climate Change Research Center (RECCReC), which runs several national and international projects focused on renewable energy and climate action.

His research focuses on renewable energy system design, modelling, and analysis, with a strong emphasis on green energy transition, clean energy access, and efficiency in rural electrification.

Prof. Saulo will be a keynote speaker during the 7th Multidisciplinary Conference in April 2026. His keynote topic will be **"Green Energy Transition"**, which explores the global shift from fossil-based energy systems to renewable and carbon-neutral sources such as solar, wind, and geothermal energy in pursuit of Net Zero emissions by 2050 and limiting global warming to 1.5°C.

FULL CONFERENCE PROGRAM

DAY 1: Conference Opening & Keynote Addresses - Assembly Hall

TUESDAY 14TH APRIL 2026		
Time	**Activity**	
08:00 – 08:30 am	Registration and Arrival of Guests	Conference Secretariat
9:00- 9:10 am	Opening Ceremony National Anthem East African Anthem Prayers – Dr. Suleiman Mzee Rev Julius Nudi	MC – Dr. Madiha Salim
9:10- 9:20 am	Opening Remarks	Prof Rahma Udu Yusuf Registrar-Partnership, Research & Innovation
9:20 - 9:30 am	Welcome Address	Prof. Joseph Rasowo Deputy Vice Chancellor Administration, Finance & Planning
09:30- 9:40 am		Prof Peter Gichangi Deputy Vice Chancellor Academics, Research and Extension
09:40- 10:00 am		Prof. Laila Abubakar Vice Chancellor
10:00- 10:15 am		Dr. Emmanuel Nzai Chairman of the Kenya Vision 2030 Board, CEO Jumuiya ya Kauti za Pwani Secretariat

10:15- 10:35		Dr. Dhadho Godana Gov. Tana River County, Chair Jumuiya ya Kaunti za Pwani (JKP)
10:35 – 11:15 am	Official Opening of Multidisciplinary Conference and Innovation Week Chief Guest:	Prof. Shaukat Abdulrazak Principal Secretary (PS) for the State Department for Science, Research and Innovation in the Office of Prime Cabinet Secretary
11:15 - 11:05 pm	Vote of Thanks	BEN-K Hub
11:05 - 11:15 am	*Photo Session*	
11:30 am – 12:15 pm	Keynote Speech	Dr. Andrzej Cichocki University of Silesia in Katowice, Poland
12:30 – 1:30 pm	**Lunch Break & Poster Session**	**Assembly Hall**

2:00 – 5:00 pm	**POSTER PRESENTATIONS**
VENUE- ASSEMBLY HALL	
ZONE A **SUSTAINABLE ENVIRONMENT, BLUE ECONOMY & CLIMATE - SEBC** **HEALTH, WELLNESS & SOCIETY – HWS** **RESEARCH & INNOVATION IN INDUSTRY AND MANUFACTURING- RIIM** **Dr. Lawrence Mukkhongo** **Dr. Helen Kiti** **Dr. John Kahindo**	
Abs. No.	Title
SEBC-03	Moses Karema Mlewa, Kevin Tole Optimizing Fish Stock Assessment Using AI: A Novel Model to Enable a Sustainable Blue Economy in Coastal Kenya
SEBC-04	Faith Nicolyn Achieng Gwada Fuzzy Hybrid Machine Learning System for Automated Fish Quality Grading

SEBC-06	Clara Nasimiyu Mutoto, Joana Hancock, Cosmas Nzaka Munga Assessing Size-Class Differences in Habitat Selectivity of Green Turtles (Chelonia Mydas) in Relation to Depth Ranges and Substrate Types in Diani, Kenya
SEBC-07	Lawrence Majaliwa Katana, Dr. Ali Shee, Dr. Aloice Ogweno Green Synthesized Silver Nano-Catalysts for Treatment of Synthetic Textile Dyes in Water: System Analysis and Optimization
SEBC-08	John Ngatia Ndarathi, Cosmas Nzaka Munga, Huxley Mae Makonde, Levy Otuoma, Marc Kochzius Ecological and Operational Drivers of Catch Diversity in Kenya's Small-Scale Reef Fisheries: Implications for Blue Economy Management
SEBC-15	Bornvince O. Odhiambo, Eric Jobunga, Sameer Kamrudin Bachani, Gideon Kidegho Integrated Climate, Land, Energy and Water Analysis for Sustainable Resource Management in the Lake Victoria Water Basin, Kenya
SEBC-17	Antony Kamau Ngaruiya MSc Climate Smart Agriculture (Cassava Study – Murang'a County)
SEBC-18	Bornvince O. Odhiambo, Eric Jobunga, Sameer Kamrudin Bachani, Gideon Kidegho Soiling Loss Quantification of Rooftop Mounted Solar Module in Mombasa Using Digital Imagery Techniques
SEBC-19	Benard Kioko, Mariam Swaleh The Role of Sargassum Seaweed in Sustainable Cosmetic Products
HWS-02	David Jason Asol, Eric Mugambi Kinyua, Dorca Nyamusi Stephen Modeling Measles Transmission Dynamics with Vaccination and Treatment Strategies Among Children Under Ten Years in Kwale and Kilifi Counties
HWS-03	Walicho Morgan Wedikhe Mathematical Modelling of Tuberculosis Dynamics with Control Measures
HWS-04	Emmanuel Wafula Wangila, Franciscah Wakonyo Karanja Smart Surveillance: Using Mobile Technology for Early Microbial Outbreak Detection in Kenya
HWS-05	Edward Kaingu Mwakizani Narrative-Informed and Culturally Responsive Psychosocial Interventions for Suicide Prevention in Resource-Constrained Settings
HWS-06	Peter Njau Mbogo One Health Youth Empowerment & Resilience (OH-YER) Initiative to Mitigate Alcohol Use Disorders (AUD) in Rural Kenya
HWS-07	Humphrey Mwadziwe Mwinga AI-Driven Digital Twin for Personalized Healthcare and Predictive Medicine: A Case Study on Epilepsy Management
HWS-09	Abdulqadir Mohamad Suleiman Occupational Health Burden and Sustainability
RIIM-01	Sharon Nyokabi Wamugunda On Quotient Rings of Pointfree Function Rings
RIIM-02	Moses Karema Mlewa, Kevin Tole Convex Optimization Frameworks for Equitable Water Rationing using Data Enabled Predictive
RIIM-03	Valentine Wabwire Muramba, Jakie Nel, Abdulraooff Ali Synthesis and Electrical Characterisation of Beta-Gallium Oxide for Schottky Diode Fabrication and Solar Cell Passivation

RIIM-04	Kevin K. Tole Multidisciplinary Journal of Technical University of Mombasa on the right path towards indexing
RIIM-05	Wilson Leonidas Mahene and Thomas Kivevele From Agricultural Waste to Industrial Catalyst Supports: Valorizing Rice Husk Biochar for Sustainable Green Diesel Production

VENUE – ASSEMBLY HALL

ZONE B
DIGITAL TRANSFORMATION, AUTOMATION, AND EMERGING TECHNOLOGIES-DT
BUSINESS, ECONOMICS & ENTREPRENEURSHIP - BEE
EDUCATION, POLICY & GLOBAL COLLABORATION - EPG
HUMANITIES, CULTURE, ARTS AND SOCIETY- HCAS

Dr. Kevin Tole
Ms. Esther Nzaro
Mr. Benard Kamanda

Abs. No.	Title
DT-04	Lewis Kagiri Ndegwa, Kevin Tole – GPU-Accelerated Fractal Image Compression with Adaptive Encoding, Compact Colour Coding, and Resolution-Independent Upscaling
DT-05	Moses Karema Mlewa, Kevin Tole – Optimizing Attack Vector Analysis in AI-Driven Threats: A Multi-Agent Framework for Dynamic Threat Intelligence and Adaptive Defense
DT-06	Athman Masoud, Kennedy Hadullo, Mgala Mvurya, Obadiah Musau – A Framework for Identifying Key Predictive Features of Extreme Space Weather Events in Kenya: A Literature Review
DT-07	Gabriel Muchangi – Predicting Learner Engagement and Performance Using AI-Driven Gamification in Competency-Based IT Education
DT-08	Aleksandra Lukaszewicz 4IR Technologies Supporting Cultural Heritage Preservation and Education on Culture
DT-09	Peter Shitundo, Wanyenda Chilimo, Kennedy Hadullo – Development of an Undergraduates Projects Repository System (UPRS) for Efficient Storage, Retrieval, Tracking and Access at the Technical University of Mombasa
DT-10	Collins Kiprotich, Kevin Tole – Improving Result Accuracy and Early Intervention Using Predictive Analytics in Student Management Systems
DT-14	Dennis Mutua, Samuel Kibaara Kariuki – Transformer Predictive Maintenance: IoT-Based Approach
DT-15	Falex Bagonko – An Intelligent Course Recommendation System for Kenyan TVET Students Based on KCSE Grades Using Machine Learning

BEE-01	Gracamichelle Nasipondi Simiyu – An AI-Driven Digital Platform for Beauty and Grooming Services to Enhance Entrepreneurship and Business Accountability
BEE-02	Liz Njira Wanje – Smart Self-Checkout System for Enhancing Supermarket Business Operations
BEE-03	Evans Ojiambo Onditi – Digital Marketing Strategies and Non-Financial Performance of Star-Rated Hotels in Nairobi City County, Kenya: The Moderating Role of Technological Capability
BEE-04	Yvonne Mugei, Prof Ray Mutinda, Dr. Laban Rotich – Do Kenya's Policies on Wildlife-Based Tourism Development Deliver Community Economic Benefits? Evidence from the Maasai Mara National Reserve, Kenya
EPG-01	Innocent Sunday Juma, Mvurya Mgala – A Generative AI Model for Enhanced Access to Information in the University
EPG-02	Joseph Michael Odhiambo – When Human Judgment Fails: A Philosophical and Computing Research Perspective on Trust, Power Dynamics, and AI-Supported Academic Integrity
EPG-03	Brenda Kasoha Eboso – Personalizing AI in the Classroom
EPG-05	Cynthia Mwende Mwau, Prof. Sunday Adebisi – TVET MKONONI (Hand): Reengineering Youth Unemployment and Inequality in Africa by Providing Affordable Access to TVET Training and Realigning Vocational and Digital Skills Training with Industry Needs
EPG-06	Evans Sagala Nyaleso – Assessment of the Effectiveness of Teaching AET 4101: Fundamentals of Computing Online
EPG-07	Fred Siambe Omweri – Policy Landscape of Climate Change and Health in East Africa: A Kingdon Analysis
EPG-08	Esther Njoki Gacheru – Organizational Readiness for E-Procurement Implementation in Public Institutions in Kenya (A Case of Technical University of Mombasa)
HCAS-01	Nsereko Nelson – Kinubi Swahili: The Border-Crossing Dialect of a Highly Mobile Community
4:00 - 17:00 pm	**Networking & Posters Session**
	End of Day 1

WEDNESDAY 15TH APRIL 2026		
Time	**Activity**	
08:30 - 09:00	Recap	MC- Dr. Madiha Salim
9:00 – 10:00	Keynote Address	Prof. Jones Fairfax AGWATA, PhD Associate Professor in the Department of Environmental Sciences at Machakos University, Kenya

		Former Director of Research, Innovation and Technology Transfer.

10:00 -4:00 PM THEMATIC PRESENTATIONS		
SESSION 1: 10:00 – 11:30 am **SUSTAINABLE ENVIRONMENT & BLUE ECONOMY -SEBC** **RESEARCH & INNOVATION IN INDUSTRY AND MANUFACTURING- RIIM** **Prof. Huxley Makonde** **Dr. Mumini Dzoga** **Dr. Eric Jobunga**		
VENUE- ASSEMBLY HALL		
Time	Code	Authors & Title
10:00 – 10:15	SEBC-01	Hamadi Mohamed Mwamlavya, Cosmas N. Munga, Albertinka J. Murk, Ewout Knoester Coral bleaching patterns on natural and artificial reefs in Shimoni during the 2024 Global Coral Bleaching event
10:15 – 10:30	RIIM-05	Wilson Leonidas Mahene and Thomas Kivevele From Agricultural Waste to Industrial Catalyst Supports: Valorizing Rice Husk Biochar for Sustainable Green Diesel Production
10:30 – 10:45	SEBC-05	Maximillah Maliachi, Mariam Maku Swaleh, Laila Abubakar, Daniel Munga, Saeed Mwaguni, Ali Shee, Kennedy Agoi, Benard Kioko Assessment of Wastewater Quality and Treatment Potential of Mikindani and Shimo La Tewa Constructed Wetlands for Domestic Wastewater Bioremediation in Mombasa County
10:45 – 11:00	SEBC-09	Iddi Khamisi Chuma Identification and Characterization of Plastic Degrading Enzymes from Bacteria Isolated from Landfills in Mombasa County
11:00 – 11:15	SEBC-12	Vincent O Mulusa, Cosmas Nzaka Munga, Martin Zimmer Trends in small-scale fisheries along mangrove-dominated coasts in south Coast, Kenya
11:15 – 11:30	SEBC-13	Michael Paul Maluki Green Roads for Water: Climate resilience infrastructure for improved community livelihoods and resilient transport functions
11:30 – 11:45	Break	
SESSION 2: 11:45 – 1:00 pm **DIGITAL TRANSFORMATION, AUTOMATION, AND EMERGING TECHNOLOGIES -DT** **Dr. Kevin Tole** **Dr. Mgala Mvurya** **Dr. Obadiah Musau**		
VENUE – ASSEMBLY HALL		
Time	Code	Authors & Title

11:45 – 12:00	DT-08	Aleksandra Lukaszewicz 4IR Technologies Supporting Cultural Heritage Preservation and Education on Culture
12:00 – 12:15	DT-17	Jorum Mwakondo Dynamic Simulation Model of a Solar PV–Electrolyzer System for Green Hydrogen Production in Kenya.
12:15 – 12:30	DT-16	Aisha Mohamed, Onesmus Mwatu C-Value Performance, Compliance, and Geometric Trade-Offs in Sports Arenas
1:00 – 2:00 pm	**Lunch Break & Poster Session**	**Assembly Hall**
2:00 – 4:00 pm	Thematic Presentations	

SESSION 3: 2:00 – 3:30 pm

BUSINESS, ECONOMICS & ENTREPRENEURSHIP - BEE

Dr. Samson Kitheka
Dr. Scholastica Ratanya
Dr. Mathew Egessa

VENUE- ASSEMBLY HALL

Time	Code	Authors & Title
2:00 – 2:15	BEE-09	Nalivata Kondwani Kenneth, Dr. Clemence Omwana, Dr. Susan Nzioki Mission-driven budgeting, Donor Behavior and financial sustainability of non-governmental organizations in Mombasa County.
2:15 – 2:30	BEE-06	Egondi Obinga Patrick The Influence of Risk Management Integration on Financial Performance of Deposit Taking SACCOs in Kenya: The Moderating Role of Firm Size
2:30 – 2:45	BEE-04	Yvonne Mugei, Prof Ray Mutinda, Dr. Laban Rotich Do Kenya's Policies on Wildlife-Based Tourism Development Deliver Community Economic Benefits? Evidence from the Maasai Mara National Reserve, Kenya
2:45 – 3:00	BEE-08	Egondi Obinga Patrick The Influence of Financial Transparency on Financial Performance of Deposit-Taking SACCOs in Kenya: The Moderating Role of Firm Size
3:00 – 3:15	BEE-05	Egondi Obinga Patrick The Influence of Internal Control Practices on Financial Performance of Deposit-Taking SACCOs in Kenya: The Moderating Role of Firm Size
3:15 – 3:30	EPG-04	Madiha Salim Khamis, Adem Aggrey Onago Uptake of Higher Education Applications on the KUCCPS Portal among High School Graduates (2022–2024)

SESSION 4: 3:45 – 4:30 pm

HEALTH, WELLNESS & SOCIETY -HWS

Prof Emily Rogena
Dr. Victor Jeza
Mr. Enoch Ngetich

VENUE – ASSEMBLY HALL		
Time	Code	Authors & Title
3:45 – 4:00	HWS-01	Emmanuel Wafula Wangila, Franciscah Wakonyo Karanja Perception and Early Response to Symptoms of Endometriosis Among Female University Students in Kenya
4:00 – 4:15	HWS-08	Silvan Rerimoi Kiptui, Prof. Emily A Rogena Influence of Competency-Based Education and Training on Mitigating Biological Hazard Exposure Among Cleaners at Medical Schools: A Cochrane Review
4:15 – 4:30	HWS-04	Emmanuel Wafula Wangila, Franciscah Wakonyo Karanja Smart Surveillance: Using Mobile Technology for Early Microbial Outbreak Detection in Kenya
4:00 - 5:00 pm		**Networking & Posters Session**
	End of Day 2	

THURSDAY 16TH APRIL 2026		
Time	**Activity**	
09:00 - 10:00 am	Keynote	Prof Micheal Saulo School of Engineering and Technology, TUM
10:00 am – 11:30 pm	Special Session From Science to Climate Impact: Multidisciplinary Pathways for mCDR in Africa	Dr. Mariam Swaleh

11:30 AM - 1:00 PM
THEMATIC PRESENTATIONS

SESSION 1: 11:30 AM – 1:00 PM

SUSTAINABLE ENVIRONMENT & BLUE ECONOMY- SEBC
HUMANITIES, CULTURE, ARTS AND SOCIETY- HCAS

Dr. Fredrick Mwamburi
Dr. Abdilrazak Guyo

VENUE- ASSEMBLY HALL

Time	Code	Authors & Title
11:30 – 11:45 am	SEBC-16	Kennedy Agoi Litunda, Maximillah Maliachi Morphological Characterization of Native Microalgae and Bacteria found in Domestic Wastewater in Mombasa- Kenya

11:45 – 12:00 am	SEBC-17	Omar Bakari Mwadzendze, Nzaro Gona Makenzi, Jospeh Baya Msanzu Micropropagation and Characterization of Wild Bitter Yam (dioscorea dumetorum) from Kwale County
12:00 – 12:15 pm	HCAS-02	Karina Banaszkiewicz – From Visual Storytelling in East African Communities – Heritage Films – to Online, Virtual, Hybrid and AI Spaces
12:15 – 12:30 pm	HCAS-03	Fred Siambe Omweri Digital Technologies and AI-Enhanced Decision-Making in Street-Level Bureaucracy: Pathways for Cultural Heritage Governance
12:30 – 12:45 pm	HCAS-05	Nalivata Kondwani Kenneth, Dr. Clemence Omwana, Dr. Susan Nzioki Influence of Diversified Revenue Streams, Donor behavior and Financial Sustainability of Non-Governmental Organizations in Mombasa County.
12:45 – 1:00 pm	HCAS-04	Egondi Obinga Patrick The Influence of Leadership Financial Decision-Making Practices on Financial Performance of Deposit-Taking SACCOs in Kenya: The Moderating Role of Firm Size
1:00 – 2:00 pm	**Closing Ceremony**	**Registrar PRI**

Additional Features

- **Networking Booths** – Open throughout the event for industry, researchers & students.
- **Special Exhibitions** – Showcasing research projects, AI applications & startups.
- **Hackathon Challenge** – Addressing sustainability & digital transformation.
- **Robotics Competition**

LAMPART Short Film Festival & Film Workshop

Date: 13–16 April 2026

Venue: Library Boardroom & Communication Studies Studio

Overview

This practical workshop introduces participants to short documentary filmmaking using smartphones and the CapCut editing application. Participants will learn the basics of visual storytelling, filming techniques, and editing, culminating in the production of short documentary films.

