



**DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY**

**BOOK OF ABSTRACTS**

**THE 7<sup>TH</sup> DeKUT INTERNATIONAL CONFERENCE ON  
SCIENCE TECHNOLOGY, INNOVATION &  
ENTREPRENEURSHIP**



**DATE: 8<sup>TH</sup> - 10<sup>TH</sup> NOVEMBER, 2023**

**VENUE: DeKUT MAIN CAMPUS, NYERI**

## Sponsors



## **CONFERENCE THEME**

# **Leveraging Science, Technology, Innovation and Entrepreneurship for sustainability and Development**

## **CONFERENCE SUB-THEMES**

1. Engineering Technologies and Innovations
2. Business Management and Entrepreneurship
3. Basic and Applied Sciences
4. Agricultural Sciences and Technologies
5. Water, Energy, GIS and Remote Sensing
6. Health Sciences, Community Development and Post Covid-19 Dynamics
7. ICT and Data Science, IOT, AI and Emerging Technologies
8. Tourism, Wildlife, Hospitality Management, Environment and Climate Change
9. Security Management, Forensics and Contemporary Crimes
10. Trends in Technical Education and Training
11. Project Management for Micro-Public Project

## Conference Announcement

The 7<sup>th</sup> DeKUT International Conference on Science,  
Technology, Innovation and Entrepreneurship

Dates: 8<sup>th</sup> – 10<sup>th</sup> November, 2023

Venue: DeKUT Main Campus

# Table of Contents

## Contents

LETTER FROM THE CONFERENCE ORGANIZING COMMITTEE.....	11
AGRICULTURAL SCIENCES AND TECHNOLOGIES(AST).....	13
GENETIC ANALYSES OF POD QUALITY AND POD YIELD OF FRENCH BEANS GROWN IN KENYA.....	13
Evaluation of Physicochemical Properties and Cupping Quality of SL-28 Purple Coffee .....	14
Formulation and Evaluation of Lemongrass ( <i>Cymbopogon Citratus</i> ) Value- Added Coffee .....	15
Physicochemical and Sensory Evaluation of Lemon Grass Leaves Extract Enriched Soybean Milk Yoghurt.....	16
The Effect of Drying Processes on the Nutritional and Phytochemical Levels of Chia Leaves ( <i>Salvia     hispanica L.</i> ) at Different Stages of Growth .....	17
BASIC AND APPLIED SCIENCES FOR ADVANCEMENT OF RESEARCH AND INNOVATIONS (BAS) .....	19
Adsorption equilibrium studies of <i>p</i> -Nitrophenol in aqueous solutions <i>onto</i> activated carbon from macadamia nutshell waste .....	19
Formulation and characterization of floor tile composite derived from Polyethylene Terephthalate waste and sand .....	20
Adsorption of Methyl Red from Textile Dyeing Wastewater Using Coffee Husks Biochar .....	21
Modelling the Control Interventions on Human Immunodeficiency Virus and Hepatitis B Integration .....	22
A Survey of Farmers Knowledge and Practice on The Management of Watermelon Diseases in Horticultural Belt of Mt. Kenya Slopes.....	24
Eco-Tanning Using Tannins Extracted from <i>Tamarindus indica leen</i> Seeds and Evaluation of Leather Quality.....	25
Efficacy of Quaternary Ammonium Functionalized Waste Paper Bio-Coagulant for Removal of Fluoride Ions from Aqueous Solution .....	26
Enhancing Pay-As-You-Go Model for Off-grid Solar: A Particle Swarm Optimization and Random Forest Approach.....	28
Determination of Tannin Content in Banana ( <i>Musa spp</i> ) Midribs: a Comparative Study .....	29

Investigation of Clay Minerals – Vegetable Tanning as An Alternative Method to Chrome Tanning .....	30
Removal of Cd <sup>2+</sup> and Cr <sup>3+</sup> ions from aqueous solution using modified polypropylene plastic waste .....	31
Facile extraction and characterization of silica nanopowder from Marine National Park beach sand from Malindi, Kilifi County, Kenya via Alkali Fusion route .....	32
Determination of physical and fastness properties of leather dyed using natural dye extract from beetroot peels with the help of biomordant .....	34
<b>BUSINESS MANAGEMENT AND ENTREPRENEURSHIP FOR SUSTAINABLE DEVELOPMENT (BME) .....</b>	<b>36</b>
Influence of Leadership on Innovation Efficiency in Manufacturing Firms .....	36
in Kenya.....	36
Effect of Investing Practices on Sustainability of Water and Sanitation Companies in Kenya .....	36
The Impact of Adaptive Behavior on Employee Performance in the Ministry of Education Kenya .	38
Combined Influence of Selected Predatory Loan Practices on Loan Performance Among Commercial Banks in Kenya .....	39
Effect of Financing Practices on Sustainability of Water and Sanitation Companies in Kenya .....	41
Effect of Autonomy on Growth of Microfinance Institutions in Murang’a County, Kenya .....	43
Effect of Technology–Organization–Environment Framework and Entrepreneur Practice in Kenyan Public Universities .....	44
Effect of Sustainability Reporting on Financial Performance of Listed Financial Firms in Kenya .....	45
<b>ENGINEERING TECHNOLOGIES AND INNOVATIONS FOR INDUSTRIALIZATION (ETI) ..</b>	<b>50</b>
The Use of UAV Derived Data for Tree Height Estimation.....	50
Low-cost Particle Image Velocimetry as an additional tool for Fluid Dynamics Trainers.....	51
Model Development for Predicting Carrying Capacity of Concrete Filled Bamboo Columns .....	52
Development of a Virtual Environment-Based Electrooculogram Control .....	53
System for Safe Electric Wheelchair Mobility for Individuals with Severe Physical Disabilities.....	53
Fundamental Study on Neural Network based Forward Kinematics Model for a 6-DoF Parallel Link Robot.....	54

Development of Geocapillary Barrier System for Water Retention in Highway Landscaping .....	56
Overcoming wireless communication bottlenecks by leveraging the IRS .....	56
Enhancing Child Safety through Wearable IoT Devices: Real-Time Monitoring and Reporting of Distress Levels using Machine Learning.....	57
Development of A Drone with A Robot Hand for Doing Light Works at High Places .....	59
Collaborative space engineering project between Gifu University, high schools and Gifu Prefecture .....	59
Influence of Methyl Linolenate and Methyl Palmitate on Soot nucleation rates in Biodiesel Flames .....	61
Performance Evaluation of Biomass Dryer .....	62
<b>Assessment of the Cooking Environment in Kenya</b> .....	63
Designing Biosensors Integrated with Biomolecular Machines .....	63
A techno-economic feasibility study of hybrid energy PV/biogas/battery for Mara Serena Safari Lodge.....	64
The Effect of Different Insulation Layer Materials on Cookstove Efficiency .....	65
Integration of Solar Energy into Milk Processing.....	66
ENVIROGUARD: Machine Learning-Powered Detection of Air-Polluting Vehicles in Kenyan roads using IoT.....	67
Data Quality Control and Validation Techniques in IoT.....	68
Polymer-bound gold nanoparticle as a switch for a reversible biomolecular artificial muscle.....	69
Analysis of women representation in STEM in Africa.....	70
Introducing a Data Pipeline for The Tahmo Network.....	71
Data driven maintenance policies optimization for manufacturing systems: A case study.....	72
<b>HEALTH SCIENCES AND COMMUNITY DEVELOPMENT AND POST COVID – 19 DYNAMICS (HSC) .....</b>	<b>74</b>
Predictors of Psychological Well-Being among Parents with Visually Impaired Children in Post Covid-19 Era in Nigeria.....	74
Effectiveness Of Covid-19 Crisis Management Strategies On Business Continuity of Tour Operators in Nairobi County .....	46