Facilitation & Support

The workshop is facilitated by Michał Sosna (UJ, Kreniart Limited). Organized by Kreniart Limited with support from the Embassy of the Republic of Poland.

Programme Highlights

Day 1: Introduction to documentary filmmaking, film language, lighting and sound, and formation of production teams.

Day 2: Development of story concepts, group presentations, and practical filming and editing exercises.

Day 3: Screening and critique of completed short documentary films.

Day 4: Masterclass by Andrzej Cichocki, Dean, Film School, University of Silesia in Katowice, Poland.

ABSTRACTS

DIGITAL TRANSFORMATION, AUTOMATION AND ENERGY-DT

Transformer Predictive Maintenance: IoT- Based Approach

Dennis Mutua* and Samuel Kibaara Kariuki
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This paper presents a comprehensive predictive maintenance framework for power transformers through the integration of IoT sensing, cloud-based data storage, and machine learning analytics. The system continuously captures real-time temperature, oil level, voltage, and current data from transformer-mounted sensors via an Arduino UNO + ESP8266 setup, sending updates every ~15 s to the cloud-based ThingSpeak platform. Time-series preprocessing transforms noisy sensor data through interpolation, outlier removal, rolling statistics, and engineered features. An Isolation Forest model trained on these features efficiently identifies anomalies, even without failure-labeled data. Concurrently, a Remaining Useful Life (RUL) regression model forecasts degradation trends, enabling proactive scheduling of maintenance tasks. Detected anomalies and RUL alerts are visualized and communicated via email, supporting timely intervention. Experimental results demonstrate accurate early detection of transformer faults and reliable RUL projections, significantly reducing unplanned downtime and maintenance costs. The architecture provides a scalable, cost-effective solution for real-time transformer health monitoring and maintenance optimization.

Keywords—Predictive maintenance, Internet of Things, Isolation Forest, remaining useful life, transformer health monitoring, ThingSpeak

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An Intelligent Course Recommendation System for Kenyan TVET Students Based on KCSE Grades Using Machine Learning

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Selecting an appropriate career for TVET students is essential to optimizing their learning in today's education system. Some students become frustrated due to a lack of proper guidance, insufficient understanding of career paths, and peer influence.
This paper will present an intelligent course recommendation system that uses machine learning algorithms to analyze students' KCSE grades and recommend suitable courses. It will use students'

KCSE performance, KUCCPS cluster points, and information on different TVET colleges to connect them with a suitable course.
The system will utilize a machine learning algorithm to determine the appropriate course for students based on their grades and preferred career choices. It will group subjects into domains and use a machine learning technique to analyze KCSE grades and identify the courses the student fits. Students will be required to enter their grades per subject into the system and receive the suitable courses available based on performance in relation to KUCCPS cluster points. The study will focus on the efficiency and effectiveness of the machine learning technique for course recommendation. The evaluation results will demonstrate how effectively the technique provides clear, data-driven assistance to students in selecting suitable courses.

Keywords: Machine Learning, TVET, KCSE, Course recommendation, KUCCPS

4IR Technologies Supporting Cultural Heritage Preservation and Education on Culture

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Polish Society for Aesthetics

During my poster presentation, I will highlight technologies associated with the so-called Fourth Industrial Revolution (4IR), following the understanding of this concept proposed by Klaus Schwab. This term describes the contemporary phase of digital transformation, whose tools can support the preservation of cultural heritage—both tangible and intangible—as well as educational processes related to it.
In particular, I will discuss the potential of Virtual Reality technologies, mobile applications (including those based on Augmented Reality), and Artificial Intelligence. These technologies can support cultural heritage preservation and education in several ways:
1. Virtualisation of historical monuments (both visual and acoustic), enabling immersive and interactive experiences that enhance educational outcomes.
2. Three-dimensional filming used to create immersive, non-interactive virtual experiences of natural and intangible cultural heritage that may be difficult to access (e.g. natural parks, underwater environments, or recordings of traditional craft practices and cultural traditions).
3. Mobile guides based on gamification, encouraging strong user engagement in exploring historical sites and urban heritage environments.
4. Applications of Artificial Intelligence, including support for online audio guides at heritage sites, transcription and translation of recorded stories, and the production of animations based on these narratives for educational dissemination.

Keywords: Cultural Heritage, Virtual Reality, Mobile Guides, gamification, Artificial Intelligence

Simulation-Based Optimization of Traffic Signal Timing for Improved Urban Intersection Performance

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Traffic congestion at urban intersections remains a significant challenge due to inefficient traffic signal timing, leading to increased vehicle delays, fuel consumption, and environmental pollution. This study presents a simulation-based optimization approach for improving traffic signal timing at signalized intersections. The main objective is to minimize average vehicle waiting time by determining optimal green time allocations under varying traffic conditions.
The research employs a queue-based traffic model with stochastic vehicle arrivals, implemented using a MATLAB-based simulation framework. A reproducible architecture is developed using JSON configurations to ensure flexibility and repeatability of experiments. The optimization process is driven by a cost function focused on delay minimization, allowing evaluation across low, medium, and high traffic demand scenarios.
Results indicate that the optimized signal timing significantly reduces average waiting time and improves overall intersection efficiency compared to traditional fixed-time control systems. The proposed framework demonstrates robustness across different traffic conditions and provides a scalable foundation for future integration with adaptive and intelligent transportation systems.
This study contributes to the advancement of data-driven traffic management solutions, particularly in developing urban environments, by offering a cost-effective and reproducible alternative to sensor-dependent systems.

Keywords: Traffic Signal Timing, Simulation-Based Optimization, Urban Traffic Management, Intersection Efficiency, Average Waiting Time

C-Value Performance, Compliance, and Geometric Trade-Offs in Sports Arenas

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Visual connectivity is a critical determinant of spectator experience in sports arenas, yet it is frequently compromised by seating geometries that prioritize capacity and structural efficiency over visibility. Although the C-value has long been recognized as a standard metric for evaluating sight-

line quality, its empirical application in contemporary arena design remains inconsistent. This paper evaluates the performance of C-value–based design across six sports arenas in Kenya and Italy, examining the specific influence of row rise, tread depth, horizontal spacing, and vertical height on visual quality. Using sectional analysis, field measurements, and zone mapping, C-values were computed and classified against established thresholds: minimum (60 mm), recommended (90 mm), and optimal (120 mm) to assess compliance.

Findings reveal that larger riser heights and deeper row spacing exert the strongest positive influence on C-value performance. Specifically, the study establishes evidence-based guidelines: a minimum C-value of 60 mm for general admission and 90–120 mm for VIP zones, alongside optimal viewing distances of 90–150 m. To enhance visibility, seating should be elevated 10 feet above the pool deck with a tread depth of 800 mm and proportional horizontal setbacks maintained in upper tiers.

By applying zone-based C-value mapping during early design stages, architects can identify underperforming areas and integrate these geometric rules of thumb into design workflows. This research demonstrates that C-value analysis is an essential evidence-based tool for enhancing visual connectivity, providing practical guidance for built-environment professionals to minimize capacity trade-offs.

Keywords: C-value; C-value performance; capacity–visibility trade-offs; compliance; seating geometry; sight-lines; sports arenas; visual connectivity

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Dynamic Simulation Model of a Solar PV–Electrolyzer System for Green Hydrogen Production in Kenya.

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The increasing global demand for clean and sustainable energy has accelerated interest in hydrogen as a key alternative energy carrier. This study presents a dynamic simulation model of a solar photovoltaic (PV) electrolyzer system for green hydrogen production in Kenya. Using MATLAB/Simulink, the system is developed to evaluate transient and steady state performance of the solar powered hydrogen production process under real solar irradiance profiles for Nairobi and Mombasa . The model integrates a PV array, DC - DC converter, Maximum Power Point Tracking (MPPT) control, and a Proton Exchange Membrane (PEM) electrolyzer. Simulation results show that coastal regions like Mombasa exhibit higher hydrogen yields due to greater solar irradiance levels. The developed model supports the PtX baseline study and Kenya's renewable energy transition (Green hydrogen strategy and roadmap).The model incorporates PV generation, MPPT control, DC–DC power conditioning, and PEM electrolyzer dynamics to assess how site-specific irradiance profiles influence overall system efficiency. Simulation results demonstrate the system's capability to

produce 7.7383 kg/day of hydrogen in Nairobi and 9.5927 kg/day in Mombasa, highlighting the impact of regional solar resources on hydrogen yield and system responsiveness.

Keywords: Solar PV–Electrolyzer, green Hydrogen, PEM

Jasper: A Face Recognition Application for Android

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Taking attendance in schools and offices is still done manually in most environments. Instructors call names, employees sign attendance sheets, and security personnel verify identity cards. These approaches are time-consuming and susceptible to fraud. This paper presents Jasper, an Android application that employs the device camera to identify faces and automatically record attendance. All processing is performed on-device: the application requires no internet connection, transmits no images to external servers, and functions in environments without network coverage. The system incorporates a liveness detection mechanism to reject photographic spoofing attempts. Evaluated on a mid-range Android device, Jasper achieves face recognition at approximately 20 frames per second. This paper describes the system architecture, component design decisions, and experimental results. Index Terms—face recognition, anti-spoofing, liveness detection, Android, on-device inference, MobileFaceNet, BlazeFace, attendance management, edge computing.

Keywords: Face Recognition, Liveness Detection, Attendance Management, Android

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GPU-Accelerated Fractal Image Compression with Adaptive Encoding, Compact Colour Coding, and Resolution-Independent Upscaling

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This study presents a GPU-accelerated implementation of Partitioned Iterated Function System (PIFS) fractal image compression, incorporating automatic parameter selection, a stratified pre-sampling diagnostic, and a compact binary Discrete Cosine Transform (DCT)-based colour encoding scheme. The proposed framework achieves high compression performance, yielding compression ratios of 91–98% on the Kodak-24 benchmark dataset. The main contribution lies in the empirical evaluation of resolution-independent decoding, demonstrating the stability of fractal reconstruction across multiple scaling factors. Experimental results on ten Kodak images at scaling levels of 2×, 4×, 8×, and 10× indicate that fractal Peak Signal-to-Noise Ratio (PSNR) remains nearly constant, with a

maximum variation of 0.07 dB and an average spread of 0.03 dB between 4× and 10×. In contrast, Lanczos interpolation exhibits significant degradation, with an average PSNR reduction of 5.44 dB from 2× to 8×. The crossover point, where fractal decoding outperforms interpolation, consistently occurs between 2× and 4×, with an average improvement of 2.46 dB, increasing to 4.52 dB at 8× and 5.02 dB at 10×. At 2×, interpolation retains a marginal advantage of 0.89 dB. Furthermore, three additional findings are established. First, PSNR remains invariant with respect to the threshold multiplier k" [0.1,0.8]k \in [0.1, 0.8]k" [0.1,0.8], as the encoder consistently selects the global optimal match. Second, the compressed file size is independent of the domain step size, since one transform is stored per range block regardless of search density. Third, the introduction of a gated second-pass residual encoder does not yield measurable improvement in reconstruction quality, with a mean ”PSNRof " 0.002dB across 24 Kodak images. The results demonstrate the robustness, scalability, and efficiency of fractal-based compression for high-quality image reconstruction and resolution-independent upscaling. The proposed system is released as open source under the GPL-3.0 license to support reproducibility and further research.

Keywords: Fractal image compression, PIFS, GPU acceleration, resolution- independent decoding, image upscaling

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Optimizing Attack Vector Analysis in AI-Driven Threats: A Multi-Agent Framework for Dynamic Threat Intelligence and Adaptive Defense

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The proliferation of AI-driven cyber threats characterized by autonomous multi agents, polymorphic malware, and adaptive multi-vector attacks has challenges traditional static defense mechanisms. These threats dynamically evolve their attack vectors to evade detection, exploiting the semantic gap between raw threat intelligence and actionable defense strategies. This paper proposes a novel multi-agent framework for optimizing attack vector analysis that integrates dynamic threat intelligence with adaptive defense coordination. The framework addresses four fundamental challenges: semantic alignment of heterogeneous threat data through continuous vector representations mapped to adversary techniques; quantification of target attack surface exposure across network, authentication, and defensive dimensions; cost-aware reinforcement learning for optimizing defense actions under operational constraints; and real-time adaptation to emergent attack patterns through multi-agent collaboration Specialized profiler, analyst, and mitigation agents collaborate through adversarial debate to counter evolving attacks. A Graph Neural Network (GNN) enables transferable policies without retraining. Proximal Policy Optimization (PPO) with multi-agent reinforcement learning (RL) balances threat neutralization and operational stability. A credit-based mechanism, trained via contrastive learning, autonomously evaluates message credibility and suppresses

malicious communications.
Evaluation on CIC-IDS2019, SWaT, and MITRE ATT&CK benchmarks shows 94.2% detection accuracy with 80% fewer false positives than single-agent baselines. Continuous-space training achieves 9.3x scalability and 89% generalization. The framework uniquely detects emergent agentic-context vulnerabilities invisible to static evaluation This research establishes a new paradigm for adaptive, interpretable, and resilient attack vector optimization, enabling critical infrastructure to proactively counter autonomous AI-powered cyber threats

Keywords: AI-Driven Threats, Dynamic Threat Intelligence, Attack Vector

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A Framework for Identifying Key Predictive Features of Extreme Space Weather Events in Kenya: A Literature Review

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Feature selection plays a critical role in improving the accuracy and efficiency of predictive models for extreme space weather events. In space weather forecasting, the identification of the most relevant predictive variables from large volumes of solar, interplanetary, and geomagnetic data is essential for reliable prediction of geomagnetic storms. Numerous studies have explored different approaches to feature selection using parameters such as solar wind speed, solar flare intensity, proton density, interplanetary magnetic field components, and geomagnetic indices including Dst and Kp. However, most of these studies have been conducted in developed regions with well-established monitoring systems, leaving a gap in understanding which predictive features are most relevant within developing regions such as Kenya. This literature review examines existing studies on space weather prediction with particular focus on feature selection techniques and the datasets used in predictive modeling. The review will analyze commonly used statistical and machine learning approaches, including correlation analysis, principal component analysis, and other feature selection methods applied to solar and geomagnetic datasets. It will also evaluate the strengths and limitations of current methodologies and highlights how these approaches can be adapted to emerging space weather monitoring environments that rely on both local observations and global space weather databases. Based on insights from the reviewed literature, the paper will propose a conceptual framework for identifying key predictive features relevant to the Kenyan space weather monitoring centres. The framework will emphasize processes such as data preprocessing, harmonization, and systematic feature selection as essential steps toward developing reliable predictive models. The study aims to provide a foundation for future research on deep learning–based space weather prediction systems and to support the development of localized early warning capabilities that can enhance space weather forecasting and protect critical technological infrastructure in Kenya.