High Performance Work Practices and Performance of Level 4, 5 And 6 Public Hospitals in Kenya	48
Effects of Dietary Regimens on The Development of Cart-Associated Metabolic Syndrome .....	75
<b>ICT AND DATA SCIENCE, IOT AND EMERGING TECHNOLOGIES(ICT) .....</b>	<b>77</b>
Enhanced OpenCV for Text Detection Using Multi-Scale Attention.....	77
Mechanism.....	77
Higher Education in Low and Middle-Income Countries: How is AI likely to disrupt the sector? ....	78
Evaluating Public Value Creation Through Electronic Human Resource Management.....	78
Role Of Instant Messaging Forensic Investigations on Detection of Corporate Fraud Among Commercial Banks in Kenya .....	79
A Python Script for The Homogenization of Nonlinear Properties of Three-Dimensional Metal Matrix Composites Using Abaqus .....	80
Investigating Supervised Learning Models for Enhancing the Precision and Accuracy.....	81
<b>SECURITY MANAGEMENT, FORENSICS AND CONTEMPORARY CRIMES(SMF) .....</b>	<b>83</b>
Personal Data Security Syndrome, Kenyan Desperate Economic Search: Philosophical Perspective on the Worldcoin. ....	83
Evaluation Of Identity Access Management and Maintenance Frameworks on The Safety of Mobile Money Transactions Used by Fintechs In Nairobi, Kenya.....	84
Social Media Users’ Willingness to Report Cyberhate to the Police: An Exploratory Study .....	85
<b>TRENDS IN TECHNICAL EDUCATION AND TRAINING (TTE) .....</b>	<b>87</b>
<b>Integration Of Concept Inventory into Education and Training System .....</b>	<b>87</b>
Sustainable Development Goals and Quality of Education in Kenya.....	87
<b>TOURSIM, WILDLIFE HOSPITALITY MANAGEMENT ENVIRONMENT AND CLIMATE CHANGE(TWE).....</b>	<b>89</b>
Kitchen Ambience and Kitchen Work Surface Height as determinants of Cooks’ Productivity in Hotels in Machakos County – Kenya .....	89
Influence of Motivation on Domestic Tourists’ Visit Behaviour in Historical Heritage Sites: An Example from An African Heritage Circuit .....	90
Effects of the Informal Street Food Vendors on the Nyeri Town Publics .....	91

Digital Security Systems Effect on Market Performance In 3-5 Star Rated Hotels in Nakuru County, Kenya.....	92
Assessment of Socio-Economic Gender Issues Affecting Women Participation in Alpine Tourism: A Case Study of Mt.Kenya National Park .....	93
Effectiveness Of Aberdare Electric Fence on Human-Wildlife Conflicts in Amboni Community, Nyeri County, KENYA .....	95
The Contribution of Adventure Recreation Infrastructure Development to Rural Livelihood. A Case of Nyeri County, Kenya .....	96
Value Proposition Innovations and Sustainability of Restaurants in .....	97
Nairobi County, Kenya .....	97
Management Commitment as a Deterrent of Adopting Food Safety .....	98
Management Systems by Public Universities Catering Facilities in The .....	98
Mount Kenya and Aberdare Regional Bloc.....	98
Influence of Hospitality strategic management practices on performance and sustainability of Hotels in Kenya .....	100
The Role of innovative leadership on organizational performance and Sustainability: A Case of SME in Kenya.....	101
<b>WATER ENERGY, GIS AND REMOTE SENSING(WEG).....</b>	<b>103</b>
Optimization of Rainwater Harvesting Sites Selection Using Geospatial .....	103
Technologies: A Case Study of Ewaso Ng'iro South River Basin, Kenya .....	103
Sr/Ca ratios sclero-thermometer developed from <i>Porites ssp.</i> coral skeleton for monitoring Sea Surface Temperature .....	104
Developing a Novel Soil Moisture Content Index under the Effects of Droughts Using Deep Learning Techniques .....	105
The Characteristics and Impacts of Streamflow Variation: A Review of The Influence of Climate Change and Anthropogenic Activities.....	106
Spatial Monitoring of River Discharge Using Low-Cost Sensors .....	108
A Framework for Implementing Participatory GIS For Environmental Conservation of The Muringato Catchment.....	109
Modeling of Water Level Trends and Characterization of Its Potential Factors in Lake Baringo in Kenya.....	111

Satellite-Based Analysis of 20-Year Trends in Water Levels and Land Cover Change in Key Kenyan Lakes .....	112
Assessment of stream flow Variability in Response to the Changes in Climate, Rainfall and Water Demands .....	113
Modelling Rural Food Deserts in Agro-Pastoral Tharaka Constituency using Composed Index of Critical Accessibility to Open-air Food and Livestock Markets .....	115

## **LETTER FROM THE CONFERENCE ORGANIZING COMMITTEE**

*Dear colleagues and friends,*

On behalf of the conference organizing committee, it is my great honor and pleasure to welcome you to the 7th DeKUT International Conference on Science, Technology, Innovation and Entrepreneurship. The conference theme is **“Leveraging Science, Technology, Innovation and Entrepreneurship for sustainability and Development.**

The conference aims to provide a forum for research peers from local and international institutions to showcase innovations, and to discuss, share and publish research findings. The conference sub themes include: Engineering Technologies and Innovations, Business Management and Entrepreneurship, Basic and Applied Sciences, Agricultural Sciences and Technologies, Water, Energy, GIS and Remote Sensing, Health Sciences, Community Development and Post Covid-19 Dynamics, ICT and Data Science, IOT, AI and Emerging Technologies, Tourism, Wildlife, Hospitality Management, Environment and Climate Change, Security Management, Forensics and Contemporary Crimes, Trends in Technical Education and Training, Project Management for Micro-Public Project

We encourage all scientists and researchers in science, technology, innovation and entrepreneurship to join this opportunity as the conference promises a lineup of international experts in these areas.

Selected papers will be published in the Journal of Applied Science, Engineering and Technology for Development. This journal has a reputation of high international standards and a reference in engineering, applied sciences and development. We continue to seek collaboration with the largest number of authors and institutions, to assist us in maintaining our reputation.

The conference organizing committee would like to thank all the key note speakers, authors and sponsors for their great effort to make this outstanding conference come true. We are hopeful that you will enjoy the conference.

Dr. Waweru Njeri

**Chairman, Conference Organizing Committee**

## CONFERENCE ORGANIZING COMMITTEE MEMBERS

1. Dr. Waweru Njeri - Chairperson
2. Dr. Samuel Macharia - Co-Chairperson
3. Prof. Nicholas Mariita - Director, GeTRI
4. Dr. Wilson Ogot Addero - CoD, Technical Education
5. Dr. Daniel Njoroge - Lecturer, IFBT
6. Dr. Ann Sang - Dean, SBME
7. Dr. George Musumba - Dean, Computer Science &IT
8. Dr. Peninah Chege - Director, IToHM
9. Dr. Edwell Tafara - COD, EEE
10. Dr. Kelvin Achieng - CoD, Civil Engineering
11. Dr. Matayo Ratemo - CoD, Operations & Supply Chain Mgt
12. Dr. Paul Tanui - CoD, Chemistry Department
13. Dr. Anthony Ngunyi - Dean, School of Science
14. Dr. John Mburu - CoD, Mechanical Engineering
15. Dr. Anthony Maina - Director, ICT
16. Dr. Florence Mbuthia - Dean, School of Nursing
17. Mr. Dennis Miano - Director, ICFoSS
18. Ms. Faith Mutheu - Public Relations Officer
19. Mr. Peter Irungu - HOD, Catering
20. Mr. James Murigu - Finance Department
21. Mr. Zakayo Kamangu - Procurement
22. Ms. Hadija Dahal - SAA, RIMCL
23. Ms. Elizabeth Ndungu - RIMCL