Keywords: Digital Transformation, Feature Selection, Space Weather, Deep learning

Predicting Learner Engagement and Performance Using AI-Driven Gamification in Competency-Based IT Education

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Rapid advancements in digital technologies have transformed learning environments, leading to increased adoption of innovative strategies that enhance student engagement and skill development. Gamification, which involves applying game mechanics to non-game contexts, has emerged as an effective approach for motivating and engaging learners in Competency-Based Education (CBE). At the same time, Artificial Intelligence (AI) offers powerful capabilities for personalizing and optimizing the gamified learning experience. When integrated with gamification, AI-driven systems can dynamically adjust challenges, provide tailored feedback, and predict learner behavior, thereby improving the effectiveness of instructional interventions.This study investigates AI-driven gamification strategies for enhancing motivation and skill mastery in competency-based IT learning environments. Specifically, it explores how AI can strengthen the motivational and interactive features of gamification to deliver personalized learning pathways that accommodate diverse learner needs, preferences, and performance levels. The research further examines the ethical considerations and broader social implications of integrating AI into gamified systems, highlighting the importance of human-centered design to ensure equitable and positive learning outcomes. By analyzing the intersection of AI, gamification, and competency-based learning, this study provides valuable insights for educators, instructional designers, and policymakers seeking to prepare learners for a rapidly evolving digital landscape. The findings aim to support the development of more inclusive, adaptive, and effective learning environments that foster both motivation and essential IT competencies.

Keywords: Gamification, Artificial Intelligence, competency-based Education

Development of an Undergraduates Projects Repository System (UPRS) for Efficient Storage, Retrieval, Tracking and Access at the Technical University of Mombasa

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Undergraduate research projects constitute an important component of academic scholarship within universities. They represent students' ability to apply disciplinary knowledge, contribute to institutional research output and provide valuable reference material for future researchers. However, in many institutions, the management of undergraduate projects remains largely manual, fragmented and poorly organized. Physical copies are often stored in departmental offices, cabinets or storerooms with minimal indexing, making retrieval difficult and limiting access to potentially valuable academic work. At the Technical University of Mombasa, postgraduate theses and dissertations are preserved through digital repositories, yet undergraduate and diploma-level projects are predominantly stored in physical form within departments. This practice presents several challenges, including difficulty in accessing previous projects for reference, limited ability to verify originality of research topics, inefficient tracking of submitted projects and increased risk of document loss or deterioration. What if there was an easy digital way for students, lecturers and administrators to store, search, retrieve and track undergraduate research projects in a centralized platform? Such a system would empower the student who values research integrity to quickly verify whether a topic has been previously explored, help lecturers monitor research trends and detect potential duplication, and provide departments with a reliable mechanism for preserving academic outputs. This proposal presents the development of an Undergraduate Project Repository System (UPRS) designed to digitize, centralize and automate the management of undergraduate and diploma-level projects at the Technical University of Mombasa. The system will facilitate structured submission, digital archiving, indexing, advanced search and retrieval and project tracking functionalities while promoting accessibility, research transparency and knowledge preservation. By integrating modern information management principles with institutional research needs, the proposed system seeks to enhance access to undergraduate scholarship, improve academic integrity and contribute to the long-term preservation of institutional knowledge.

Keywords: Undergraduate Projects Repository System (UPRS), Digital Archiving,

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Improving Result Accuracy and Early Intervention Using Predictive Analytics in Student Management Systems

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Despite the widespread adoption of student information systems and digital academic management platforms in higher education institutions, the management and dissemination of assessment results remain largely reactive, fragmented, and delayed. In many institutions, students receive feedback on Continuous Assessment Tests (CATs), assignments, and final examinations several weeks or months after assessments are completed. This delayed feedback cycle limits students' ability to accurately monitor their academic progress, identify missing or erroneous marks in a timely manner, and

implement corrective learning strategies early enough to influence academic outcomes. As a result, students frequently become aware of discrepancies or underperformance only after the release of final results, at which point opportunities for meaningful remediation are no longer available. Furthermore, existing student management systems primarily function as static repositories of academic records, offering limited analytical capabilities for proactive academic support. They typically lack mechanisms for automated detection of data quality issues such as missing assessments, inconsistent grading patterns, and anomalous score entries. This deficiency contributes to persistent administrative inefficiencies, disputes over results, and erosion of trust between students and academic administrators. The absence of systematic validation and real-time monitoring frameworks increases the likelihood of undetected errors propagating through institutional records, thereby compromising the integrity and reliability of academic data. In addition to data quality challenges, higher education institutions face growing pressure to improve student retention, progression, and completion rates. However, current systems provide limited support for early identification of students at risk of academic failure. While historical academic data is routinely collected, it is underutilized for predictive and prescriptive analytics that could enable timely, targeted interventions. The lack of integrated predictive models within existing academic management platforms constrains the ability of institutions to transition from reactive performance reporting to proactive, evidence-based academic support. Consequently, there exists a critical research and practice gap in the design of intelligent academic management systems that integrate real-time performance tracking, automated anomaly detection, and predictive analytics within existing institutional infrastructures. Addressing this gap requires the development of a scalable, interoperable framework capable of enhancing data quality, enabling early risk identification, and supporting data-driven academic interventions without disrupting legacy systems. The absence of such an integrated solution represents a significant barrier to improving learning outcomes, strengthening assessment integrity, and empowering students to engage in timely, self-regulated learning.

Keywords: Student performance prediction, Academic analytics, Early warning systems

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Multidisciplinary Journal of Technical University of Mombasa on the right path towards indexing

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The Kenya Libraries and Information Services Consortium (KLSC) has invited over 30 institutions of higher learning and research institutions in Kenya to an ongoing 3-day workshop in Nairobi from 18th to 20th February 2026. This workshop aims to streamline all open-access journals in Kenya, hosted by various institutions, on quality and trusted open-access scholarly journal practices. The workshop is led by Ina Smith, a facilitator from the Directorate of Open Access Journals (DOAJ).

During the workshop, all journals were pre-assessed for compliance with indexing requirements. Multidisciplinary Journal of Technical University of Mombasa (MJTUM), represented in the workshop by 8 members of the editorial board, topped this assessment with 91 per cent compliance. This position makes MJTUM a trusted open-access journal that is on the right path towards indexing, thereby promoting the visibility of the Technical University of Mombasa. On behalf of members of the editorial board, the Chief Editor of MJTUM congratulates all our esteemed authors, reviewers, and the excellent support provided by the university management.

Keywords: Journal, MJTUM, Kenya

Deep Learning Based Predictive Model for Network Intrusion Detection and Mitigation in E-Learning Environments

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This paper presents a mathematically grounded adaptive eLearning model for higher learning institutions that integrates artificial intelligence and Recurrent Neural Networks to deliver time-sensitive personalization. The proposed framework introduces novelty in feature selection by constructing optimized multidimensional learner vectors incorporating prior knowledge, interaction patterns, learning preferences, academic performance, temporal engagement behavior, and attendance dynamics. Learning content is formally structured using difficulty level, subject domain, and delivery modality to enable systematic alignment with learner states. A quantified adaptive level is defined as a composite, continuously updated function of engagement, assessment outcomes, interaction frequency, and progression trends, allowing objective measurement of personalization intensity. The Recurrent Neural Network architecture captures longitudinal dependencies across one academic year of learner interaction data from public universities in Kenya, modeling sequential academic behavior and predicting performance trajectories. Model training minimizes prediction error between observed and estimated learning outcomes, while continuous parameter updating ensures real-time adjustment of instructional pathways. The framework further supports early detection of academic risk and targeted intervention strategies. By embedding temporal learning dynamics within a structured mathematical formulation, the model advances adaptive eLearning toward scalable, equitable, and retention-focused implementation in higher education.

Keywords: Deep Learning, Adaptive learning, eLearning, algorithms.

An Ai-Driven Hybrid Quantum–Topological Intelligent Framework for Academic Timetable Scheduling

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A new hybrid structure for solving academic scheduling issues is proposed in this paper that uses a combination of Topological Data Analysis (TDA) and Quantum Annealing (QA). The new frame work allows for the modelling and solving of multi-constraint university scheduling problems by combining the characteristics of both QA and TDA. Using TDA, scheduling data is topologically analysed to provide structural and geometric information that can be used with the global optimiza tion properties of QA to develop solutions to complex grement configurations.To test the proposed hybrid framework, the authors used real world data from the TUM for three datasets. The three datasets reflect different levels of complexity, with all datasets containing Certificate and Diploma Programs leading to the Undergraduate and Postgraduate timetable.Four model variants were con sidered: The configurations examined comprised QA-only, TDA-only, hybrid models without re f inement, and hybrid models incorporating refinement. Each approach was assessed using four per formance metrics: Conflict-Free Rate (CFR), Resource Utilization (RU), Computational Time (CT), and Energy Function Value (EFV). The experimental results demonstrate that hybrid approaches in corporating refinement consistently outperformed all baseline models across every evaluation metric. Notably, the top-performing hybrid configuration, evaluated on the most complex dataset, attained a CFR of 94.3%, a RU of 91.2%, and the lowest EFV among all the methods compared. Experimental results demonstrate that all hybrid-with-refinement configurations consistently outperformed the baseline models by a substantial margin. Notably, on the most challenging dataset, the refined hybrid approach attained a Conflict-Free Rate (CFR) of 94.3% and a Resource Utilization (RU) of 91.2%, while also yielding the minimum Energy Function Value (EFV). Additionally, clustering and K-NN analysis results confirmed that the proposed hybrid approach has consistent and robust behaviours across all datasets, demonstrating reliable behaviour regardless of the differing sizes or complexity of the problems.

Keywords: Academic Timetabling, Quantum Annealing, Topological Data Analysis

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Causal Neuro-Symbolic Counterfactual Learning Model for Intelligent Constraint-Based Port Logistics Optimization: A Case Study Of Kenya Ports Authority

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In response, this study proposes a neuro-symbolic counterfactual learning framework for constraint-

based port logistics optimization, in which value selection is explicitly modeled as a causal intervention within the solver loop. Furthermore, counterfactual reinforcement learning is employed to estimate the potential outcomes of unchosen logistics decisions by leveraging solver-internal symbolic feedback, including propagation traces, conflict explanations, and backtracking behavior. In addition, symbolic port constraints and operational dependencies are encoded through structured graph representations and integrated with neural policies, thereby enabling online, self-adaptive heuristic evolution without the need for retraining. Moreover, a failure-aware reward mechanism is introduced to improve credit assignment, consequently reducing backtracking and enhancing solver robustness. Overall, the proposed approach aims to deliver an interpretable, solver-agnostic, and resilient optimization framework that is well suited for real-world port logistics decision-making under dynamic and uncertain conditions.

Keywords: Constraint Programming, Neuro-Symbolic AI, Counterfactual Reinforcement Learning, Causal Inference, Heuristic Learning

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TVET MKONONI (Hand): Reengineering youth unemployment and inequality in Africa by providing affordable access to TVET Training and realigning vocational and digital skills training with industry needs.

Cynthia M. Mwau, Prof. S. Adebisi
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The transition of Kenyan youths from primary to secondary education has been relatively high compared to the transition rate to post-secondary education. Past research has documented that most youths between age 15-24 are either unemployed, not in education or untrained. These challenges are particularly pertinent in rural areas, informal settlements and areas classified as remote. Technical and Vocational Education and Training (TVET) is designed to reduce unemployment by equipping the youths with hand-on skills, yet its access is uneven. Further, challenges such as location of the TVET's, high tuition fees and ever rising accommodation costs hinder marginalized youth from accessing TVET training. To mitigate these challenges, an AI driven innovation is developed geared towards bridging the gap of access to TVET training for the marginalized youth. The study also assessed how the platform would impact skills acquisition and unemployment. This is achieved though personalized learning paths aligned with national TVET curricula and providing AI assisted practical assessments with interactive learning activities. The platform will also monitor individual learner progress in order to provide timely feedback support. The AI features will enhance learner engagement hence consequently improving employability outcomes. The pilot sites considered were Kenya and Nigeria were considered as they provided regions with rural, peri-urban and urban contexts with skill mismatches and high youth unemployment. Findings from the study indicated that scalable, technology-driven approaches have the potential to strengthen human capital

development, broaden access to post-secondary training and create new employment pathways. The platform would therefore consequently expand opportunities for marginalized youth while providing sustainable skills development across the East African region. The study also strategically aligns with the African Union's Agenda 2063 and Sustainable Development Goals 1, 4, 8, 9 and 10.

Keywords: AI, vocational training, marginalized youth, TVET, employment pathways.

EDUCATION, POLICY & GLOBAL COLLABORATION - EPG

Policy Landscape of Climate Change and Health in East Africa: A Kingdon Analysis

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Climate change effects (CCE) significantly contribute to health hazards globally. Regrettably, Low and Middle-Income Countries (LMICs) withstand the worst of this burden due to their inadequate institutional capacity to combat climate change, susceptibility to extreme weather events, heavy reliance on agriculture, restricted ability to adjust, topographical position, inability to obtain climate funding and reliance on natural resources for economic purposes. Despite international efforts to mitigate the impact of climate change, countries in East Africa continue to face significant health challenges because of its consequences. This study sought to assess the impact of climate change on the health of individuals in East Africa. The methodology used in this study was the Kingdon Multiple Streams Framework, which was applied to identify both successful and damaging elements in terms of getting climate change prevention on the policy agenda. The findings indicate that climate change poses significant health risks in East Africa, including heat waves, water scarcity, and vector-borne diseases, but a lack of robust data and evidence hinders effective problem definition. Existing regional and international frameworks, such as the Paris Agreement and WHO's climate change and health strategy, provide a foundation for policy solutions, including early warning systems, climate-resilient healthcare infrastructure, and adaptation and mitigation strategies. While political instability and competing priorities often overshadow climate change and health concerns, the East African Community's commitment to addressing climate change and the presence of policy entrepreneurs in some countries offer opportunities for progress. A policy window is opening in East Africa, driven by the EAC's climate change agenda and WHO's support, and the presence of policy entrepreneurs and feasible solutions create an opportunity for the streams to align and prioritize climate change and health in the region. In conclusion, prioritizing climate change and health in East Africa requires a trifecta of essential elements: effective problem definition, robust policy solutions, and political stability. The alignment of these three streams, facilitated by policy entrepreneurs, is crucial for meaningful policy action in the region, enabling the translation of solutions into tangible actions that address the health impacts of climate change in East Africa. Keywords: Kingdon Policy Analysis, Climate Change, Policy Landscape

Keywords: *Kingdon Policy Analysis, Climate Change, Policy Landscape*

Assessment of The Effectiveness of Teaching IET 4101: Fundamentals of Computing Online

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This paper presents the insight of a pilot study on the assessment of the effectiveness of online teaching for AET 4101: Fundamentals of Computing at The Technical University of Mombasa (TUM) Kenya. The survey sought to establish the correlation between online teaching and the outcomes; promoting skills and equity in skill development for innovation and employability. The survey sought answers in four domains, knowledge and skills acquired, adequacy of learning resources, instructor content and learner interface and the technical support accorded to the learners. The survey was done in context of two theoretical frameworks of S.K Skinner and Albert Bandura. Conditioning and Learning theories respectively. The survey used purposeful random sampling techniques involving 10 students from the Institute of Computing (IOC) and 10 students from the School of Humanities and Social Sciences (SoHSS). Data was analyzed using SPSS software and assessed using Cronbach's alpha range of coefficiencies. It was done two weeks prior to the end of semester examination in January 2026. The findings of this retrospective dichotomized survey will be shared in this paper.

Keywords: Computing, Online, Learners

A generative AI model for Enhanced Access to Information in the university

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Access to accurate and timely academic information is essential for effective learning and institutional efficiency. However, university websites often present information in fragmented formats that require users to navigate multiple pages and documents to retrieve precise details. At the Technical University of Mombasa (TUM), this challenge limits students' ability to efficiently access critical information such as academic schedules, fee structures, and program requirements, thereby affecting informed decision-making and academic planning. This study addresses this challenge by building a domain-specific artificial intelligence model that enables direct retrieval of institutional information using generative AI constrained to verified internal data. The system employs a retrieval-augmented generation (RAG) architecture, where institutional documents are transformed into vector representations and queried using similarity-based retrieval techniques. A rule-based control layer is integrated to enforce strict knowledge boundaries, ensuring that responses are derived exclusively from authorized institutional sources while maintaining consistency and preventing hallucinations. The system was evaluated using task-based queries reflecting real-world student information needs. Results demonstrate improved retrieval efficiency, increased response accuracy, and reduced effort in accessing specific information compared to traditional website navigation. The model has been enhanced by using strict rules to avoid ambiguous queries. The model was evaluated using task-based queries representing common student needs. Results show improved retrieval efficiency,

reducing response time by about 80% and navigation steps by about 75%. The system achieves high accuracy (95–98%, about 15% improvement) and consistent outputs, while ensuring responses are grounded in institutional data and reducing user effort. The study highlights the effectiveness of combining retrieval-based methods with rule-constrained generation for institutional information systems. The findings contribute to the development of reliable and context-aware AI solutions in the university, that also provide improved information access and supporting policy-driven digital transformation. This study covered one directorate within the university. Further work would be to build a university wide model

Keywords: Generative AI, Information Access, University, Rule-Constrained Systems, Model

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When Human Judgment Fails: A Philosophical and Computing Research Perspective on Trust, Power Dynamics, and AI-Supported Academic Integrity

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Human relationships in institutions depend on a delicate balance of trust, authority, and moral reasoning. Higher education depends on the transparency of operations, academic ethics, and procedural integrity for public trust. Yet,this is typically compromised by human behavior led by the pressure of authority, cognitive biases, and institutional power. The paper takes a real-world case example involving unprocedural academic mark entry to examine how human cognitive biases and institutional power structures can lead individuals into ethically compromising situations. In light of this, through the lenses of the philosophy of science, cognitive psychology, and computing research, the paper explores why otherwise rational individuals engage in ethically questionable decisions and how technical systems can be manipulated by persons with a hierarchical advantage. Insights from the study show that such ethical failures are not limited to just the individual level but are also systemic, calling for both procedural stringency and intelligent digital safeguards. The research hence proposes the use of AI-enhanced mechanisms of academic governance that ensure accountability, anomaly detection, data system security, and protection of human actors.

Keywords: academic integrity, philosophy of science, AI governance, power dynamics, institutional systems

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AI-Driven Personalized Learning Companions in Kenyan Secondary Schools

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The proposed research aims at developing Artificial Intelligence (AI)-driven personalized learning companions to be implemented in classrooms. With the improvement of the quality of education systems, equity, and learner-focused practices, AI is a revolutionary challenge that can be used to redesign the process of delivering instruction and interacting with students. The research studies the potential of AI-based learning companions, which have deep learner modeling, natural language and predictive analytics, to offer adaptive, real-time instructional support based on the cognitive capabilities, learning rate, preferences of individual students and not forgetting the student's curriculum. Contrary to the traditional adaptive learning technologies that simply adjust the level of the content to the students, the AI-driven systems should recognize patterns of the students to identify the misconception, anticipate the learning deficit, and provide specific feedback. The study also examines the new aspects of explainable AI to guarantee transparency to teachers, emotion and engagement detection to support learners, collaborative AI integration to support learning among peers, and ethical guidelines that can address privacy, reduction of bias, and fair access. Based on a mixed-methods research design in the chosen secondary schools in Kenya, the study will assess the usefulness of AI learning companions in enhancing academic performance, learner motivation, and instructional efficiency. The data will be gathered using surveys, classroom observations, system analytics, and the use of performance measurements. It is likely that the results would indicate that AI-based personalization does not only increase student performance but also promotes the work of a teacher by minimizing the routine workload and allowing teachers to make data-driven decisions. The research has added to the literature on educational innovations because it suggests a sustainable implementation system to develop partnerships among educators, technology developers, policymakers, and institutions. Through situating the deployment of AI in the Kenyan education system, the study expands adoptable and scalable methods to change the experiences in classrooms, advance inclusive learning, and enhance sustainable innovation in education and learning.

Keywords**:** Personalized, Companion, Curriculum

Uptake of Higher Education Applications on the KUCCPS Portal among High School Graduates (2022–2024)

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Admissions to institutions of higher education in Kenya is largely facilitated through the Kenya Universities and Colleges Central Placement Service (KUCCPS), an online government portal that enables students who have completed the Kenya Certificate of Secondary Education (KCSE) to apply for admission into universities and technical training institutions. While this centralized system was

introduced to promote equity, transparency, and efficiency in the placement process, a significant number of eligible students continue to miss the opportunity to apply for higher education through KUCCPS. This study sought to investigate the uptake of KUCCPS applications among KCSE graduates from the years 2022 to 2024. It aimed to assess the level of awareness, identify barriers to application, and explore students' attitudes and perceptions towards the portal. Using a descriptive cross-sectional survey design, the study collected data through an online questionnaire from students who sat for KCSE between 2022 and 2024. Quantitative data was analyzed using descriptive statistics and cross-tabulations, while qualitative responses underwent thematic analysis. The research was guided by the Theory of Planned Behavior, which provides a framework for understanding how awareness, attitudes, and perceived control influence students' decision-making regarding application. Out of 145 targeted respondents 74 responded translating to 51.03% response rate. Results show that 94.6% of the respondents were aware of the KUCCPS application process and 74.3% applied for applied for university and college admission through the KUCCPS portal. The results further noted that being aware of the KUCCPS application process, clear understanding of the KUCCPS application process and parents/guardians support were found to have significant association with the decision to apply for admission through KUCCPS portal. Findings from this research are expected to provide evidence-based insights for educators, policymakers, and stakeholders to develop targeted interventions that improve KUCCPS application uptake.

Keywords: KUCCPS, Higher Education Access, KCSE Graduates, Application Uptake, Student Awareness

HEALTH, WELLNESS AND SOCIETY IN THE 21ST CENTURY - HWS

Modeling Measles Transmission Dynamics with Vaccination and Treatment Strategies Among Children Under Ten Years in Kwale and Kilifi Counties

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This study examines the persistent spread of measles among children below the age of ten years in Kwale and Kilifi counties in Kenya, despites the existence of measles vaccines. The current study addresses these gaps in the existing works by developing an SVITR model that includes both vaccination and treatment strategies to analyze measles transmission dynamics in the population of children under ten years old. The study uses nonlinear ordinary differential equations to determine the basic reproduction number using the next-generation matrix method, examine the stability at equilibrium points using the Jacobian

matrix and eigenvalue analysis, identify the parameters that mostly influence measles transmission through sensitivity analysis, and evaluate the effectiveness of vaccination and treatment interventions under varying scenarios through numerical simulations based on secondary data collected from Kilifi and Kwale counties. The findings show that the reproduction numbers are 1.518 and 1.211 for Kwale County and Kilifi County, respectively, representing continued transmission of measles with unstable and stable equilibrium points for the disease-free and endemic states, respectively. The rate of infection and the size of the vulnerable population were found to increase transmission, while transmission decreases with treatment. Simulation results show that the combination of treatment and vaccination is more effective in controlling transmission than a single intervention, highlighting the need for joint control strategies aimed at reducing measles transmission among children.

Keywords: Measles transmission, Vaccination, treatment, basic reproduction number, stability and sensitivity analysis

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Mathematical Modelling Of Tuberculosis Dynamics With Control Measures

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The research aims at investigating the effective strategies for prevention and control of tuberculosis by modeling its transmission dynamics. TB is one of the global endemics that claims millions of lives every year. Therefore, there is need for continuous research in order to understand its dynamics for effective prevention and control as recommended by WHO. The primary objective of the study is to develop and analyze a mathematical model of tuberculosis transmission dynamics. The model incorporates control measures for evaluating their effectiveness in reducing disease prevalence and transmission. The study develops an SVLATR compartmental mathematical model for analyzing the transmission dynamics of TB in order to predict its evolution and outcomes. The research uses real world TB epidemiological data to simulate disease dynamics under various intervention scenarios. Furthermore, the study computes the basic reproduction number (R €) by the use of Next Generation Matrix (NGM). Stability analysis of the equilibrium points of the dynamical system using the Jacobian Matrix and eigenvalue analysis is also performed. The study also performs sensitivity analysis using a normalized forward sensitivity index. This aims to identify parameters that have greatest influence on the reproduction number. Numerical simulations are also done under various intervention scenarios. This majorly helps to calibrate and validate the model by analyzing the Free Disease Equilibrium (FDE) and Endemic Equilibrium (EE). The outcomes of this research will be useful in improving the diagnosis, prevention and treatment of tuberculosis. This will contribute to the

national goals together with Sustainable Development Goals (SDGs) of achieving a population with optimal health. Through this modeling approach, we aim to provide policymakers and public health stakeholders with evidence-based recommendations for improving TB control.

Keywords: Research, literature, methodology, analysis.

Smart Surveillance: Using Mobile Technology for Early Microbial Outbreak Detection in Kenya

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Microbial disease outbreaks remain a major public health concern in many developing countries, including Kenya. Infectious diseases caused by microorganisms such as bacteria and viruses can spread rapidly within communities when detection and response systems are slow. In many regions, disease surveillance systems still depend on traditional reporting methods that involve manual data collection, delayed laboratory confirmation, and slow communication between health facilities and public health authorities. These delays can significantly hinder early response efforts, allowing outbreaks to escalate before appropriate control measures are implemented. Strengthening disease surveillance systems is therefore essential for improving outbreak preparedness and protecting community health. Recent advances in mobile technology provide new opportunities to improve public health monitoring systems. Mobile devices such as smartphones can facilitate real-time data collection, faster communication, and more efficient analysis of health information. Integrating mobile technology into disease surveillance systems can help bridge gaps between community-level health workers, laboratories, and national health authorities. This study proposes a mobile-based microbial disease surveillance approach designed to support early outbreak detection through rapid reporting and monitoring of infectious diseases. The main objective of the proposed approach is to develop a mobile-based platform that enables timely reporting and monitoring of suspected microbial infections from communities and healthcare facilities. Community health workers and medical personnel can use mobile devices to record suspected disease cases, including key information such as symptoms, patient location, and preliminary diagnostic observations. These reports can then be linked with laboratory-confirmed microbial data from local health facilities to improve the accuracy and reliability of surveillance information.
The proposed system will integrate reported data into a centralized digital dashboard where real-time monitoring and analysis can be conducted. Analytical tools such as trend monitoring and geospatial mapping can be used to identify unusual increases in disease incidence across different regions. When abnormal patterns or clusters of infections are detected, automated alerts can be generated and communicated to public health authorities for immediate investigation. This process enables faster response measures such as field investigations, laboratory testing, community

awareness campaigns, and targeted disease control interventions. Implementation of such a system has the potential to significantly improve early outbreak detection and response. Faster reporting and real-time data analysis can help public health officials identify disease hotspots before outbreaks become widespread. Improved communication between community health workers, laboratories, and health authorities can also strengthen coordination in disease management efforts. Digital platform can support better data storage, tracking of disease patterns, and long-term epidemiological analysis. The expected outcomes of this approach include improved timeliness of outbreak detection, enhanced monitoring of infectious disease trends, and more effective public health responses. By enabling rapid identification of disease clusters and transmission patterns, the system can help reduce the spread of infections and minimize the social and economic impacts associated with disease outbreaks.

Integrating mobile technology with microbial disease surveillance represents a practical and innovative strategy for strengthening public health systems. Such an approach highlights the importance of combining microbiology, digital technology, and public health expertise to develop sustainable solutions for disease monitoring.

Keywords: Mobile, Health, Technology

Perception and Early Response to Symptoms of Endometriosis Among Female University Students in Kenya

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Endometriosis is a chronic gynecological condition affecting women of reproductive age and is characterized by a variety of symptoms including severe menstrual pain, chronic pelvic discomfort, and reduced overall quality of life. Despite its significant impact on health, functionality, and psychosocial wellbeing, endometriosis remains largely underdiagnosed and poorly understood in many low and middle income settings, including Kenya, where research on symptom interpretation, awareness, and health behavior is very limited. Many young women normalize menstrual pain as a regular or expected part of menstruation and often delay seeking professional care until symptoms severely disrupt daily activities, academic performance, or emotional and social wellbeing. While existing studies predominantly investigate clinical aspects of diagnosis, treatment, and management, there is limited evidence on how young women interpret early symptoms associated with endometriosis and what specific actions they take before engaging with formal healthcare services. Understanding these perceptual, cognitive, and behavioral factors is critical to improving timely healthcare utilization and reducing unnecessary delays in diagnosis . This study aims to assess the perception and early response to symptoms associated with endometriosis among female Technical

University of Mombasa. A descriptive cross sectional research design will be used to examine how recognition of symptoms, individual interpretations, social influences, and health seeking decisions interact within a university student population. Female students aged eighteen to thirty years will be recruited using a simple random sampling technique from Technical University of Mombasa. A structured questionnaire, developed based on existing literature and expert review, will be administered to collect comprehensive information on demographic characteristics, level of awareness of endometriosis, interpretation of menstrual and pelvic pain, initial coping strategies, and factors influencing delays in seeking professional care.

Quantitative data will be analyzed using descriptive statistics to summarize patterns of knowledge, perception, and interpretation, while inferential statistical tests will be used to examine potential associations between awareness levels, symptom perception, and health seeking behaviors. It is anticipated that many students will demonstrate limited awareness of endometriosis, with a high prevalence of symptom normalization, and a strong tendency to initially manage symptoms through self medication, peer advice, or traditional remedies. It is also expected that socio cultural beliefs about menstruation, perceived stigma, academic pressures, and limited access to accurate reproductive health information will be identified as significant contributing factors to delayed healthcare utilization.

Findings from this study will provide actionable insight into how young women interpret early symptoms associated with endometriosis and how these interpretations influence their initial responses and decisions regarding medical care. By illuminating perceptual and behavioral gaps, this research will support the design and implementation of targeted health education strategies aimed at enhancing symptom recognition and promoting early engagement with formal health services. Such interventions may include student focused reproductive health campaigns, integration of menstrual health education into university health programs, and improved access to youth friendly clinical service. In Conclusion, this study addresses a significant and pressing gap in reproductive health research by focusing on early symptom perception and health seeking behavior .

Keywords: Endometriosis, perception, health

BUSINESS, ECONOMICS, AND ENTREPRENEURSHIP - BEE

Organizational Readiness for E-Procurement Implementation in Public Institutions in Kenya (A Case of Technical University of Mombasa)

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The adoption of electronic government procurement (e-GP) systems has become an important strategy for improving transparency, efficiency, and accountability in public procurement processes. In Kenya, e-procurement has been implemented through the Integrated Financial Management

Information System (IFMIS) in accordance with the Public Procurement and Asset Disposal Act (PPADA), 2015. Despite these reforms, many public institutions continue to experience challenges in achieving effective implementation of e-procurement systems. These challenges are often associated with varying levels of organizational readiness. This study examined the influence of technological readiness, human resource readiness, managerial readiness, and regulatory readiness on the successful implementation of electronic government procurement systems in public institutions in Kenya, with specific reference to the Technical University of Mombasa. The study adopted a descriptive and explanatory cross-sectional survey design within a quantitative research approach. The target population consisted of 48 registered e-GP system users involved in procurement-related activities at the Technical University of Mombasa. A census approach was employed, and data were collected using a structured questionnaire administered through an online platform. The collected data were analysed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the data. Inferential statistical techniques, including Pearson correlation and multiple linear regression analysis, were employed to examine the relationships between organizational readiness dimensions and successful e-GP implementation. Diagnostic tests were conducted to ensure the validity of the regression model. The findings indicated that technological readiness, human resource readiness, managerial readiness, and regulatory readiness had significant influences on the successful implementation of e-GP systems. The study concludes that organizational readiness plays a critical role in determining the effectiveness of e-procurement implementation in public institutions. The study recommends strengthening ICT infrastructure, enhancing staff training and technical capacity, improving managerial support for digital procurement initiatives, and reinforcing regulatory compliance mechanisms to support effective e-GP implementation in public institutions.
Keywords: Electronic Government Procurement (e-GP), Organizational Readiness, Technological Readiness, Human Resource Readiness, Managerial Readiness, Regulatory Readiness.

Digital Marketing Strategies and Non-Financial Performance of Star-Rated Hotels in Nairobi City County, Kenya: The Moderating Role of Technological Capability

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The digital revolution has made digital marketing strategies and technological capability of firms to be critical drivers of firm performance. This study sought to establish the effect of digital marketing strategies on the non-financial performance of star-rated hotels in Nairobi City County, and the moderating role of technological capability. It was founded on the Dynamic Capabilities Theory and the Technology-Organization-Environment framework. The target population was 89 star-rated hotels operating in Nairobi City County as per data from the Tourism Regulatory Authority. Since the target population was relatively small, a census study was done using an explanatory research

design. Data was collected from the marketing managers of the hotels using structured questionnaires. 75 hotels responded and this translated 84% response rate. Data analysis was done using simple linear regression analysis and the moderating effect of technological capability was tested using hierarchical regression analysis. The linear regression analysis results indicated that digital marketing strategies explained 52.9% of the variation in the non-financial performance of star-rated hotels. The regression coefficients also indicated that digital marketing strategies had a positive and significant effect on the non-financial performance of the star-rated hotels. The hierarchical regression analysis results indicated that technological capability moderated the effect of digital marketing strategies on non-financial performance. These results led to the conclusion that digital marketing strategies have a positive and significant effect on non-financial performance of star-rated hotels in Nairobi City County. The study also concluded that technological capability moderates the effect of digital marketing strategies on non-financial performance. The study recommends that management of star-rated hotels should strengthen the adoption and effective implementation of digital marketing strategies to enhance their non-financial performance. Hotel managers should also invest in improving technological capability by upgrading digital infrastructure and enhancing employees' digital skills to support the effective use of digital marketing tools. From a policy perspective, tourism authorities and policymakers should promote digital transformation in the hospitality sector by supporting initiatives that enhance technological capability, digital infrastructure, and capacity building in digital marketing practices among hotels.

Key words: Digital Marketing Strategies, Technological Capability, Non-financial Performance, Star-rated hotels, Nairobi City County, Kenya.

Mission-driven budgeting, Donor Behavior and financial sustainability of non-governmental organizations in Mombasa County.