## AGRICULTURAL SCIENCES AND TECHNOLOGIES(AST)

STI07-AST-001

### GENETIC ANALYSES OF POD QUALITY AND POD YIELD OF FRENCH BEANS GROWN IN KENYA

Serah Njau and Edith Esther Arunga\*

Department of Water and Agricultural Resource Management, University of Embu,

P.O. Box 6-60100 Embu, Kenya

\*Email: [arunga.esther@embuni.ac.ke](mailto:arunga.esther@embuni.ac.ke)

#### Abstract

French bean (*Phaseolus vulgaris* L.) is among the leading vegetables in Kenya that is mainly grown for export, with a potential of increasing household income. However, there are few programs in Kenya that focus on breeding new cultivars for increased production. The development of French bean varieties that are resilient to the changing climate is crucial for sustainable agriculture in Kenya. To achieve this, knowledge of gene action, trait expression, and heritability is vital in effective breeding for complex traits like pod quality and yield. A study was conducted to investigate the inheritance of pod quality and yield traits in snap bean, which can inform the breeding of French beans. A half diallel cross involving two indeterminate dry bean and five determinate snap bean varieties was conducted, and data on pod traits were collected from 21 F<sub>1</sub>s and 7 parents grown in two locations in Kenya. The results showed significant genotypic and environmental effects ( $P < 0.001$ ) for all traits, with significant genotype by environment interactions for most traits. General and specific combining abilities were significant for all traits. The study revealed that Vanilla and Serengeti had the highest GCA estimate for pod quality traits, while G2333 and MCM5001 had the highest GCA estimate for pod yield traits. Additive gene effects were predominant, suggesting that selection for these traits in segregating generations could yield satisfactory gains. By incorporating dry bean varieties in the breeding of French beans, the genetic base of French beans can be broadened to address the challenges of climate change. The results of this study could potentially lead to the development of French bean varieties

that are more resilient to the effects of climate change, improving the sustainability and productivity of the agriculture sector in Kenya.

**Keywords:** French bean, general combining ability (GCA), specific combining ability (SCA), gene action, heritability.

---

**STIE07-AST-002**

## **Evaluation of Physicochemical Properties and Cupping Quality of SL-28 Purple Coffee**

Mbithe Mariona, Mwirigi Peterb and Owaga Eddy

*a*Institute of Food Bioresources Technology, Dedan Kimathi University of Technology,  
Private Bag, Nyeri, , Kenya, E-mail: [ifbt@dkut.ac.ke](mailto:ifbt@dkut.ac.ke)

*b* Research, Innovation Management and Community Linkages, Dedan Kimathi  
University of Technology, Private Bag, Nyeri, , Kenya, E-mail:

[peter.mwirigi@dkut.ac.ke](mailto:peter.mwirigi@dkut.ac.ke)

### **Abstract**

The aim of this research proposal is to evaluate the physicochemical properties and cupping quality of SL-28 purple coffee, a unique cultivar of coffee that exhibits distinctive purple- colored cherries. SL-28 is known for its exceptional cup characteristics and has gained popularity among coffee enthusiasts. SL-28 is a distinct variety of coffee known for its vibrant purple color in its cherries, which is attributed to a natural mutation. Despite its unique appearance, limited research has been conducted on the physicochemical properties and cup quality of SL-28 purple coffee. This research proposal outlines a comprehensive investigation to analyze various physicochemical properties of SL-28 purple coffee. These properties include total titrable acidity, pH, total caffeine content and phenolic content. Additionally, the sensory evaluation of coffee will be performed through cupping tests, assessing attributes such as aroma, flavor, aftertaste, acidity, and body. Preliminary results indicate differences in cherry yield, parchment weight and mucilage loss percentage among the samples collected and the harvest seasons. The findings of this research will

provide valuable insights into the physicochemical properties and cupping quality of SL-28 purple coffee, highlighting its distinctive attributes and potential for specialty coffee markets. These results will contribute towards a better understanding of the unique characteristics of SL-28 purple coffee and aid coffee producers, roasters, and consumers in making informed decisions regarding its cultivation, processing, and consumption. Overall, this research proposal aims to fill the existing knowledge gap related to SL-28 purple coffee by investigating its physicochemical properties and cupping quality. The findings will not only enhance our understanding of this unique coffee variety but also pave the way for its recognition and marketability as a distinct specialty coffee offering.

**Keywords:** physicochemical properties, cupping quality, aroma, flavor.

---

**STIE07-AST-003**

## **Formulation and Evaluation of Lemongrass (*Cymbopogon Citratus*) Value- Added Coffee**

Ndanu Patience<sup>a</sup>, Mwirigi Peter<sup>b</sup> and Owaga Eddy<sup>a</sup>

<sup>a</sup>Institute of Food Bioresources Technology, Dedan Kimathi University of Technology, Private Bag, Nyeri, , Kenya, E-mail: [ifbt@dkut.ac.ke](mailto:ifbt@dkut.ac.ke)

<sup>b</sup>Research, Innovation Management and Community Linkages, Dedan Kimathi University of Technology, Private Bag, Nyeri, Kenya, E-mail: [peter.mwirigi@dkut.ac.ke](mailto:peter.mwirigi@dkut.ac.ke)

### **Abstract**

Herbal beverages are one of the beverage diversification products that have been well recognized in the market. Addition of herbs or spices in coffee, not only offer an enhanced flavor characteristic, but more importantly also offer the consumer to gain a health benefit. Lemongrass is commonly recognized as an herb. This research aims to develop a lemongrass value-added herbal coffee with the aim of increasing consumption of coffee and to study the characteristics of herbal coffee obtained physico-chemically and by sensory analysis. Ground coffee shall be blended with

ground lemongrass at different proportions of 0% which is the control, 2.5%, 5% and 7.5% of the weight of coffee to obtain ready to drink lemongrass herbal coffee. The infused drinks, the control with the lemongrass coffee at different proportions, shall be then subjected for consumer preference and acceptance by testing it to panelists based on preference test using the ranking test. The blends shall also be analyzed for its physico-chemical characteristics such as its powder and brewing appearance, Ph., TTA, total phenolic compounds, antioxidant activity and caffeine concentration. The results shall be expressed as the means of standard deviation. The significance of difference will be tested by one-way analysis of variance (ANOVA), using Excel (Microsoft Office, 2007; Microsoft Corporation, Redmond, WA, USA) and SPSS version 18.0.

---

**STIE07-AST-004**

## **Physicochemical and Sensory Evaluation of Lemon Grass Leaves Extract Enriched Soybean Milk Yoghurt**

Nyiranshuti Angelique<sup>1</sup>, Kipkorir Koskei<sup>1</sup>, Marguerite Niybituronsa<sup>2</sup>

<sup>1</sup>Institute of Food Bio-resources Technology at the Dedan Kimathi University of Technology, Kenya

<sup>2</sup>Research Station Rwanda

Corresponding email: [anyiranshuti25@gmail.com](mailto:anyiranshuti25@gmail.com)

### **Abstract**

There are challenges in the utilization of soybean-based foods due to undesirable flavors associated to the Lipoxygenase and trypsin inhibitors causing oxidation of polyunsaturated fatty acids (Linoleic Acid and alpha linolenic) in soybean. This study aimed to prepare soybean based yoghurt with different amounts of lemon grass essential oil in the ratios of 0, 25, 50, 75, and 100 µl per liter of soy yoghurt. The different treatments of Soybeans based yoghurt were analyzed for protein by Kjeldhal method, fats by Soxhlet method, total ash by muffle furnace method, crude fiber, pH, titratable acidity, syneresis and viscosity by AOAC method, total phenolic compounds

by spectrophotometric method and sensory analysis by effective tests with 10 panelists using 5 hedonic scale tools. The results ranges for Moisture content, % (89.3-89.6%); Protein, % (5.5-6.8%); Fat, % (2.7-3.6%); Total Ash % (0.43-0.53 %); Crude Fiber, % (0.06-0.33 %) and Carbohydrate, % (0.59-0.93 %). Physicochemical properties ranges for PH (4.30-5.59); Viscosity, Pa.s (2.85- 3.17); Titrable acidity, g/l (0.01-0.07) and Syneresis (6.44-7.56) and Total Phenolic compound mg/g (8.59-18.40). The level of pH showed a significant variations between the treatments while titratable acidity, syneresis and viscosity did not show any significant variations. Total phenolic compounds varied between 8.59 to 18.40 mg/g and Sensory evaluation showed that the treatment (100 µl) with highest level of lemon grass essential oil per liter of soy yoghurt was the most liked. In conclusion, incorporation of lemon grass essential improved the level of phenolic compounds and sensory properties of yoghurt. More studies that are extensive need to be carried out on the microbial status and other parameters of the lemon grass extract enriched soy yogurt.