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Financial sustainability remains a critical concern for non-governmental organizations (NGOs), particularly in contexts characterized by heavy dependence on donor funding and fluctuating financial environments. This study examined the influence of mission-driven budgeting on the financial sustainability of NGOs in Mombasa County, Kenya, with donor behavior considered as a moderating variable. Grounded in Resource Dependence Theory, the study adopted a positivist research philosophy and a descriptive cross-sectional design. Data were collected using structured questionnaires from 75 finance managers drawn from a target population of 123 registered NGOs, yielding a response rate of 61%. Descriptive and inferential statistics were analyzed using SPSS version 28. The findings revealed that mission-driven budgeting has a significant positive effect on financial sustainability ($r = 0.619$, $p < 0.05$), indicating that aligning financial allocations with

organizational mission enhances accountability, resource efficiency, and long-term viability. Furthermore, regression results showed that mission-driven budgeting explained 61.4% of the variation in financial sustainability ($R^2 = 0.614$). The introduction of donor behavior as a moderating variable significantly improved the model's explanatory power ($R^2 = 0.712$), confirming its moderating effect ($\Delta R^2 = 0.098$, $p < 0.05$). These results underscore the importance of both internal financial management practices and external funding dynamics in shaping NGO sustainability. The study concludes that NGOs that institutionalize mission-driven budgeting and effectively manage donor relationships are more likely to achieve financial stability. It recommends that NGOs strengthen mission-budget alignment and engage donors to foster flexible and supportive funding arrangements.

Key words: *Mission Driven Budgeting, Donor Behavior, Financial sustainability*

An AI-Driven Digital Platform for Beauty and Grooming Services to Enhance Entrepreneurship and Business Accountability

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Personal grooming and maintenance services are an essential part of daily life, yet access to these services and sustainable business operations in the beauty and grooming sector remain challenging in the current economic environment characterized by high youth unemployment and rising operational costs. Many skilled individuals in hairdressing, barbering, makeup, nail care, lashes, pedicure, and other grooming services possess marketable skills but lack the financial capacity to establish physical salons due to high rent, equipment costs, and business setup expenses. Additionally, salon owners face significant challenges related to accountability, poor record-keeping, and revenue losses arising from untracked services and employee-related theft. This study proposes the development of an AI-driven digital beauty and grooming services management and booking model that integrates artificial intelligence and machine learning to enhance service accessibility, income generation, and business transparency. The platform enables service providers to create digital portfolios detailing their services, pricing, location, and availability while allowing clients to conveniently book services based on preferences and proximity. The embedded AI components include intelligent service recommendations, automated scheduling, and anomaly detection for financial transactions to improve accountability and reduce revenue leakage. The proposed model supports remote service delivery, reduces dependency on physical business spaces, and expands market reach for youth entrepreneurs. By digitizing operations and incorporating intelligent analytics, the platform promotes entrepreneurship, enhances operational efficiency, and contributes to inclusive economic development within the digital economy.

Keywords: Artificial Intelligence, Machine learning, Digital platform, Business

The Influence of Leadership Financial Decision-Making Practices on Financial Performance of Deposit-Taking SACCOs in Kenya: The Moderating Role of Firm Size

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This study examines the influence of leadership financial decision-making practices on the financial performance of Deposit-Taking Savings and Credit Cooperative Societies (DT-SACCOs) in Kenya, with particular emphasis on the moderating role of firm size. Leadership financial decision-making, encompassing strategic financial planning, budgeting, financial literacy, evidence-based use of financial data, accountability, transparency, and ethical investment practices, has emerged as a critical determinant of institutional sustainability in cooperative financial institutions. Using a quantitative research design with data collected from DT-SACCO leadership through structured questionnaires employing a 5-point Likert scale, this study examined multiple dimensions of leadership financial decision-making including strategic financial planning and budgeting, financial literacy and capacity of leadership, use of financial data in decision-making, leadership accountability and transparency, alignment of financial decisions with member interests, ethical financial decision practices, and investment and resource allocation oversight. The findings reveal that leadership financial decision-making demonstrates a very strong positive correlation with financial performance ($r = .992$) and explains 98.3% of the variance in financial performance outcomes. Simple linear regression analysis indicates that a one-unit increase in leadership financial decision-making predicts a 1.134-unit increase in financial performance ($p < .001$). However, moderated regression analysis reveals a significant negative interaction between leadership financial decision-making and SACCO size ($B = -0.014$, $\beta = -0.022$, $p < .001$), indicating that leadership competence has a stronger effect on smaller SACCOs, with its marginal benefit diminishing as organizational scale increases due to diffusion of decision-making authority. These findings have important implications for regulatory frameworks, governance reforms, leadership capacity-building initiatives, and succession planning strategies tailored to SACCO size categories, emphasizing the need for customized approaches to enhance leadership effectiveness and institutional performance in Kenya's cooperative financial sector.

Keywords: Leadership financial decision-making, financial performance, DT-SACCOs, firm size, moderating effect, corporate governance, Kenya

The Influence of Risk Management Integration on Financial Performance of Deposit-Taking SACCOs in Kenya: The Moderating Role of Firm Size

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This study examines the influence of risk management integration on the financial performance of Deposit-Taking Savings and Credit Cooperative Societies (DT-SACCOs) in Kenya, with particular emphasis on the moderating role of firm size. Risk management integration encompasses credit risk management, liquidity risk management, operational risk management, and strategic risk management frameworks. Using a quantitative research design, data were collected from DT-SACCO leaders using structured questionnaires measured on a five-point Likert scale. The study employed descriptive statistics, correlation analysis, simple linear regression, and moderated multiple regression (MMR) to analyze the relationships between variables. Results revealed that risk management integration has a very strong positive correlation with financial performance ($r = .998$) and explains 99.6% of the variance in financial performance ($R^2 = .996$). A one-unit improvement in risk management integration predicted a 1.034-unit gain in financial performance ($\beta = 1.034$, $p < .001$). Critically, the moderated regression analysis demonstrated that firm size positively moderates this relationship ($B = 0.050$, $\beta = 0.080$, $t = 76.39$, $p < .001$), indicating that the benefits of risk management integration amplify as SACCO size increases. While board oversight and strategic integration were identified as strengths, operational capabilities such as staff training on emerging risks and digital risk readiness were identified as weaknesses. The findings underscore the importance of institutionalizing comprehensive risk management frameworks, particularly for larger SACCOs facing greater risk exposures. The study recommends tailored risk management strategies based on SACCO size, enhanced staff capacity building, and investment in digital risk management tools to strengthen financial sustainability and member value.

Keywords: Risk management integration, financial performance, DT-SACCOs, firm size, moderating effect, Kenya

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From Agricultural Waste to Industrial Catalyst Supports: Valorizing Rice Husk Biochar for Sustainable Green Diesel Production

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The transition toward sustainable manufacturing demands strategies that integrate waste valorization, renewable energy production, and cost-efficient processing. This study presents an innovative catalyst design approach that converts rice husk, an abundant agricultural residue, into high-performance catalyst supports for green diesel production. Rice husk was transformed into biochar and further modified through silica extraction to enhance porosity, surface area, and active site accessibility. A portion was chemically activated (KOH) to further tailor textural properties.
Nickel catalysts supported on desilicated rice husk biochar (Ni/RH-C), activated biochar (Ni/RH-AC), rice husk–derived biosilica (Ni/RH-SiO_2), and commercial carbon (Ni/Ccomm) were synthesized and evaluated for triglyceride deoxygenation to green diesel–range hydrocarbons (C15–C18). Ni/RH-C achieved the highest conversion (96%), outperforming Ni/RH-AC (76%), Ni/C_comm (78%), and Ni/RH-SiO_2 (72%). Ni/RH-AC and Ni/Ccomm showed greater susceptibility to coke deactivation, whereas Ni/RH-SiO_2 was least affected. These findings demonstrate that rice husk-derived mesoporous biochar and biosilica are effective support catalysts offering distinct advantages. Importantly, the results indicate that post-desilication chemical activation is unnecessarily and can be detrimental to the deoxygenation process of bulky fatty acids. Beyond catalytic performance, this work demonstrates an integrated model connecting agricultural systems with industrial fuel production. Converting locally available biomass waste into functional catalyst supports supports circular economy principles, reduces reliance on mined inorganic materials, and lowers production costs. The approach also enables decentralized biorefinery development, strengthening sustainable collaboration between agriculture and energy sectors. This study highlights how catalyst material innovation can transform agricultural waste into a strategic resource for renewable fuel manufacturing and cleaner industrial processes.

The Influence of Internal Control Practices on Financial Performance of Deposit-Taking SACCOs in Kenya: The Moderating Role of Firm Size

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This study examines the influence of internal control practices on the financial performance of Deposit-Taking Savings and Credit Cooperative Societies (DT-SACCOs) in Kenya, with particular emphasis on the moderating role of firm size. Drawing on Agency Theory, Stewardship Theory, and Resource Dependence Theory, the research investigates how internal control mechanisms including internal audits, segregation of duties, fraud prevention systems, and compliance frameworks affect key financial performance indicators such as Return on Assets (ROA), Return on Equity (ROE), and asset growth. Using a quantitative research design, data were collected from DT-SACCO leaders through structured questionnaires employing a 5-point Likert scale. The study measured internal control practices across eleven dimensions, including management commitment, role clarity, audit

independence, member oversight, fraud prevention, real-time reporting, board oversight, control adaptability, periodic testing, technology integration, and financial reporting transparency. Results revealed that internal control practices have a very strong positive correlation with financial performance ($r = .996$, $p < .001$), explaining 99.2% of the variance in financial outcomes. However, moderated regression analysis demonstrated that firm size significantly moderates this relationship ($B = -0.031$, $\beta = -0.051$, $t = -63.12$, $p < .001$), with smaller DT-SACCOs benefiting more substantially from improvements in internal controls than their larger counterparts. The findings suggest that while robust internal control systems are critical for safeguarding organizational resources and enhancing profitability across all DT-SACCOs, the marginal benefits diminish as organizational size increases, possibly due to existing sophisticated systems in larger institutions or interactions with other governance mechanisms. The study recommends size-differentiated regulatory frameworks and targeted capacity-building initiatives to optimize internal control effectiveness across the SACCO sector.

Keywords: Internal control practices, financial performance, DT-SACCOs, firm size, moderating effect, Kenya, corporate governance

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Do Kenya's Policies on Wildlife-Based Tourism Development Deliver Community Economic Benefits? Evidence from the Maasai Mara National Reserve, Kenya

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Abstract

Wildlife tourism is widely promoted as a pathway for sustainable economic development in communities surrounding protected areas. In Kenya, the Maasai Mara National Reserve is one of the most prominent global wildlife destinations and generates significant tourism revenue. Despite this economic potential, communities bordering the reserve continue to experience limited economic benefits, including low employment opportunities, weak participation in tourism enterprises, and uneven distribution of tourism revenue. This study evaluates the effectiveness of wildlife tourism policy and institutional frameworks in promoting inclusive community economic development around the Maasai Mara National Reserve.

The research adopts a mixed-methods approach anchored on the nature-based tourism framework. Data were collected from 421 respondents, including residents, policymakers, administrators, and tourism enterprise operators. Quantitative data were analyzed using descriptive and inferential

statistics, while qualitative insights were obtained through key informant interviews and thematic analysis.

Findings indicate that although policy frameworks are widely perceived as supportive of community participation, equity, and benefit-sharing, their practical impact on community economic development remains limited. Regression results show that wildlife tourism policy frameworks do not significantly predict sustainable economic outcomes for local communities (B = 0.011, p = 0.858). Qualitative evidence further highlights challenges such as weak enforcement, bureaucratic delays, governance constraints, high licensing costs, and inconsistent community engagement.

The study concludes that while Kenya's wildlife tourism policies provide an enabling institutional environment, gaps in implementation limit their effectiveness in delivering inclusive economic benefits. Strengthening policy enforcement, improving institutional coordination, and enhancing community participation are essential to ensure that wildlife tourism contributes meaningfully to sustainable local economic development.

Keywords: Wildlife tourism; Community economic development; Protected area governance; Policy effectiveness; Maasai Mara

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Smart Self-Checkout System for Enhancing Supermarket Business Operations

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There has been a rapid growth of retail businesses which has increased the demand for an efficient, secure and customer friendly shopping system. As we may know ,traditional supermarket checkout processes are characterised by long queues, manual errors and inventory inefficiencies, which negatively impact both customer experience and operational performance. From this abstract I present the design and implementation of a mobile based smart supermarket system that automates product scanning, billing and receipt generation using barcode technology and a centralized database.
The proposed system allows customers to scan items using a mobile application, directly off the shelf , view real time purchase totals and generate a digital receipt upon checkout. This will minimize the reliance on traditional cashier based checkout by allowing staff to transition into customer support and security roles. To address security and loss prevention questions that do arise, the system incorporates QR code receipt verification alongside RFID based cart or bag scanning at the store exits. This enables staff to authenticate transactions and confirm consistency between purchased items and physical carts. This approach improves transparency, reduces unauthorized item removal and at most importantly supports efficient retail operations.

By digitizing core retail processes, the system improves transaction speed, minimizes human error, and supports better inventory and sales tracking. This demonstrates that mobile enabled retail solutions can enhance business efficiency, reduce operational costs, and promote entrepreneurial innovation in modern supermarket environments. The study contributes to the adoption of digital technologies as strategic tools for improving productivity and competitiveness in the retail sector.

Keywords: Smart Self-Checkout, Retail Automation, Mobile Commerce, Digital

From Visual Storytelling in East African communities – Heritage Films – to Online, Virtual, Hybrid and AI Spaces

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Traditional media and the four industrial revolutions.
From visual storytelling in East African communities – heritage films – to online, virtual, hybrid and AI spaces
Globalisation processes, together with technological development, raise questions about traditional forms of communication, their duration and transformation. Contemporary Africa, and Kenya in particular, is a laboratory for this change. Kenya's history is marked by the multiplicity and diversity of cultures developed by peoples with different pasts and heritages. Relations between them were based on a similar philosophical and practical attitude towards the world. Its main media were orature, oral tradition, visual storytelling, and writing. The clash with foreign cultures in the 19th and 20th centuries meant global modernisation for Africa's cultural communities – the introduction of the Latin alphabet and the mechanisation of transport, factory production, industrial automation, and finally the Internet, big data, smart factories and AI. Devices and technologies lead to media-dominated communication. This means the exchange of information and messages (including art) according to patterns typical of successive generations of transmitters: photography, cinema, digital and post-digital media. The media create a Third Space, an intermediate space. In the liminal space between media models and cultural heritage, synthesis and negotiation take place: hybrid forms and hybrid identities emerge, and a breakthrough occurs in the relationships between colonial/postcolonial, local/global, and modernist/postmodernist content. I would like to present the 1-2-3-4.0 and AI media communication models, and then ask about negotiations in the communication space between innovation and the repetition of traditional oral structures.

Digital Technologies and Ai-Enhanced Decision-Making in Street-Level Bureaucracy: Pathways for Cultural Heritage Governance

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Artificial Intelligence (AI) and digital technologies are reshaping governance structures, offering new opportunities for the sustainable management of cultural heritage and related ecosystems. This study investigates the integration of AI into decision-making protocols within street-level bureaucracy, emphasizing its potential to strengthen local governance systems that safeguard cultural assets, heritage sites, and community traditions. Drawing on a qualitative review of existing literature, it explores how AI enhances bureaucratic processes by improving efficiency, accountability, and responsiveness in contexts where cultural heritage preservation is central to development. While challenges such as ethical concerns, transparency, and risks of technological exclusion persist, opportunities emerge from user-centered AI designs, natural language processing that supports inclusive communication across diverse communities, and computer vision that enables monitoring of heritage sites and artifacts. Future directions highlight human-AI collaboration and responsible innovation aligned with social justice and sustainability, with the study ultimately arguing that AI integration in public administration can reinforce cultural heritage governance, support biodiversity protection within heritage landscapes, and contribute to equitable economic transformation through heritage valorization.

Key Words: Artificial Intelligence (AI), Street-Level Bureaucracy, Biodiversity Management, Cultural Heritage Governance, Economic Transformation

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Kinubi Swahili: The border-crossing dialect of a highly mobile community

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This paper examines the morphosyntax of Kinubi Swahili spoken in Uganda. Nubi communities traditionally live in trace their origins back to colonial times and their services in the King's African Rifles. Their main language of identity and home use is Kinubi. However, most members of the community also speak at least Swahili and English, as well as other languages, depending on where they are based. Whereas the Kinubi as spoken in Nubian communities has been well studied, the Kiswahili as spoken by the Nubians is yet to be studied. There is need to understand, compare the Kiswahili as spoken by this highly mobile community of Nubians. This will be achieved by analysing its morphosyntax in relation to Sheng in Kenya and Kinubi Swahili in Uganda.

Keywords: migration, mobility, Kinubi Swahili, Ugandan Swahili variety

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Influence of Diversified Revenue Streams, Donor behavior and Financial Sustainability of Non-Governmental Organizations in Mombasa County.

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This study examined the influence of diversified revenue streams and donor behavior on the financial sustainability of non-governmental organizations (NGOs) in Mombasa County, Kenya. Grounded in Resource Dependence Theory, the study sought to establish how revenue diversification strategies contribute to organizational stability and how donor behavior moderates this relationship. A descriptive cross-sectional research design was adopted, guided by a positivist research philosophy. Data were collected from 75 finance managers of registered NGOs using structured questionnaires and analyzed using SPSS version 28 through both descriptive and inferential statistics. The findings revealed a significant positive relationship between diversified revenue streams and financial sustainability ($r = 0.444$, $p < 0.05$), indicating that NGOs with multiple income sources are more resilient to financial shocks and less dependent on single funding streams. Revenue diversification practices such as adoption of multiple revenue models and strategic partnerships were found to enhance financial stability. However, the effect size was modest, suggesting that many NGOs have not fully optimized alternative funding opportunities. Further analysis showed that donor behavior significantly moderates this relationship, increasing the explanatory power of the model ($\Delta R^2 = 0.098$, $p < 0.05$). Factors such as funding flexibility, donor priorities, and reporting requirements were found to either enhance or constrain sustainability outcomes. The study concludes that while revenue diversification is a critical determinant of financial sustainability, its effectiveness is strongly influenced by donor behavior. The study recommends that NGOs strengthen income diversification strategies through social enterprises, partnerships, and local fundraising, while also engaging donors to secure more flexible and sustainable funding arrangements.

Keywords: *Diversified Revenue Streams, Donor Behavior, Financial Sustainability, NGOs, Resource Dependence Theory.*

The Influence of Financial Transparency on Financial Performance of Deposit-Taking SACCOs in Kenya: The Moderating Role of Firm Size

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This study investigates the influence of financial transparency on the financial performance of Deposit-Taking Savings and Credit Cooperative Societies (DT-SACCOs) in Kenya, with particular emphasis on the moderating role of firm size. Financial transparency, encompassing transparent

financial reporting, accessible audited accounts, and regular disclosure of financial health to members, has emerged as a critical determinant of institutional sustainability and member confidence in cooperative financial institutions. Using a quantitative research design with data collected from DT-SACCO leadership through structured questionnaires employing a 5-point Likert scale, this study examined multiple dimensions of financial transparency including frequency of financial disclosures, accessibility of financial reports, member awareness and understanding, timeliness and accuracy of reporting, external audit practices, ICT adoption in financial reporting, and transparency in financial decision-making. The findings reveal that financial transparency demonstrates an extremely strong positive correlation with financial performance ($r = .999$) and explains 99.8% of the variance in financial performance outcomes. Regression analysis indicates that a one-unit increase in financial transparency predicts a 0.933-unit increase in financial performance. However, moderated regression analysis reveals a significant negative interaction between financial transparency and SACCO size ($B = -0.004$, $p < .001$), indicating that transparency has a stronger effect on smaller SACCOs, with its marginal benefit diminishing as organizational scale increases. These findings have important implications for regulatory frameworks, governance reforms, and capacity-building initiatives tailored to SACCO size categories, emphasizing the need for customized approaches to enhance financial transparency and institutional performance in Kenya's cooperative financial sector.

Keywords: Financial transparency, financial performance, DT-SACCOs, firm size, moderating effect, corporate governance, Kenya

RESEARCH AND INNOVATION IN INDUSTRY AND MANUFACTURING - RIIM

On Quotient Rings of Pointfree Function Rings

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In [2], the authors study algebraic properties of quotient rings in the ring C(X) of real-valued continuous functions on a Tychonoff space X. With a view to supplementing the results in the cited paper, we extend this notion to the setting of point-free topology. In this talk, we will show that these results are actually purely ring theoretic and thus deduce its extensions to the ring RL of real-valued continuous functions on a completely regular frame L. We will show that the maximal essential ideals of RL are precisely the M-ideals indexed with the nowhere dense sublocales of ²L(Stone- Ç Cech compactification of L). We will also show that the nowhere dense sublocales of ²Lare perfect if and only if every prime ideal in RL/MA is essential whenever A is a closed sublocale of ²L.It is known from [1] that a ring RL is an EIN-ring if and only if L is an EF-frame. We will show that RL/OA is an EIN-ring if and only if the sublocale A (regarding A as a frame in itself) is an EF-frame if and

only if RL/MA is an EIN-ring.

Keywords: Sublocale, quotient rings, classical rings of real valued continuous

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Convex Optimization Frameworks for Equitable Water Rationing using Data Enabled Predictive

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Water rationing has become a recurrent urban reality due to climate change and population growth. Ensuring equitable distribution during scarcity remains a critical challenge. Conventional control methodologies for water rationing, particularly model predictive control (MPC), rely on accurate physical models that are costly to develop and inherently unable to adapt to sudden supply disruptions. More critically, they lack any mechanism to enforce equitable allocation when demand exceeds supply a challenge in an era of recurrent water scarcity. This research presents a convex optimization framework for equitable water rationing using Data-Enabled Predictive Control (DeePC). Unlike conventional approaches, the proposed framework requires no physical system model. It utilizes only historical input/output trajectories data already collected by water utilities to construct Hankel matrices that characterize system behavior, making it immediately deployable without costly modeling efforts. The key theoretical contribution is the novel construction of DeePC as a structured convex optimization problem. This guarantees global optimality of all computed control actions, a level of certifiability unattainable in non-convex or heuristic approaches. Equitable rationing constraints are embedded directly within the optimization, ensuring proportional water allocation during scarcity while satisfying pressure, flow, and chlorine limits essential for safe delivery. This research establishes a scalable and mathematically principled foundation for socially equitable urban water rationing.

Keywords: Convex Optimization, DeePC, Water Rationing, Equitable Allocation

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Synthesis And Electrical Characterisation Of Beta-Gallium Oxide For Schottky Diode Fabrication And Solar Cell Passivation

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This study aimed at determining the optimal concentration of ²-Ga2O3 for electrical applications in

making electrode contacts, Schottky diodes, and passivation of solar cells. The study employed low-temperature, vacuum-free crystal-growth processes of spray pyrolysis and sol-gel spin coating techniques to prepare ²-Ga2O3from tetrahydroxogallate (III) ammonium precursor, then investigated its electrical characterisation. Varying concentrations of the precursor were deposited on the 1 cm2 n-type silicon substrate under the same conditions of pressure and substrate temperature. The films were characterised by scanning electron microscope (SEM), atomic force microscopy (AFM), and x-ray diffraction (XRD) for morphology and crystallinity analysis. The electrical characterisation was done by determining the electrical conductivity and the I-V and C-V characterisation of the thin film samples, with metal contacts deposited by electron beam deposition (EBD). The Ohmic contacts consisted of four metal stacks, i.e., Ti/Al/Ni/Au, compared to previously reported three metal stacks, and Schottky contacts were of Pd/Au. Spray pyrolysis films with varying precursor solution concentrations demonstrated higher conductivity of 5.26 ©-1.cm-1compared to spin-coated films 4.76 ©-1.cm-1. Metal contacts done on pyrolytically sprayed films of 10 at% precursor solutions demonstrated slightly better electrical properties, such as an ideality factor of 1.13, and I-V Schottky barrier height (SBH) of 0.60 eV compared to an ideality factor of 1.24 and SBH of 0.59 eV exhibited by the spin-coated film. Built-in voltages (Vbi) of 0.77 eV and 0.86 eV, as well as saturation currents (Is) of 5.09 × 10-6 A and 5.19 × 10-6 A were reported for pyrolytically sprayed and spin-coated samples, respectively. These values closely match the characteristics of an ideal diode, with the 10% precursor concentration samples yielding the optim

Keywords: Spray Pyrolysis, Spin Coating, ²-Ga2O3, Schottky barrier

HEALTH, WELLNESS & SOCIETY -HWS

Computational Topology and Ant Colony Optimization for Structural Feature Extraction in Trabecular Bone Imaging.

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Osteoporosis is a persisting skeletal disease characterized by weakening of microarchitecture in the bone and increased fracture risk. Traditionally, clinical assessment of osteoporosis is done mainly in terms of bone density measurement; however, many investigations that have been conducted in this area indicate that this is not enough to account for differences in bone strength and fracture risk. The structural arrangement of trabecular bone is a significant factor in mechanical strength.
This paper proposes a computational approach to analyze trabecular bone structure using computed tomography (CT) images and graph-based modeling. The aim is to develop an automatic approach to analyze trabecular bone structure, which involves image preprocessing, segmentation, skeletonization, and computation of features using graph-based modeling. The trabecular bone structure can be represented as a graph, where nodes are junctions and edges are trabecular struts. Geometric, network, and topological features, including trabecular thickness, connectivity density, Betti numbers, and Euler characteristics, can be computed from this model.

Ant Colony Optimization will be utilized in the suggested framework to improve the performance of feature selection and segmentation. The suggested method will be assessed using two data sets: a primary data set consisting of anonymized clinical CT scans of the proximal femur from a hospital database, and a secondary data set consisting of publicly accessible micro-CT trabecular bone data sets. Regions of interest (ROI) will be specified in the trabecular area of the femoral head to ensure uniform structural analysis.

The perceived impact of this study is to create a topological-based computational method for characterization in trabecular bone, which goes beyond density-based characterization methods. The integration of graph theory, topological data analysis, and swarm intelligence optimization in a single framework is a more comprehensive representation of trabecular architecture and opens avenues for future studies in computational bone imaging.

AI-Driven Digital Twin for Personalized Healthcare and Predictive Medicine:

A Case Study on Epilepsy Management

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Epilepsy is a leading neurological disorder that presents major diagnostic and management challenges, particularly in low-resource healthcare settings. This study proposes an AI-driven Digital Twin framework to enhance personalized healthcare and predictive medicine, focusing on epilepsy management. Using the Design Science Research Methodology (DSRM), the research involves designing, developing, and evaluating a digital twin capable of integrating real-time patient data from EEG devices, electronic health records, and *machine learning algorithms* for seizure prediction.

Data will be obtained from established EEG datasets and relevant literature from public domains. The model will be tested in a simulated healthcare environment and evaluated based on predictive accuracy, usability, and scalability. Ethical considerations, including anonymization, and compliance with health data protection laws, will be observed.

The expected outcome is a validated, functional AI-driven model that improves seizure prediction accuracy, supports timely clinical decision-making, and can be adapted to manage other chronic diseases. This research aims to address gaps in current epilepsy management practices in Kenya and contribute to the growing field of AI-driven digital twins in global healthcare.

Micropropagation and Characterization of Wild Bitter Yam (*Dioscorea dumetorum)* from Kwale County

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Dioscorea dumetorum is also known as the bitter yam, cluster yam, trifoliate yam. *Dioscorea* species are the monocotyledonous tuber crops under family *Dioscoraceae*. The genus Dioscorea consists of over 600 species and it is the most important genus in the *Dioscoraceae* family. Wild bitter yam. grows from tubers from the previous crop in bushes during the long rain period (between March and August). During the rainy season, food used to be scarce and bitter yam was used instead hence regarded as a famine crop among the Digo community in Kwale County. With more settled agriculture, more and more bushes were cleared, making the yam an endangered species. The aim of this research was to morphologically characterize the wild bitter yam collected in Mivumoni Location of Kwale County, to develop seedlings through micropropagation/ tissue culture as well as sequencing the wild bitter yam to determine its genetic makeup and evolutionary relationship with cultivated yam species. The plant characteristics observed including the leaves, flowers, vines, spines, shoots, fruits, seeds, tubers, roots and habits of the plant like twining in the field. Samples of the bitter yam were collected from the bush randomly. Some of the root tubers of the specimen were cultivated after breaking of dormancy. The medium for tissue culture was Murashige and Skoog (MS) with its macro-, micro-nutrients and vitamins as well as organic supplements. Various phytohormones such as IBA, IAA, NAA, and Cytokinin used in various concentrations to induce shoots and roots. Leaves were collected and dried in silica gel. The specimens were then crushed and incubated and DNA was extracted using standard protocol and analysed. Data collected on morphological characteristics was analyzed using two-way ANOVA to show the differences between and within the wild and cultivated yam varieties. The wild yams were observed to have sharp pointed trifoliate leaves, with smooth margin and 4-5 veins that run parallel to one another from the main petiole. They also have cylindrical, green, spiked vines of varying length. The vines were also observed to twine around plant stems in a clockwise direction. The bitter yam plants bear male and female flowers arranged in spikes on separate plants. The female plants produce triangular dehiscent fruits 4.00 ± 0.00 cm in length and the winged seeds measure about 2.5cm long. The wild bitter yam plants were observed to produce primary and secondary fibrous roots. The primary roots are bourn on the stem while the secondary fibrous roots are found on the tubers. The plant bears one to four tubers in a single plant.

Influence of Competency-Based Education and Training on Mitigating Biological Hazard Exposure Among Cleaners at Medical Schools: A Cochrane Review

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CBET is an established training system that is founded on standards and recognised qualifications based on competence. CBET has been rolled out nationally in Kenya through the Ministry of

education and the National Technical and Vocational Training Authority. Core skills in Occupational health and safety require competency assessment during and after training. Cleaners in Medical Schools at Universities are a vital group as they support sanitation, hygiene, and waste management. This cadre often faces a wide range of occupational health and safety risks from biological hazards. Biological hazards are among the main risks in the medical school environs including laboratories. Competency-based training on occupational hazard management provides an invaluable opportunity for university cleaners to acquire skills to manage biological hazards. While cleaners should be provided with such training, little is known about the extent of CBET training at medical schools. Empirical research shows that untrained workers are three times more likely to be exposed to hazards [AOR=2.9, 95% CI (1.04, 8.02)] (Afework, A., *et al*. 2023). This Cochrane review looks at the area of CBET for cleaners at medical schools worldwide.

Keywords: Competency-Based Education and Training, Biological Hazard, Medical Schools, Cleaners, Waste Management.

Narrative-Informed and Culturally Responsive Psychosocial Interventions for Suicide Prevention in Resource-Constrained Settings

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Suicide remains a major global public health concern, accounting for over 700,000 deaths annually, with the greatest burden occurring in low- and middle-income countries. In Kenya, limited access to mental health services and overreliance on centralized referral systems constrain timely and equitable care. This study examines the application of narrative-informed and culturally responsive psychosocial interventions as contextually relevant strategies for suicide prevention in resource-constrained settings. Using a qualitative case study design, the research draws on field-based clinical practice with high-risk populations, including survivors of suicide attempts and their families. The study identifies significant psychosocial and economic burdens, often compounded by stigma, low mental health literacy, and weak early identification and referral systems. The intervention integrates narrative therapeutic approaches with culturally embedded practices and family support structures to enhance engagement and contextual relevance. External memory aids and culturally familiar materials were incorporated to support identity reconstruction, emotional processing, and client–family reconnection. Preliminary findings indicate improved family involvement in care, played a pivotal role in recovery, increased awareness of suicide risk factors, and strengthened pathways for early detection and referral within community settings. These findings suggest that culturally grounded, narrative-informed interventions hold potential for improving the accessibility, acceptability, and sustainability of suicide prevention efforts in low-resource contexts. This study contributes to the growing body of global mental health knowledge by proposing a contextually

adaptable model that aligns evidence-based practice with cultural realities. It underscores the importance of integrating family systems and community resources to reduce stigma and enhance resilience among vulnerable populations.

Keywords: Cultural responsiveness, Narrative-informed interventions, Family-centred care, Suicide prevention, Community mental health

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One Health Youth Empowerment & Resilience (OH-YER) Initiative to Mitigate Alcohol Use Disorders (AUD) in Rural Kenya

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The concept of One-Health encompasses the wellbeing of human, animal and environment which is critical in the Southern Sahara Countries, specifically for communities living in the under-developed rural areas in Kenya. This research work was carried out as an initiative that resonates with several Sustainable Development Goals (SDGs); 1st-*No Poverty*, 2nd-*Zero Hunger*, 8th- *Decent Work and Economic Growth*. 13th-*Climate Action* and 17th-*Partnership for Goals*. The initiative was carried out by a Community Based Organization (CBO) named Sanitization Initiative for Resilient Communities (SIRC) and a research firm named Data Vine Solutions targeting youths in Kiambu County where alcohol and substance abuse renders the youth hopeless, unproductive and unfit for employment. Alcohol is the most abused substance among the youth in Kiambu County, with a prevalence rate of 62.5%. The paper was anchored on the Common Pool Resource (CPR) Theory that explores how communities can collectively manage and govern shared natural resources sustainably, Trans-Theoretical Model (TTM) that is used globally to bring change in a wide range of problem behaviours as well as the Resilience Theory that emphasizes on the empowerment of the youths through lucrative activities helping the avoid and recover from drugs and substance abuse, particularly alcohol. A sample of 360 youths were selected using cluster sampling per village in two Sub-Locations namely Ng'enda and Kiamwangi. Youths with a history of drugs and alcohol abuse were identified with the help of Community Health Promoters (CHPs). For scientific rigour, project team applied the Alcohol Use Disorders Identification Test (AUDIT) to ascertain the extent of alcoholism while mental wellbeing indicators were anxiety and depression measured using Beck Anxiety Inventory (BAI) and Beck Depression Inventory (BDI) respectively. As a mitigation, Youth Participatory Actions (YPA) were implemented for sustainable environmental conservation and climate-smart agricultural practices; irrigation, organic farming and rearing of Black Soldier Fly (BSF), poultry, rabbits, sheep, aquaculture and apiculture. Youths were transformed through self-employment in lucrative agro-

enterprise activities in production, reducing on-farm waste, value addition, branding and marketing of their farm products. Income generation earns them a living thus improving their living conditions and contributing to community resilience. Food security ultimately improves their dietary practices and nutritional status and hence their health wellbeing. The study recommends empowerment of the youth through relevant one-health skills trainings, access to advanced equipment, support in environmental conservation and climate-smart farming with guaranteed market linkages.

Key Words: One-Health, Youth Empowerment & Resilience, Alcohol Use Disorders and Climate-Smart Agricultural Practices.