**Key words:** Physicochemical, soy yoghurt, sensory evaluation, lemon grass extract

---

**STIE07-AST-005**

## **The Effect of Drying Processes on the Nutritional and Phytochemical Levels of Chia Leaves (*Salvia hispanica* L.) at Different Stages of Growth**

Jackline S. Kirruti<sup>a</sup>, Monica W. Mburu, and Daniel M. Njoroge

<sup>a</sup>Institute of Food Bioresources, Dedan Kimathi University of Technology, Private Bag, 10143

Nyeri, Kenya, E-mail: [jackykirruti@gmail.com](mailto:jackykirruti@gmail.com)

### **Abstract**

Chia (*Salvia hispanica* L.) is a source of underutilized nutrients that has a low cost. Chia leaves are not commonly used as food as the seeds are the dominant components that are used even as a business product. Increased utilization and proper preservation of the chia leafy vegetables would greatly contribute to mitigating food and nutrition

insecurity. This study was carried out to evaluate how different developmental stages and drying techniques affected the nutritional and phytochemical content of Chia leaves. Leaves were harvested at four stages during the early and late vegetative stages, budding, and flowering stages of plant development. Leaves were oven dried at 45°C for 24 hours, while the solar drying was conducted evenly until the steady weight of the sample was obtained. AOAC analytical methods were used to determine the samples' nutrition composition and phytochemical contents. Results indicated that leaves that were solar-dried retained more nutrients and phytochemical content than those which were oven-dried. Crude protein content for early vegetative leaves was highest (4.48%) for solar-dried (SD1) chia leaves compared to oven-dried (OD1) (4.44%). The fibre content of leaves harvested at the early vegetative stage increased from 12.4% for fresh leaves to 23.33% for solar-dried leaves (SD1), while oven-dried leaves harvested at the flowering stage (OD4) had the highest content at 22.09%. For fat content, the fresh sample of Chia leaves had (5.91%), which was similar to the solar-dried sample. In comparison, oven-dried had a fat content of 5.68% and 4.71% for the early vegetative (OD1) and budding stages (OD3), respectively. The ash level of the leaves varied significantly between the samples taken for the oven and solar drying processes. Samples harvested at the budding stage had the highest level of phenolic content (147.62 mg/GAE) after solar drying (SD3). In addition, these samples also recorded the highest retention of phenolic content at 147.62 mg/GAE. Oven-dried leaf samples harvested at the late vegetative stage (OD2) also recorded a high phenolic content of 124.06mg/GAE. Additionally, higher flavonoid content of 299.8 mg/CE was recorded for the solar-dried leaves at the budding stage of growth (SD3), compared to the 270.4 mg/CE content recorded in oven-dried leaves (OD3). From the study we can conclude that solar drying is the most suitable technique for drying Chia leaves because it doesn't result in a significant loss of nutrients, is less expensive, and is simple to carry out.

**Keywords:** Keywords: Chia leaves, nutrient retention, oven-drying, phytochemicals, solar drying.

# BASIC AND APPLIED SCIENCES FOR ADVANCEMENT OF RESEARCH AND INNOVATIONS (BAS)

STIE07-BAS-001

## Adsorption equilibrium studies of *p*-Nitrophenol in aqueous solutions onto activated carbon from macadamia nutshell waste

Lydia Nanjala Simiyu<sup>a</sup>, Esther Wanja Nthiga<sup>a</sup>, Paul Tanui<sup>a</sup> and Gerald Kanyago  
Muthakia<sup>a</sup>

<sup>a</sup>School of Science, Dedan Kimathi University of Technology, Private Bag, Nyeri,  
10143, Kenya, E-mail: [lynalonja2019@gmail.com](mailto:lynalonja2019@gmail.com)

### Abstract

Water pollution by organic pollutants has been a source of major concern because they tend to accumulate in the body to toxic levels [1]. *p*-Nitrophenol (PNP), has negative effects on humans such as cancer, immune system suppression, and gastrointestinal [2]. Various technologies have been developed for its removal from the water such as chemical precipitation, distillation, and solvent extraction but are expensive. Adsorption became reliable and cheap method hence this study dealt with adsorption equilibrium studies of *p*-Nitrophenol onto Macadamia nutshell in non-activated and activated form [3]. The methods of scanning electron microscopy (SEM) and Fourier-transform infrared analysis (FT-IR) were utilized for characterization in this study and results further investigated on the optimization batch experiments. Initial PNP ions increased with an increase in adsorption capacity between (5 – 60) mg/L, from (0.52-0.77) mg/g and (2.38-3.14) mg/g for the unmodified macadamia nutshell (UMNS) and modified macadamia nutshell (MMNS) respectively. The highest PNP ions uptake was recorded at pH 4 and the sorbent dosage in terms of PNP percentage removal increased from 67.53%, to 87.97% and 87.97% to 94.22 % with increase in the dose of 0.05 g and 0.2 g at fixed PNP concentration for both the UMNS and MMNS. This is designated to a bigger number of active adsorption sites with greater availability for adsorption process in the modified material. Adsorption equilibrium for the UMNS and MMNS was attained after 30 minutes with an optimum dose of 0.1g. The presence of the amides, hydroxyl, asymmetric and antisymmetric vibrations (C-H) and amines

functional groups was detected using FTIR which captured change in the pores and functional groups on the material surface after modification. Surface structure and morphology of the adsorbents was analyzed by the SEM. From the equilibrium models, the sorption behaviour fitted well with and the Langmuir isotherm. The technique proved to be remarkably efficient in the production of a newly developed activated carbon that serves as an alternative to commercial carbon. I worked on non-activated carbon and activated carbon, but the focus of our consideration is currently on activated carbon.

**Keywords:** macadamia, activated carbon, p-Nitrophenol, adsorption capacity, wastewater

---

**STI07-BAS-002**

## **Formulation and characterization of floor tile composite derived from Polyethylene Terephthalate waste and sand**

Emmanuel Mache<sup>1</sup>, Dr. Esther Nthiga<sup>2</sup>, Prof. Gerald Muthakia<sup>3</sup>

*<sup>1</sup>Chemistry Department, Dedan Kimathi University of Technology, Kenya*

*<sup>2</sup>Chemistry Department, Dedan Kimathi University of Technology, Kenya*

*<sup>3</sup>Chemistry Department, Dedan Kimathi University of Technology, Kenya*