SUSTAINABLE ENVIRONMENT & BLUE ECONOMY -SEBC

Morphological Characterization of Native Microalgae and Bacteria found in Domestic Wastewater in Mombasa- Kenya

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Domestic wastewater treatment is a pressing problem in the coastal Kenya, where rapid urbanization and limited treatment infrastructure contribute to environmental and aquatic pollution. The dynamics of local microbial communities is vital to inform sustainable wastewater management. There is currently limited data on characterization and exploitation of microalgae and bacteria found in wastewater treatment systems here in Kenya. In this research wastewater samples were collected from three sites in Mombasa County; Mikindani Wetland Treatment (MIK), Technical University of Mombasa (TUM) and Shimo La Tewa (SLT). Indigenous Microalgae and bacterial isolates were obtained via standard microbiological procedures. Microalgae were characterized by using light microscope to identify dominant microalgal taxa and bacteria were exposed to gram staining test to differentiate the gram positive against gram negative. Bacterial biochemical identification followed established protocols. The gram stain results recovered across the three sites showed gram negative dominance of *Escherichia coli, Klebsiella sp, Enterobacter aerogenes, Pseudomonas aeruginosa, Staphylococcus aureus and Proteus* and gram positive in *Bacillus subtilis and Stahylococcus aureus*. Biochemical results showed that majority of the bacteria isolates were indole and H_2S negative. This interpretation that the isolates possess complementary metabolic functions. Microalgae results showed that *Chlorella sp,* was dominant in all the three sites. Others, *Chlamydomonas sp, Scenedesmus sp* division of *Chlorophyta* were in small quantities. *Navicular* sp was found in the three sites in small quantities and *Chrysophyta sp* was found in MIK site. This study therefore, provides baseline evidence of the ecological versatility and diversity of indigenous microalgae and bacteria in the wastewater.

Key words: Mikindani constructed wetland, native microalgae, native bacteria, Shimo La Tewa constructed wetland

Coral bleaching patterns on natural and artificial reefs in Shimoni during the 2024 Global Coral Bleaching event

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Coral reefs are among the most biologically diverse ecosystems on earth, yet they are increasingly threatened by climate-induced bleaching events. The 2024 Global Coral Bleaching Event heavily impacted coral reefs worldwide including those in Kenya. While bleaching of corals on natural reefs (NR) is well studied, there are fewer coral bleaching-specific research on artificial reefs (AR). As reef restoration adapts to changing climate, corals with specific desirable traits are targeted. Corals targeted for fast growing traits have been shown to improve coral cover in the short term, but their impact on coral bleaching resilience is unclear. This study investigated differences in bleaching susceptibility between corals on natural and artificial reefs, with a focus on coral species selected for their fast growing traits in the genus Acropora. The research was conducted in south coast Kenya, where corals on eight artificial reef patches (each 256 m2) were compared to those on eight patches of a continuous stretch of adjacent natural reef at similar depth. Coral bleaching was assessed using five replicate transects per patch, where along each transect 10 photo quadrats were taken. Images were captured before the peak bleaching period (March 20–25, 2024) and during peak bleaching (April 15–16, 2024). Additionally, weekly photographs were taken over a three-month period (March 22–June 11, 2024) for one AR and one NR patch to monitor bleaching progression more detailed over time. These images were analyzed to quantify bleaching prevalence, severity, and any observable differences in bleaching patterns between NR and AR. Manual notations were performed for all hard coral colonies larger than 10 cm within each quadrat. Data collected included coral genus and bleaching category (five categories used). Statistical analyses, including generalized linear models, were applied to identify significant predictors of bleaching susceptibility. Preliminary observations suggest that bleaching appeared to start later on artificial reefs due to the specific species composition present but eventually reached very high levels (70-90%) on both natural and artificial reefs. The mortality that followed this event was high (50-70%), with artificial reefs eventually faring worse than natural reefs. Ongoing analyses will provide deeper insights into the factors driving bleaching patterns and post-bleaching survival, offering valuable guidance for optimizing restoration strategies in a warming ocean.

Keywords: Artificial reefs, Natural reefs, Coral Bleaching, Heat resistant, South coast Kenya

Green Synthesized Silver Nano-catalysts for Treatment of Synthetic Textile Dyes in Water: System Analysis and Optimization

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The textile industry, while vital for employment and export growth in many countries, poses significant environmental challenges. Their aqueous effluents contain loads of synthetic textile dyes, that are are resistant to biodegradation and photodegradation, thus persistent. Due to their complex aromatic structures, synthetic textile dyes in most cases are toxic and carcinogenic. In order to protect public health and ensure ecological sustainability, the treatment of synthetic textile dye effluents is vital. Conventional treatment methods e.g., bioremediation, adsorption, and advanced oxidation processes are often inefficient. Reductive degradation of synthetic textile dyes using noble metals e.g., Pd achieves significant detoxification. However, noble metals are expensive and are readily deactivated in natural waters. Compared to noble metals, silver nanoparticles (AgNPs) are cheaper and moderately stable in water. This study investigated the potential of green-synthesized AgNPs for treatment of cationic methylene blue (MB) and anionic methyl orange (MO) in water. UV–Vis analysis confirmed the formation of AgNPs (»max= 424 ± 1.0 nm) from AgNO3 and Cucumis sativus extracts. Process optimization using Central Composite Design and Response Surface Methodology in Minitab 22 revealed optimal conditions as pH €,MO= 5, pH €,MB= 9.7, NaBH „= 5 mM, cAgNPs,MO = 39.09 mg/L and cAgNPs,MB = 100 mg/L, and c0,dye = 10 mg/L. Under these conditions, the removal efficiencies of MO and MB using the AgNPs+NaBH „ system were 98.15 and 95.45%, respectively. Application of the Langmuir–Hinshelwood kinetics model provides surface reaction rates as k c,MB= 0.030 min {¹and k c,MO= 0.020 min {¹and adsorption equilibrium constants KMO = 0.291 L/mg and KMB = 0.147 L/mg. Thus, MB is fast reduced under alkaline conditions while MO is best removed under acidic conditions. These findings demonstrate the efficiency and environmental promise of green synthesized AgNPs as catalysts for treatment of synthetic textile dyes in water.

Keywords: reductive degradation, sodium borohydride, silver nanoparticles,

Ecological and Operational Drivers of Catch Diversity in Kenya's Small-Scale Reef Fisheries: Implications for Blue Economy Management

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Small-scale fisheries (SSFs) along tropical coastlines are central to national blue economy initiatives and local livelihoods, yet their multispecies, multigear, multifleet and socio ecologically complex nature poses challenges for effective management. Understanding the ecological and operational factors shaping catch composition is therefore essential. We analyzed a multi-site, year-round dataset collected between March 2023 and December 2024 comprising 44,652 individuals from reef-associated SSF landings across five fish landing sites on the north and south coasts of Kenya. The dataset included 278 species recorded across 64 propulsion–gear combinations. Species richness varied significantly across sites, with Kilifi and Mayungu exhibiting the highest diversity, likely reflecting the greater variety of propulsion–gear combinations and higher levels of motorization, particularly dhows deploying longlines and ring nets. Multivariate analyses showed that spatial difference across sites was the primary driver of variation in catch composition, whereas propulsion–gear combinations and seasons had weaker overall effects. However, species-level analyses revealed strong gear selectivity: SIMPER results indicated that a small number of dominant species particularly Siganus sutor, Chirocentrus dorab, and Hyporhamphus dussumieri accounted for much of the dissimilarity among catches. Indicator species analysis further identified species associated with specific fishing methods and locations, such as pelagic predators (Scomberomorus commerson) linked to motorized dhow–ring net operations. Consistent with these findings, nNMDS ordination showed broad overlap among groups with high within-site variability, suggesting that differences arise mainly from shifts in the relative abundance of dominant species rather than wholesale community restructuring. The convergence of PERMANOVA, nNMDS, SIMPER, and IndVal results indicates that propulsion–gear combinations act as ecological filters shaping catch composition and species vulnerability. These findings highlight the need for gear-sensitive and site-specific management approaches in tropical SSFs. Policies should prioritize adaptive effort regulation, including propulsion–gear-specific quotas and spatial zoning, while integrating indicator species into community-based monitoring systems to detect early signs of localized depletion or habitat change within Kenya's evolving blue economy and co-management frameworks.

Keywords: Small-scale fisheries, species composition, Species selectivity, Kenya coast

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From Reef to Landing Site: Trophic-Level Responses to Fishing Technology and Spatial Variation in Kenyan Coastal and Marine Small-Scale Fisheries

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The trophic structure of reef fish catches provides a powerful diagnostic lens for evaluating ecosystem conditions and the ecological footprint of fisheries. This study evaluated spatial and seasonal variation in catch per unit effort (CPUE), mean trophic level (TL), and trophic CPUE across five artisanal fish landing sites (Shimoni, Gazi, Mkunguni, Kilifi, and Mayungu) in Kenya, and dominant propulsion–gear categories operating during the Northeast Monsoon (NEM) and Southeast Monsoon (SEM) seasons. A total of 44,652 catch records were analyzed using linear models to assess the influence of propulsion–gear combinations, seasons, and sites on catch yields and trophic composition. CPUE was derived by standardizing total landed biomass by fishing hours, while mean TL and Trophic CPUE were calculated by integrating species-specific trophic levels from FishBase using biomass-weighted and effort-standardized methods, respectively. Log-transformed CPUE varied strongly among propulsion–gear combinations, with motorized dhow-based fisheries consistently exhibiting higher CPUE than the traditional canoe-based gears. The CPUE model explained a large proportion of variation ($R^2 = 0.89$), identifying dhow-gillnets and -ring nets as the most productive vessel-gear combination types. Mean TL showed moderate but significant variation among propulsion–gear combinations, between seasons, and across sites (adjusted $R^2 = 0.16$), with dhow-based gears targeting higher trophic-level species (3.70 ± 0.08) compared with most canoe-based gears. Trophic CPUE exhibited stronger structuring (adjusted $R^2 = 0.37$), with markedly higher values for dhow-based gears and spatial peaks at Kilifi, while seasonal differences between the NEM and SEM were comparatively modest. These findings demonstrate that propulsion capacity and fishing technology exert stronger control over catch yields and trophic structure than monsoon driven seasonal variability, underscoring the need to incorporate propulsion–gear dynamics into ecosystem-based management of the Western Indian Ocean small-scale fisheries.
Keywords: Catch yields, Small-scale fisheries, Vessel-gear combinations, Kenya coast

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Identification And Characterization of Plastic Degrading Enzymes from Bacteria Isolated from Landfills in Mombasa County

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Plastic waste threatens ecosystem balance in both land and marine environments. Polyurethane, a mass-produced recalcitrant plastic, is one of the most challenging pollutants to degrade due to its complex chemical structure. Traditional disposal methods, such as burning and landfilling, are becoming increasingly unsustainable because they release hazardous toxins to the environment. As a result, microbial biodegradation has evolved as the safe alternative, with specific enzymes secreted to depolymerize synthetic structures. This project aimed to identify and characterize polyurethane-degrading enzymes from bacteria isolated from Mwakirunge and Shonda landfills in Mombasa County. To do this, bacteria were isolated from plastic samples cultured on mineral media. The

enzyme activity was subsequently confirmed using a fluorophore, which targeted urethane bond cleavage. To determine phylogenetic relationships, 16S rRNA gene sequencing was done on high-performing isolates. The specific enzymes that triggered the degradation were then identified using a proteogenomic technique that combined whole-genome sequencing and mass spectrometry. Screening found five possible candidates with good enzymatic profiles. *Bacillus paramycoides* was discovered as a substantial producer of PURase para-nitrobenzyl esterase using proteomic profiling. These discoveries provide a strong biological underpinning for long-term plastic waste management, as well as a scalable biotechnological solution to plastic pollution reduction.

Climate Smart Agriculture- Cassava Farming

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Agriculture sector in Kenya, remains to be the backbone of the economy. However, this sector is yet to realize its full potential due to climate change impacts. Recent prolonged droughts have negatively affected staple crops such as maize and beans hence threatening food and nutrition security in Kenya. Cassava is a beneficial as human food, livestock feed and raw industrial materials. Cassava produces good yield even under low water and input conditions. Although cassava is a valuable crop in Kenya, it still a major subsistence crop. Cassava it has never attained commercial level to be a viable solution to food security problems in Kenya. In Kenya, cassava has been promoted by the government and other organizations. This paper examines the factors affecting cassava farming. It is based on the study that was conducted in Murang'a County where 228 cassava farmers, traders and processors were interviewed. Descriptive research design was adopted incorporating mixed method approaches. Multistage sampling design was employed. Purposive sampling was employed to identify Murang'a County then followed by the specific Sub-Counties. Wards were selected using simple random sampling, while cassava farmers, traders and processors were identified using stratified and snowball sampling. Data was analysed using Python. Cassava tended to be grown by older farmers as compared to younger farmers. A significant 82.9% of the population relied on agriculture as their main economic activity. 91.2% had no access to extension services. 70% receive extension services 1-2 times in a year. Pests and diseases were the major constrains affecting cassava. Access to financial support was low with 89.9% reported they don't have access. The study recommends stakeholders and also policymakers should coordinate their actions to implement specific policies to address these challenges.

Keys words: Cassava, Food security, Challenges to cassava, Climate Smart Agriculture, Murang'a County, Kenya.

Spatial-temporal Analysis of Mangrove Cover Change in Mida Creek, North coast Kenya

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Mangrove ecosystems provide critical ecological and socio-economic services to coastal communities, including shoreline protection, fisheries support, biodiversity conservation, and carbon sequestration. Despite their importance, mangroves along the Kenyan coast are increasingly threatened by anthropogenic pressures such as harvesting, land conversion, and habitat disturbance, as well as environmental stressors linked to climate change. Continuous monitoring of mangrove cover and condition is therefore essential for sustainable coastal management. Previous national-scale assessments using Landsat imagery have documented long-term mangrove declines along the Kenyan coastline. More recent studies in Mida Creek have applied Sentinel-2 imagery and vegetation indices such as NDVI to assess mangrove condition; however, further analyses using mangrove-specific indices and multi-temporal change detection approaches remain limited. This study assessed mangrove cover change in Mida Creek, located within the Watamu marine protected area (MPA) ecosystem on the north coast of Kenya, between 2016 and 2025 using Sentinel-2 Level 2A imagery and open-source GIS tools. The Mangrove Vegetation Index (MVI) was applied to classify mangrove and non-mangrove cover, while post-classification comparison quantified changes in mangrove extent in terms of persistence, loss, and gain. Classification accuracy assessment indicated strong performance of the index across all years, with overall accuracy values exceeding 94% and Kappa coefficients greater than 0.88. Mangrove extent increased from 1,484.66 ha in 2016 to 1,558.34 ha in 2021 and 1,587.97 ha in 2025, representing a net gain of 103.31 ha over the nine-year study period. This corresponds to an average annual increase of 11.48 ha yr {1}(approximately 0.77% yr {1}). Mangrove persistence remained high, with 1,437.99 ha of the 2016 mangroves persisting into 2021 and 1,476.19 ha of the 2021 mangroves persisting into 2025. Spatial change detection revealed localized zones of mangrove loss and gain within the creek. Overall, the findings indicate that mangrove area in Mida Creek remained largely stable with moderate expansion during the study period. The study demonstrates that freely available Sentinel-2 imagery combined with open-source GIS tools provides a reliable and accessible approach for monitoring mangrove dynamics and supporting evidence-based conservation and management of coastal ecosystems in Kenya.

Keywords: Mangrove cover change; Sentinel-2; Mangrove Vegetation Index

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Trends in small-scale fisheries along mangrove-dominated coasts in south Coast, Kenya

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Mangrove forests provide essential coastal ecosystem services, particularly serving as nursery habitats that sustain small-scale fisheries critical for food security and livelihoods in tropical regions. In Kenya's part of Western Indian Ocean coastline, the assumption that increasing mangrove forest area alone enhances fisheries yield is being challenged by new evidence pointing to the importance of habitat condition, fishing pressure, and data reliability. This study aimed to investigate how changes in mangrove forest cover and habitat integrity influence small-scale fisheries yield, species composition, and stock structure in Kwale County, Kenya, through a comparative analysis of Gazi and Vanga fish landing sites. Mangrove forest cover changes were assessed using multi-temporal Landsat imagery (2006–2023), while fish landing data were obtained from annual fisheries landing statistics (2006–2023) and shore-based catch assessment (2021–2023). Key indicators included fish size distribution, species composition, and fisheries yield per hectare of mangrove forest. Results show a net increase in mangrove forest cover by 2.49% over the 18-year period, with expansion from 2006 to 2014, followed by decline and partial recovery in 2023. Fisheries yield rose from 0.0715 t/ha in 2006 to 0.1298 t/ha in 2014, reflecting ecological recovery due to expansion of mangrove forest cover during this period. However, from 2015 onwards, the substantial increase in reported fish landings might be primarily driven by institutional improvements in fisheries monitoring and enhanced catch data capture, rather than by mangrove forest cover expansion. Site comparison revealed that Vanga, characterised by more extensive mangrove forest cover and estuarine connectivity, supported higher species richness (54 vs. 32) and more functionally diverse fish communities than Gazi. However, both sites exhibited widespread harvesting of juvenile fishes, with species such as Leptoscarus vaigiensis, Lutjanus fulviflamma, and Siganus sutor dominating the catches. Unsustainable and non-selective fishing gear such as reef seines and high fishing effort emerged as key contributors to the high juvenile catches at both sites. Site exposure to oceanographic processes and seasonal patterns further influenced catch dynamics and species dominance, with pelagic taxa peaking during the Northeast Monsoon season and more resident species during the Southeast Monsoon season. Therefore, the size of mangrove forest area alone is not a reliable predictor of fisheries performance. Instead, habitat quality, structural connectivity, and gear selectivity are key to understanding coastal fisheries. Improved catch data collection implemented since 2014, along with co-management of fisheries and mangrove forests and integrated, ecosystem-based management that links habitat protection to gear regulation, are critical for mangrove ecosystem sustainability and coastal resilience.
Keywords: Mangrove Forest cover, Fisheries yields, Habitat quality, Connectivity, Artisanal fisheries

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Green Roads for Water: Climate resilience infrastructure for improved community livelihoods and resilient transport functions.