### **Abstract**

In Kenya, the cost of ceramic floor tiles has been increasing due to rapid population growth and urbanization. As a result, there has been significant research into developing affordable composite tiles made from plastics and sand to address this issue. Plastics, particularly PET, causes environmental pollution because they are nonbiodegradable and versatile. This study created a stain-resistant and flame-retardant floor tile composite using sand and PET plastic bottle waste as a binder to address this issue. The sand was collected from Ndong, Isiolo County, while the PET plastic bottle waste was collected from the Nyeri County dump site in Kenya. The composite tile was formulated by varying the amount of sand and keeping the weight of PET plastic bottle waste

constant. ZnO was added to the mixture, then coated using a pigment containing TiO<sub>2</sub>. The physiochemical properties of the composite tile were assessed according to ASTM standards. The sand used in the study was composed of 93.90% SiO<sub>2</sub>, and the composite tile produced with 55.56% sand content had the optimum values for compression strength and tensile strength, and water absorption (104.17 N/mm<sup>2</sup>, 12.22 N/mm<sup>2</sup>, and 0.21%, respectively). Flame retardation ability improved with adding ZnO, while chemical resistivity depended on the amount of sand added. The composite tile was mainly made of SiO<sub>2</sub> (81.39%) and showed good resistance to acids, bases, swimming pool salts, and household chemicals. The floor tile had varying levels of viscoelasticity (flexible to brittle), depending on the storage modulus. Characterization of the composite revealed that PET and sand had good crosslinking, as evidenced by FTIR analysis. XRF characterization showed that the composite tile was mainly composed of SiO<sub>2</sub> (81.39%). In summary, PET waste bottles can be used as a sand binder to create floor tile composites that are stain-resistant, flame-retardant, and suitable for residential and commercial use.

**Keywords:** Composite tile, PET, characterization, formulation, waste, cross-linking, flame retardation and viscoelasticity.

---

**STI07-BAS-003**

## **Adsorption of Methyl Red from Textile Dyeing Wastewater Using Coffee Husks Biochar**

Njeri Jacinta N.<sup>a</sup>, Nthiga Esther W.<sup>b</sup> and Muthakia Gerald<sup>a</sup>

<sup>a</sup> Department of Chemistry, Dedan Kimathi University of Technology: Email:

[jacintan08@gmail.com](mailto:jacintan08@gmail.com)

<sup>b</sup> Department of Chemistry, Dedan Kimathi University of Technology: Email:

[esther.nthiga@dkut.ac.ke](mailto:esther.nthiga@dkut.ac.ke)

<sup>c</sup> Department of Chemistry, Dedan Kimathi University of Technology: Email:

[gkmuthakia@dkut.ac.ke](mailto:gkmuthakia@dkut.ac.ke)

**Abstract**

Contamination of water has become a global problem in the twenty-first century due to the entry of both organic and inorganic toxins into the water system. Enormous amounts of wastewater are discharged into the environment from the dyeing processes. Because of their great chemical stability, industrial effluent from textile production combined with insufficient dye degradation results in significant water contamination. Dye-contaminated wastewater poses major health concerns, including cancer, as well as problems for the aquatic environment. A common azo dye used in textile manufacture and as an antibiotic is methyl red dye (MRD) which finds its way into the water system when directly released or stray during the dyeing process. It is known to be poisonous, carcinogenic, teratogenic, mutagenic, and cause respiratory issues. Therefore, it is crucial to keep an eye on the quality of water. There is a need therefore to remove these toxins from the environment and water. Coffee husks biochar (CHB) was produced by gentle pyrolysis of coffee husks at 350 °C followed by characterization using FT-IR, and SEM. Analysis using FT-IR revealed the vanishing of the O-H group in the coffee husks and the emergence of C=C, C=O, and C-O in the CHB indicating the conversion of husks to biochar. Besides, the SEM investigation demonstrated a change in the surface morphology of the CHB. In batch investigations, the impacts of CHB dose (0.2-1.2 g), medium pH (1-12), time of contact (5-60) minutes, and initial dye concentration (20-150 mgL<sup>-1</sup>) were investigated. Coffee husks biochar demonstrated remarkable efficacy in eliminating MRD with an impressive removal efficiency of up to 96.56% at optimum conditions. At pH 2 and 0.6 g of CHB, an adsorption equilibrium capacity of 10.42 mg g<sup>-1</sup> was reached in 25 minutes. Langmuir isotherm proved to be the appropriate model for describing the MRD adsorption onto CHB, assuming a chemisorption mechanism.

---

**STI07-BAS-004**

## **Modelling the Control Interventions on Human Immunodeficiency Virus and Hepatitis B Integration**

Mirgichan Khobocha James<sup>a</sup>, Gitonga Cyrus Ngari<sup>b</sup>, Stephen Karanja<sup>a</sup> and Robert Muriungi<sup>a</sup>

<sup>a</sup>School of Pure and Applied Sciences, Meru University of Science and Technology,  
P.O. BOX 972-60200, Meru-Kenya, E-mail: [kaks.mirgichan@gmail.com](mailto:kaks.mirgichan@gmail.com),  
[skaranja@must.ac.ke](mailto:skaranja@must.ac.ke), [rgitunga@must.ac.ke](mailto:rgitunga@must.ac.ke)

<sup>b</sup>School of Pure and Applied Sciences, Kirinyaga University, P.O. BOX 143-10300,  
Kerugoya-Kenya.

E-mail: [ngaricyrus15@gmail.com](mailto:ngaricyrus15@gmail.com)

## **Abstract**

Human Immunodeficiency Virus and Hepatitis B virus infections are both viral infections with the same route of transmission. The primary route being sexual contact with the infected person and Mother to Child Transmission (MTCT) among other means of transmission. These mono infections have led to the deaths of millions of people around the world despite increased access to prevention, diagnosis, treatment and care. Consequently, Human Immunodeficiency Virus and HBV co-infection is a major global health burden that have attracted limited research interest. The co-infection presents complex transmission dynamics within a population. Few mathematical models are available for Human Immunodeficiency Virus and Hepatitis B co-infection that have attempted to include risk factors and control measures. This study seeks to model HIV and Hepatitis B co-infection with optimal control interventions. The objectives of the study were to; formulate and analyse a deterministic model for Human Immunodeficiency Virus and Hepatitis B co-infection, formulate an optimal control problem for the deterministic model and establish the optimal controls and convert the developed deterministic model to a stochastic model to account for uncertainties. The deterministic model is formulated based on the SI and SIRS epidemiological models. The theories of calculus are applied to analyse the deterministic model based on reproduction numbers. In order to provide insight in designing control interventions for Human Immunodeficiency Virus-HBV co-infections, the basic and control reproduction number for the deterministic model is obtained using the Jacobian Next Generation Matrix approach and survival function. The infection Free equilibrium point is determined and it's local and global stability analysis established using stability theorems such as Meltzer Matrix and Routh-Hurwitz criterion. The local and global

sensitivity analysis of the model parameters on the control reproduction number and strength number are computed using the normalized forward sensitivity index and the order of importance illustrated on histogram. An optimal control problem is formulated for the deterministic model using Pontryagin's maximum principle. The developed deterministic model and optimal control model are simulated using the inbuilt MATLAB solver based on Runge-Kutta method. The numerical results are presented graphically to observe the dynamics of the co-infection with and without control interventions. The Continuous Mark Chain is used to obtain the transition probabilities of the Markov model. It is expected that the study provides insights in integrating control measures to this neglected co-infection. The study also contributes to the existing knowledge. In addition, the study is useful in reinforcing the policies in the health sector based on the optimal control strategies established.