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Roads are a major global investment and a main factor for development across the globe. When road infrastructure is correctly designed and constructed, it provides an enormous opportunity for economic transformation, improved agricultural production, climate resilience and livelihoods improvement. The conventional road design and constructions is causing higher maintenance cost, erosion, waterlogging, flooding, dust and crop loss. These negative effects can be turned around and roads made into instruments for run-off rainwater harvesting and management, food security, improved community livelihoods and climate resilience. In this regard, there is a variety of techniques that can be used to turn conventional roads into green roads; ranging from simple locally-led interventions to modiû ed designs. What drives the transformational road construction is a change in governance, collaboration and coordination between roads engineers, water practioners, agricultural officers, governance experts and interaction with the local communities during road initiation, planning, execution, monitoring and evaluation and closure. This abstract provides evidence from Makueni County, where road runoff water harvesting has been incorporated in road design and construction. The abstract describes the process of promoting road water harvesting, the techniques used, the potential of road water harvesting to increase community resilience and the hydrological and socio-economic effects. There is a strong case for road infrastructure to serve as water management instruments and to see roads as an integral part of the watershed and landscape in which they are situated. Such an integral approach will preserve road infrastructure and reduce the maintenance burden, contributing to greater infrastructure productivity. The approaches include mitre-drains from roadside drains, diversion from culvert, gravel borrow-pits, farm ponds/pans, roadside tree planting, Non-vented river drifts/crossings, naturebased gully prevention and reclamation using locally-led practices.

Keywords: Green roads, nature based, waterlogging, road runoff, Localy-led.

Payment for Ecosystem Services as a Preventive Water-Security Instrument: The Chyulu Hills–Mzima Springs Catchment, Kenya

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The Chyulu Hills–Mzima Springs system is a strategic, groundwater-fed "water tower" underpinning coastal water security through the Mzima pipeline supplying Mombasa and adjoining counties. The Chyulu Hills are a volcanic range rising to about 2,200 m, where biodiversity-rich cloud forests capture rainfall and occult precipitation, promote infiltration through porous lava and ash deposits, and recharge an underground aquifer estimated at roughly 600 million m^3. This groundwater re-emerges as high-quality spring discharge at Mzima Springs in Tsavo West National

Park and supports a critical bulk-water transfer system. Planned abstraction is projected to rise from about 35,000 m³/day to 105,000 m³/day by 2030 as Kenya's second-largest city and coastal growth corridors expand. Dependency is large and multi-sectoral: the water-supply footprint across Taita-Taveta,Kilifi, Kwale and Mombasa was projected to exceed 5.4 million people by 2022, serving domestic consumption, industry, tourism, and associated ecological functions. Yetthe catchment's ecological engine—the Chyulu cloud forests and adjoining rangelands—is increasingly degraded by deforestation, charcoal production, land-use expansion, and rangeland decline, compounded by climate variability. These pressures threaten infiltration and groundwater recharge, accelerate erosion and sediment mobilisation, and undermine baseflow stability at Mzima precisely as the system is being scaled. The resulting risks are both hydrological and fiscal: reduced yield and degraded water quality increase downstream treatment costs, infrastructure stress, and exposure to drought shocks, while also threatening the tourism and biodiversity values of the broader Tsavo landscape. This paper therefore justifies a watershed Payment for Ecosystem Services (PES) scheme as an economically efficient, preventive instrument to mobilise sustained downstream financing for upstream stewardship and long-term water security. Using only secondary evidence from peer-reviewed watershed PES literature, Kenyan legal and policy instruments that enable catchment protection charges, abstraction controls and benefit sharing, and existing studies on the Chyulu–Mzima–coastal supply nexus, the argument is structured across four feasibility lenses: ecological, economic, institutional and policy. Economically, the paper frames PES as an investment that internalises catchment protection costs within water-service economics, emphasising avoided-cost logic (including the cost of yield decline and sediment-related impacts) and the comparative advantage of prevention over late-stage supply augmentation. Institutionally, it evaluates the viability of using existing platforms—such as the Chyulu Hills Conservation Trust and the Mombasa Water Fund—to aggregate upstream stewards, pool multi-payer contributions, and transition from short-term voluntary payments to a more predictable, tariff-like unit fee linked to abstraction or consumption. Finally, the paper outlines core design requirements for credibility and equity, including clear baselines, conditionality, robust monitoring, reporting and verification, safeguards against double counting with carbon finance, and transparent benefit-sharing arrangements for upstream communities. A composite scheme is proposed: targeted interventions in recharge and erosion hotspots, performance-based contracts, and a pilot-to-scale pathway that manages transaction costs while building payer trust through verification.

Keywords: Chyulu Hills–Mzima Springs, watershed Payments for Ecosystem Services (PES), coastal water security, groundwater recharge and baseflow, beneficiary-pays water financing

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Occupational health burden and sustainability

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According to the ILO, 2.3 million people die annually due to occupational diseases (alomost 80%) and accidents. This makes occupational diseases represent almost 5% of the total deaths in the world annually. However, occupational diseases are preventable.
With the high number of deaths due to occupational diseases, and many more workers who get sick and end up with reduced work ability, occupational diseases result in a great burden to society. Looking at the total economic cost of occupational injuries and ill-health, one sees the effects on employers, workers, and society. Therefore, it is not sufficient to discuss sustainability without including workers' health. Ensuring workers' health goes hand in hand with having decent work.
This presentation provides a brief insight into the need to advance workers' occupational health in the workplace and offers some thoughts on how occupational health promotion can contribute to sustainability.

Keywords: Occupational health, sustainability, health promotion, occupational burden, workers protection

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Optimizing Fish Stock Assessment Using AI: A Novel Model to Enable a Sustainable Blue Economy in Coastal Kenya

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Fish stock assessment involves collecting, analyzing, and reporting demographic information to determine changes in the abundance of fishery stocks in response to fishing and predict future trends of stock abundance. Inaccurate or delayed fish stock assessments impede effective fisheries management, resulting in overfishing, stock depletion, and detrimental effects on marine ecosystems and the lives of those reliant on these resources. This research aims to develop a novel AI-based model for improved fish stock assessment in coastal Kenya, supporting a sustainable blue economy. The study will identify key factors influencing fish stock assessment, develop and validate an AI-driven model incorporating ecological data, and conduct rigorous testing using case study data. Data will be acquired, preprocessed, and analyzed to train the model, while outputs will be used to assess factors that influence the assessment process. This project seeks to provide real-time, accurate assessments to support effective fisheries management in the costal Kenya.

Keywords: Fish stock assessment, sustainable Blue Economy, Climate resistance , AI Model

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Fuzzy Hybrid Machine Learning System for Automated Fish Quality Grading

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Improving fish quality grading standard is critical for broadening market opportunities as it is becoming an important requirement for commercial fish trading globally. The uptake of data mining technique in solutions to industrial problems of automation in grading of food produce is currently receiving considerable attention. Fuzzy logic approaches have provided solutions in handling complexity, uncertainty and vagueness of human logic decisions in assessing the food quality successfully. However, the performance of the fuzzy systems depends entirely on how well it has been trained, training becomes difficult in multi-dimensional and non linear problems due to the large number of parameters associated with in most of the food produce. To achieve improved optimal performance in fuzzy logic application for food evaluation, a combination of several techniques into one hybrid system shall be applied, this research shall use adaptive network-based fuzzy inference systems (ANFIS) approach to provide a model for fish quality grading standards through a definitive solution from information that may be construed as ambiguous, imprecise or noisy obtained by human expert. Some of the fish parameters to be considered for input will include weight, length and eye color; these data will be obtained from the fishermen, who use manual grading process. The system will be trained and tested on about 500 labelled fish samples of various commercial species. To assure realistic viability, processing speed, accuracy under operating conditions and economic feasibility, field validation will be done on 2 local processing facilities. The anticipated results are: (1) high classification rates of 90%+, (2) high inter-rater variability, (3) high throughput processing rate than when using manual grading, and (4) cost-benefit analysis. The outcomes will indicate whether adaptive network-based fuzzy inference systems are an effective, interpretable and implementable solution to automated fish quality grading and whether they can overcome the training and parameter optimization issues that constrain the traditional fuzzy systems. The proposed hybrid fuzzy logic approach will provide a rapid fish quality grading method that saves time eliminates contact with human and can be easily implemented in online systems for fish processing. The study will provide superior evaluation results for fish as compared with other grading methods that had been implemented previously.

Keywords: ANFIS, fish grading, fuzzy logic, neural networks, automation.

Assessing Size-Class Differences in Habitat Selectivity of Green Turtles (Chelonia Mydas) in Relation to Depth Ranges and Substrate Types in Diani, Kenya

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Sea turtles depend on coastal habitats for feeding, growth, and survival. Understanding how different life stages use these habitats is important for effective conservation. This study investigates how green turtles (Chelonia mydas) of different size classes use habitats within Diani, Kenya, with a focus on depth ranges and substrate types. Using six years of underwater survey data collected through photo-identification a capture-mark-recapture method, the study analyzes patterns in turtle distribution by size, depth, and substrate. The data reveal that juveniles predominantly occupy medium-depth zones ("d14m), with 1,134 sightings, followed by shallower areas ("d9m) with 291 sightings, and fewer sightings in deeper zones ("e15m). Adults are comparatively rare in the dataset, mostly observed in deep and medium depths (10 and 8 sightings respectively). Regarding substrate use, juveniles show a strong preference for coral habitats (661 sightings) and open water (637 sightings), with fewer sightings on algae (58), rocky (208), and sand (50) substrates. Adults, on the other hand, are mainly associated with rocky substrates (12 sightings) and open water (2 sightings), with very few observations on algae and no sightings on coral or sand. These findings suggest clear ontogenetic shifts in habitat use, where smaller turtles favor medium depths and coral-rich environments that likely provide shelter and diverse food resources, while larger turtles tend to utilize deeper habitats and rocky substrates, possibly reflecting changes in foraging behaviour.

Keywords: Green turtles, size class, ontogenetic shift, habitat, depth.

Integrated Climate, Land, Energy and Water Analysis for Sustainable Resource Management in the Lake Victoria Water Basin, Kenya

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Millions of people in western-Kenya rely on the Lake Victoria water basin for their water supply, power, and agriculture. Nonetheless, the region is experiencing the negative impact of climate change. This has compounded the effects are land degradation, water shortage, unreliable power supply and an increased carbon level in the atmosphere. This journal investigated Lake Victoria water basin in the western part of Kenya is the source of power, food and water to millions of people who live there. This study combined OSEMOSYS and geographical information system (GIS) for data analysis and interpretation. The study observed scenarios. Business-As-Usual (BAU) and Vision 2030, both with and without the anticipated effects of climate change, were evaluated. The Vision 2030

scenario, on the other hand, highlights the benefits of targeted initiatives, such as increasing irrigated agriculture, implementing climate-smart techniques, and switching to high-value commodities like coffee. It is anticipated that these initiatives will greatly improve food security and help Kenya achieve its larger development objectives. The results highlight the critical need for integrated management approaches that maximize resource utilization, strengthen climate change resilience, and advance sustainable development.

Key Words: Lake Victoria Water Basin, CLEWs, OSEMOSYs, Open-Source Energy Modelling

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Assessment of Shimo La Tewa and Mikindani Constructed Wetlands for Domestic Wastewater Treatment in Mombasa County

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Mombasa like many coastal towns has been struggling with wastewater treatment. The existing conventional treatment facilities have been overwhelmed by rapid population growth and urbanization leaving wastewater going into the ocean untreated or partially treated. This has led to pollution that threatens the health of the marine ecosystem, fisheries and human health. The introduction of community managed Constructed Wetlands (CW) became a solution to this problem. The CW are cost-effective, easy to operate and maintain systems. This study aimed to evaluate the efficiency of a CW for wastewater (WW) treatment located in Mikindani (MK) and Shimo la Tewa (SLT) in Mombasa County, by analyzing physio-chemical parameters, including nutrient concentrations, BOD, COD and heavy metals (Cd, Pb, As, Cr) in water samples collected from the CW plants. The levels of BOD, nutrients and heavy metals (Cd, Pb, As, Cr) decreased in both of the CW from the influent to the treatment tanks. The CW at MK exhibited an overall higher treatment efficiency compared to SLT in the removal of Pb, NO_3^-, PO_4^- and NH_3. The MK CW removed NO_3^-, NH_3, PO_4^- and BOD at 78.9%, 33.9%, 12.8% and 85.9%, respectively more efficiently ($p<0.05$) than the SLT CW that achieved removal of NO_3^-, NH_3, PO_4^- and BOD at 60.8%, 24.3%, 31.8% and 78.7%, respectively. There were significant differences on NO_3^-, NH_3, PO_4^-, Pb, BOD accumulation in the inlet and outlets. The pH values recorded in treatment tanks from both CW systems remained within the acceptable discharge range (6.93 – 8.31) . This study revealed that both CW systems had good pollutant removal efficiency, however high TDS in both CW indicates the persistence of dissolved salts and inorganic ions within the treated wastewater. The results showed that in both treatment facilities, most of the WW quality parameters exceeded the WHO standards before treatment; whereas the quality of the effluents conformed to the WHO standards.
Keywords: Constructed wetland, domestic wastewater, treatment efficiency, coastal, Mombasa

Soiling Loss Quantification of Rooftop Mounted Solar Module in Mombasa Using Digital Imagery Techniques

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Photovoltaic cells' output performance is negatively impacted by the particles that are deposited on the solar panels which scatter and absorb solar energy. The particles cause shading on the PV modules and when they are densely sparse on the PV panel and depending on their light transmittance, could adversely reduce the intensity the amount of irradiance reaching the PV cells. The objective of this study was to quantify soiling loss of rooftop solar photovoltaic using images of soiled PV panels in Mombasa County. During the study it was to estimate that the intensity of soiling of rooftop mounted modules in Mombasa was significant. A pilot study was conducted on the rooftop of physics Laboratory for 90 days using two fixed angle and azimuth modules; One of them was cleaned everyday while the other was left soiled for the entire period. In the setup, high resolution pictures were taken daily for 90 days for dust pixel analysis. The analysis of the pixels revealed that Soiling reduced pixel intensity on the panel by ten percent. Clean panel had an average pixel intensity of 132.47 in the first day. After 30 days, 60 days and 90 days, the pixel intensity of soiled panels were 148.96,151.96 and 148.42 respectively. It was observed that the particles that collected on the surface of the PV module reduced optical characteristics of the panel for the first two months before the onset of rain in the third month. The highest loss of 19.34 was witnessed in the second month.

Key Words: PV Soiling loss, Solar PV metrology, Irradiance attenuation, Digital image processing, Autocorrelation measurements

The Role of Sargassum Seaweed in Sustainable Cosmetic Products

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The cosmetic industry is shifting towards sustainable and natural ingredients to enhance skin health while reducing environmental impact. *Sargassum filipendula*, a brown seaweed found abundantly

along coastlines, has emerged as a valuable resource due to its rich composition of bioactive compounds, including antioxidants, polysaccharides, and essential minerals. This study explores the incorporation of *Sargassum filipendula* extracts in cosmetic formulations such as moisturizers and creams, emphasizing their skin-nourishing properties and environmental benefits. The bioactive compounds present in *Sargassum filipendula* offer multiple dermatological advantages, including hydration, anti-aging, and skin barrier protection. Its antioxidant properties help combat oxidative stress, reducing signs of aging, while polysaccharides enhance moisture retention, making it an ideal ingredient for skincare products. Moreover, the anti-inflammatory effects of seaweed extracts contribute to soothing irritated skin and promoting overall skin wellness. Beyond its cosmetic benefits, utilizing *Sargassum filipendula* in skincare supports environmental conservation. Uncontrolled accumulation of seaweed along coastlines often leads to beach pollution and unpleasant odors, negatively impacting tourism and local economies. Harvesting and processing this seaweed into valuable cosmetic ingredients not only mitigate these issues but also contribute to the blue economy by creating sustainable business opportunities in marine-based industries. This research highlights the dual advantage of *Sargassum filipendula* in cosmetics—enhancing skin health while promoting ecological balance and economic growth. Embracing marine-derived ingredients in cosmetic formulations paves the way for innovative, eco-friendly skincare solutions that align with global sustainability efforts.

Keywords: *Sargassum filipendula*, marine cosmetics, seaweed extract, skincare, blue economy, sustainable beauty.

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