**Keywords:** HIV, HBV, Co-infection, Deterministic, Stochastic, Equilibrium point, Stability Analysis, Optimal control

---

**STI07-BAS-005**

## **A Survey of Farmers Knowledge and Practice on The Management of Watermelon Diseases in Horticultural Belt of Mt. Kenya Slopes**

Salome W. Kiarie<sup>1\*</sup>, Susan S. Imbahale<sup>1</sup>, Sheila Okoth<sup>2</sup>, Mary Gikungu<sup>3</sup>,

<sup>1</sup>School of Biological and Life Sciences, Technical University of Kenya, P.O. Box 52428-00200, Nairobi

<sup>2</sup>School of Biological Sciences, University of Nairobi, P.O. BOX 30197-00100, Nairobi

<sup>3</sup>The National Museums of Kenya, P.O. Box 40658-00100, Nairobi

\*Corresponding author: Email: [salome.thuo@yahoo.com](mailto:salome.thuo@yahoo.com) Mobile: +254727783153

### **Abstract**

Horticulture is the largest sub-sector of agriculture, in Kenya, contributing 33% of the Agricultural GDP. Watermelon is the sixth among eight listed fruits which are economically important horticultural produce. The fruit is grown mostly in dry areas of Kenya, however due to high demand, large acreage of land at the slopes of Mt. Kenya

are now covered with this crop. A study was carried out in July 2018 to examine watermelon farmers' knowledge and practice in the management of watermelon diseases at the slopes of Mt. Kenya. Semi-structured questionnaire was administered to 80 watermelon farmers selected using Snowball technique from Karurumo, Gachoka, Kiritiri and Ishiara locations. The survey revealed that majority of farmers grew watermelon on 1-2 acres. Watermelon diseases were reported to attack the plant at all stages of growth. Among the diseases, blight was the disease reported by most respondents at 63.8%, followed by fusarium wilt (41.3%) and powdery mildew (38.8%). Farmers experience of various diseases was not significantly different in the four locations except for fusarium wilt ( $p=0.046$ ) and powdery mildew ( $p=0.020$ ). Cold weather was reported by 60% of respondents as the most conducive condition for disease occurrence, followed by rainy conditions (17.5%). Most farmers in all the locations applied pesticides (97.6%) as the major method of disease control, only a few (27.5%) practiced crop rotation in addition. This was attributed to agronomic support by extension workers in the area. The slopes of Mt. Kenya have potential of increased production if farmer gets support in disease management.

**Key Words:** Watermelon, Mt. Kenya Region, watermelon diseases, Disease management

---

**STI07-BAS-006**

## **Eco-Tanning Using Tannins Extracted from *Tamarindus indica* leen Seeds and Evaluation of Leather Quality**

Martin Mwenda Nyaga<sup>a</sup>, Paul Tanui<sup>a</sup>, Samuel Njenga Mirie<sup>a</sup>

<sup>a</sup>School of Science, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [Martin.mwenda@dkut.ac.ke](mailto:Martin.mwenda@dkut.ac.ke)

### **Abstract**

Tanning is a treatment mechanism of converting collagen fibrous protein of an animal hide/skin into a stable material (leather) which has a higher hydrothermal stability. Over the years, there has been need for an alternative tanning system in line for the growing

ecological worries arising due the manufacture of leather using inorganic tanning chemicals. This has led to an increase in research for other sources of tannins that are cheap and locally available. In this study, tannins from Tamarindus Indica L. seeds were extracted for determination of tannin content and the tanning strength by the hide powder method. The physical properties of tanned leathers were tested using standard IUP methods and reference was made to the commercial tanned leather. From the results, the Tamarindus indica had  $15.14 \pm 0.93$  % tannins while the control had  $58.91 \pm 0.16$ %. The tanning strength was 1.73 for the tamarind seed extract and 2.06 for mimosa respectively. The leather had shrinkage temperature of  $80.16 \pm 0.57^\circ\text{C}$  and  $81.50 \pm 0.81^\circ\text{C}$  respectively. The tensile strength for leather tanned with TSE was  $18.39 \pm 0.44$  N/mm<sup>2</sup> and a tear strength  $32.57 \pm 0.63$ N, grain crack of  $8.40 \pm 0.39$  mm and grain burst  $8.69 \pm 0.25$  mm. The leather produced were dark brown in colour with some of the mechanical properties above the minimum recommended values. The use of tannins from Tamarind seeds which are by-product of the pulp industry amongst others can be adopted for tanning; more so in the countries within the tropical zones where the tamarind trees are mostly cultivated.

**Keywords:** Tannins, Tamarindus indica L. seed, Mimosa, Leather

---

**STI07-BAS-007**

## **Efficacy of Quaternary Ammonium Functionalized Waste Paper Bio-Coagulant for Removal of Fluoride Ions from Aqueous Solution**

Kithinji Adams Mawira<sup>a\*</sup>, Esther Wanja Nthiga<sup>b</sup>, Gerald K. Muthakia<sup>c</sup>

<sup>a,b,c</sup>Chemistry Department, Dedan Kimathi University of Technology, Private Bag,  
10143 – Dedan Kimathi, Nyeri-Kenya

\*Presenting author: [kithinji.adams@yahoo.com](mailto:kithinji.adams@yahoo.com)

### **Abstract**

Fluorides are one of the many pollutants found in water. At low concentration, fluorides are essential for improving the density and hardness of bones and teeth enamel

during their growth. A concentration greater than 1.5 mg/L in drinking water has several detrimental effects on human health, including dental and skeletal fluorosis. There are several methods employed to rid water of fluorides. These include, reverse osmosis, adsorption, ion exchange, coagulation and flocculation. This study focuses on removal of fluorides from aqueous solutions by coagulation using quaternary ammonium functionalized waste paper bio-coagulant. Quaternary ammonium compounds were synthesized from waste paper by first nitrating cellulose present in waste paper. The attached nitro groups, were reduced to amine groups and quaternization was done using methyl iodide. The prepared bio-coagulant was characterized using FTIR and TGA. The coagulant was used to remove fluorides from model solutions and real water samples from Gilgil area in Nakuru County, Kenya. A fluoride ion selective electrode was used to determine fluoride ion concentration in each model solution and in the real water samples. Optimized parameters included pH, initial fluoride ion concentration, contact time and bio-coagulant dosage. Characterization data confirmed successful quaternization was achieved. Thermal stability of the material was up to a temperature of 563.15 K. The optimum pH value was 4.0 while the contact time was 15 minutes. Fluoride removal increased with increase in initial concentration up to an optimum 20 mg/L. Fluoride removal was also observed to increase with increase in coagulant dosage. Obtained data fitted well on Langmuir adsorption isotherm with R<sup>2</sup> value of 0.9707, confirming chemisorption as the predominant intermediate process. An adsorption capacity of 3.6311 mg/g was obtained. Fluoride ion removal percentage in the model solution was 81% and 66.25% in the real water sample. It is evident from this study that used waste paper can be modified and used to treat water containing fluorides.

**Keywords**— Coagulation, Bio-coagulation, Fluoride, Quaternary ammonium, Water, Adsorption

---

**STI07-BAS-008**

# Enhancing Pay-As-You-Go Model for Off-grid Solar: A Particle Swarm Optimization and Random Forest Approach.

Denis M<sup>a</sup>, Dennis K<sup>b</sup> and Wandeto J<sup>a</sup>

<sup>a</sup>School of Business, Dedan Kimathi University of Technology, Private Bag, Nyeri, Kenya, E-mail: [denis.muriithi19@students.dkut.ac.ke](mailto:denis.muriithi19@students.dkut.ac.ke)

<sup>a</sup>School of Acturial Science, Dedan Kimathi University of Technology, Private Bag, Nyeri, Kenya,

<sup>a</sup>School of Computing, Dedan Kimathi University of Technology, Private Bag, Nyeri, Kenya.

## Abstract

As the challenge of customer default persists, it continues to have a significant impact on the loan repayment sector across various industries. This issue is particularly pronounced in the Pay-As-You-Go (PAYGo) model of asset financing within the renewable energy sector, especially in off-grid communities in Africa. Under the PAYGo model, renewable energy companies provide Solar Home Systems (SHS) to customers, with payments made incrementally through mobile money channels. Defaulting on these payments directly affects the revenue of these companies, highlighting the imperative need for early prediction of potential defaulters. In this study, an innovative approach to enhance default prediction in the PAYGo model by integrating Particle Swarm Optimization (PSO) with the Random Forest (RF) and xGBoost algorithms for feature selection is introduced. Furthermore, Synthetic Minority Oversampling Techniques (SMOTE) is used to tackle class imbalance issues. The PSO algorithm, rooted in swarm intelligence, elevates classifier optimization, resulting in improved model accuracy. Primary findings reveal that the PSO-Random Forest Classifier surpasses other models in performance. The success of the PSO-RF model is attributed to its proficiency in handling complex datasets and mitigating overfitting. Through the optimization of RF hyperparameters, the PSO algorithm substantially enhances model performance. The high precision value of 0.9961 underscores the classifier's accuracy in identifying positive cases while effectively minimizing false positives (accuracy: 0.89), outperforming the unoptimized random forest (accuracy: 0.76). In summary, this research yields valuable

insights into addressing challenges related to loan repayments within the PAYGo model, thereby contributing to the sustainability and profitability of renewable energy companies operating in off-grid communities. The optimized feature selection process results in dynamic high accuracy, reducing default rates in PAYGo models for off-grid communities. These findings hold broader implications for enhancing financial sustainability and advancing renewable energy access in underserved regions, ultimately fostering economic development and environmental sustainability.

**Keywords:** Optimization, PSO, XGBoost, churn, Prediction,

---

**STI07-BAS-009**

## Determination of Tannin Content in Banana (*Musa spp*) Midribs: a Comparative Study

James K Wangui<sup>a</sup>, Douglas Onyancha<sup>a</sup> and Benson Ongarora<sup>a</sup>

<sup>a</sup>School of Science, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [james.wangui21@students.dkut.ac.ke](mailto:james.wangui21@students.dkut.ac.ke)

### Abstract

Ecological concerns emanating from the use of inorganic tanning agents in leather processing have been on the rise, leading to increased research on alternative tanning agents. This study aimed at determining the tannin content in two banana leaf midrib samples and their tanning strengths. Soxhlet method was used to extract the tannins from the banana leaf midrib samples. Different solvents were investigated in order to determine the best candidate for the extraction of tannins. Chemical tests were used to determine the nature of tannins present in the selected banana species. Hide powder method made it possible to quantify the tannins present and their tanning strength. The extracted samples were further analyzed using FTIR to establish the functional groups present. Highest tannins yields were obtained using distilled water as solvent at  $14.51 \pm 0.17\%$  and  $7.14 \pm 0.15\%$  for sweet banana species (*Musa sapentium* Linn.) and 'Muraru' (AA genome) midribs respectively. *Musa sapentium* Linn. and 'Muraru' (AA genome) midrib tannins had tannin content of  $11.71 \pm 0.33\%$  and  $6.36 \pm 0.19\%$  respectively from the hide powder method. Both species had a tanning strength greater

than the recommended minimum value of 1.5. However, the data from the study showed that only sweet banana leaf midrib tannins can be commercially viable in leather tanning since they have a tannin content above the required minimum value (>10%).

**Keywords:** banana, banana leaf midrib, mimosa , *Musa sapentium linn*, muraru(AA genome).

---

**STI07-BAS-010**

## **Investigation of Clay Minerals – Vegetable Tanning as An Alternative Method to Chrome Tanning**

Nelly Maina<sup>a</sup>, Douglas Onyancha<sup>b</sup> and Paul Sang<sup>c</sup>

<sup>a</sup>School of Science, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [nelly.maina21@students.dkut.ac.ke](mailto:nelly.maina21@students.dkut.ac.ke)

### **Abstract**

Leather tanning involves the stabilization of the skin's collagen using organic or inorganic chemicals. Chromium III sulphate is an inorganic tanning agent that has gained popularity in the tanning industry due to its ability to impact the leather with superior properties such as high tensile strength and excellent thermal stability. However, chrome tanning has proved to cause environmental pollution at an alarming rate threatening the world's population health and marine life when the waste is openly dumped in rivers and land or incinerated. For decades now, ways to deal with chrome waste generation have been explored intensively which include: chrome tanning exhaustion, recycling of the tanning float, and use of alternative methods of tanning such as aluminum, and vegetable tanning. In this study, a combined tannage of clay minerals –vegetable tanning (mimosa) on a goatskin was investigated as an eco-friendly method of tanning. Clay samples were collected from Murang'a County and characterized using the XRF and XRD to determine the physical characteristics and chemical composition. The finding indicated that the two clays were kaolinite and halloysite and the chemical composition had SiO<sub>2</sub> and Al<sub>2</sub>O<sub>3</sub> as the major compounds present in the two clay minerals. The clay samples were then modified using

concentrated formic acid and used to tan goat skin. The physical properties of leathers obtained were analyzed using IUP methods. The results obtained for both leathers tanned using modified kaolinite and halloysite had attained the minimum recommended values for all the tests done. Moreover, leather tanned using halloysite had better physical properties compared to that tanned using kaolinite and as a result, modified halloysite clay was used for further processing of the leather. The leathers tanned using 3%:5% and 3%:10% (clay and mimosa) had properties comparable to those of chrome tanning and allowed a reduction of the amount of mimosa used during retanning which has a positive impact on the economic aspect as well as the environmental. From the findings of this study, combined tanning of clay minerals and mimosa vegetable tanning is a possible alternative to chrome tanning as it is an eco-friendly method of tanning.

**Keywords:** Halloysite, Kaolinite, X-ray diffractometer (XRD), X-ray fluorescence (XRF).

---

**STI07-BAS-011**

## **Removal of Cd<sup>2+</sup> and Cr<sup>3+</sup> ions from aqueous solution using modified polypropylene plastic waste**

Kelvin Kibet<sup>a</sup>, Esther W. Nthiga<sup>a</sup>, Moses A. Ollengo<sup>a</sup>

<sup>a</sup>School of Science, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [kelvin.kibet21@students.dkut.ac.ke](mailto:kelvin.kibet21@students.dkut.ac.ke)

### **Abstract**

Heavy metals pollution of water poses a major environmental challenge due to its antagonistic effects. They are not biodegraded and tend to accumulate in human body to toxic levels linked to some health effects. Therefore, there is need for their removal in water. Technologies that exist such as membrane filtration are limited by their high operation cost. However, adsorption is a cheap, efficient, and easy technique of removal of pollutants from wastewater. There is limited information available on value

addition of plastic waste for application as adsorbents. Application of modified polypropylene plastic waste was explored in this study for remediation of  $\text{Cd}^{2+}$  and  $\text{Cr}^{3+}$  ions from model solution. This was achieved by first chemically modifying the plastic by use of hydrogen peroxide and hydrochloric acid to create adsorption sites. The chemically modified plastic waste was characterized using Scanning Electron Microscopy (SEM) and Fourier Transform Infrared Spectroscopy (FTIR). The images obtained confirmed availability of pores in the adsorbent which are critical for  $\text{Cd}^{2+}$  and  $\text{Cr}^{3+}$  ions adsorption. The FTIR results confirmed the presence of hydroxyl groups on the adsorbent which are vital for adsorption. Effect of adsorbent dosage, contact time, solution pH and initial metal ion concentration were investigated and the concentration of the resulting filtrate after adsorption determined using Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES). The results from optimization experiments showed that  $\text{Cd}^{2+}$  and  $\text{Cr}^{3+}$  ions adsorption was optimal at initial metal ion concentration of 15 mg/L and 20 mg/L respectively, contact time of 45 mins and 60 mins respectively and optimum adsorbent mass of 0.1 g. Optimal pH values of 4.5 and 5.5 respectively were also observed. Equilibrium experimental results showed adsorption capacities of 7.395 mg/g ( $\text{Cd}^{2+}$ ) and 6.225 mg/g ( $\text{Cr}^{3+}$ ) for Langmuir isotherm model with  $R^2 > 0.99$  indicating chemisorption process. This study shows the good performance of the modified plastic waste in adsorbing the metal ions and also value addition for the plastic waste. Polypropylene plastic waste can therefore be applied in wastewater treatment to bring the concentration levels of heavy metals to the required limits.

**Keywords:** polypropylene, adsorption, heavy metals, equilibrium, adsorption capacity, adsorption isotherms

---

**STI07-BAS-012**

## **Facile extraction and characterization of silica nanopowder from Marine National Park beach sand from Malindi, Kilifi County, Kenya via Alkali Fusion route**

Dr. Esther W. Nthiga<sup>1\*</sup>, Samuel N. Ndung'u<sup>2</sup>, Prof. Ruth N. Wanjau<sup>2</sup>

<sup>1</sup>School of Science, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381,  
Kenya, E-mail: esther.nthiga@dkut.ac.ke

<sup>2</sup>Department of Chemistry, Kenyatta University, P.O Box 43844-00100, Nairobi,  
Kenya.

## Abstract

The silica nanopowder has been in demand every dawn due to its application in various emerging technological advancements [1]. This is due to its desired features such as chemically stable, friendly to the environment, easily biocompatible among others [2,3]. The material has been extracted from various sources mainly from agricultural wastes. The purpose of the study was to utilize locally available beach sand from Marine National Park from Malindi, Kilifi County, Kenya in facile extraction of silica nanopowder via a simple alkali fusion method. The sand was first purified using 6 N HCl solution to eliminate metal oxide impurities. Then, the purified sand was reacted with NaOH to form of sodium silicate ( $\text{Na}_2\text{SiO}_3$ ) solution which was then precipitated using HCl acid to form tetraortosilicate acid,  $\text{Si}(\text{OH})_4$  (silica gel). The gel was then heated to form amorphous silica ( $\text{SiO}_2$ ). The percentage yield of the extracted silica was  $35.0139 \pm 0.11$  %. The extracted silica was characterized using XRF, XRD and FT-IR. The XRF analysis revealed that the extracted silica content was  $94.16 \pm 0.47$  % which increased from  $81.32 \pm 0.81$  % (Silica sand). The XRD results revealed a highly crystalline quartz as the main component of silica sand. The XRD spectrum of extracted silica showed a broad diffraction peak at  $2\theta = 21.76^\circ$  revealing its amorphous nature. The average particle size of the extracted silica was 45.15 nm. The FT-IR analysis showed hydroxyl (-OH) in silanol (Si-OH) and siloxane (Si-O-Si) as important functional groups of the extracted silica. The results showed a low-cost technique for the production of highly pure nanosized silica that can be employed in vast industrial applications.

**Keywords:** Alkali Fusion, extracted silica, amorphous, beach sand

# Determination of physical and fastness properties of leather dyed using natural dye extract from beetroot peels with the help of biomordant

Louret A. Andalo, Paul K.M. Sang and Rose Tanui

School of Science, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381,  
Kenya, E-mail: [louretatsenga@gmail.com](mailto:louretatsenga@gmail.com)

## Abstract

Leather dyeing is an essential process in the leather industry, where synthetic dyes are predominantly used. However, the environmental concerns associated with synthetic dyes have led to rising interest in natural dyes as sustainable alternatives. The use of biomordants however, is gaining attention due to their eco-friendly nature and potential to enhance dye fixation and colour fastness. This study aimed at determining the physical and fastness properties of leather dyed using natural dye extract from beetroot peels, with the assistance of biomordant derived from *Acacia nilotica* barks and banana pseudo stem sap. The dyeing process involved the immersion of leather samples in the dye bath, in the presence of the biomordant in a pre and post-mordanting technique. To determine the effect of the biomordant on the strength properties of the leather, the physical properties of the dyed leather were evaluated. The tensile and tear strength of the dyed leather were measured on an instron tester according to IUP 6. Various fastness properties of dyed leather were investigated to assess the quality and durability of the dyeing process including water spotting fastness according to ISO 15700, mild washing fastness according to ISO 15703, and rub fastness (dry and wet rub fastness) according to ISO 11640. The dye bath exhaustion was also measured using spectrophotometric analysis. All of the samples exceeded the minimum recommended values for tensile strength ( $> 12\text{N/mm}^2$ ), percentage elongation at break ( $> 40\%$ ), and tear strength ( $> 20\text{N}$ ) for chrome tanned leather which was used in this study. On a grey scale of 5, the dyed leather's fastness properties were discovered to be good to excellent on a grey scale of 5. The samples dyed with *Acacia nilotica* bark as a biomordant had the highest dye bath exhaustion, followed by banana pseudo stem sap, and leather dyed without any mordant had the lowest dye bath exhaustion. According to the results obtained in this study, the use of biomordant in the dyeing of leather with

natural dye from beetroot peels improved the fastness properties of the dyed leather as well as the strength of the resulting leather. Furthermore, the biomordant promoted dye uptake.

**Keywords:** Biomordant, *Acacia nilotica*, Banana pseudo stem sap, Physical properties, Fastness properties, Leather

# BUSINESS MANAGEMENT AND ENTREPRENEURSHIP FOR SUSTAINABLE DEVELOPMENT (BME)

**STI07-BME-001**

## Influence of Leadership on Innovation Efficiency in Manufacturing Firms in Kenya

Isaac Muiruri Gachanja gachanjai39@gmail.com

### Abstract

The emerging strategic intent of firms is to expand their growth opportunities by optimizing their capacities. Leadership has the responsibility of optimizing firms' capacities by utilizing the resources efficiently for the sustainable development. The purpose of this paper is therefore to determine the influence of leadership on Innovation Efficiency (IE) in manufacturing firms in Kenya. The study was anchored on the theory of leader-member exchange. A mixed research methodology was used and cross-section design was applied. The target population was 2484 leaders and multi-stage sampling was used to sample 345 respondents. Primary data was collected which was both qualitative and quantitative. The results revealed that leadership has a significant influence on IE. It is concluded that management should practice and encourage creativity, exploration, inspiration, exploitation and entrepreneurial mindset to promote IE. Further research should be conducted to find out how leadership should balance the trade-off between risk management and IE.

**Key Words:** Leadership, Innovation Efficiency, Exploration, Entrepreneurial Mindset

---

**STI07-BME-002**

## Effect of Investing Practices on Sustainability of Water and Sanitation Companies in Kenya

David Ndumo<sup>a</sup>, Prof. David Kiragu<sup>b</sup> and Dr. Mohamed Shano<sup>c</sup>

<sup>a</sup> PhD Candidate, School of Business Management and Economics, Dedan Kimathi University of Technology, P.O Box Private Bag, Dedan Kimathi, Kenya. E-mail: dndumo@gmail.com

<sup>b</sup> Professor, School of Business Management and Economics, Dedan Kimathi University of Technology, P.O Box Private Bag, Dedan Kimathi, Kenya, E-mail: [david.kiragu@dkut.ac.ke](mailto:david.kiragu@dkut.ac.ke)

<sup>c</sup> Senior Lecturer, School of Business Management and Economics, Meru University of Science and Technology, P.O. Box 972-60200, Meru, Kenya, E-mail: mohamedshano@gmail.com

## **Abstract**

Sustainability of the water and sanitation companies (WASCO) is a global problem. Sustainability is complex balance between water access and quality for the country to achieve the SDG Goal 6. The problem is more pronounced on water access compared to water quality. A World Health Organisation report 2022 indicates that worldwide, 1.4 million people die annually from diseases related to poor water access, sanitation and hygiene. Kenya has an estimated population of 53million people. Statistics indicate that approximately 53% and another 77% have no access to safe water and improved sanitation respectively hence making this a national problem. The water and sanitation sector is one of the significant sectors in Kenya contributing approximately 5.78% of national employment and further supports among others agriculture, forestry and fisheries. Water access is the major single most contributor to food insecurity in Kenya. By the year 2022, Kenya ranked bottom 30 among 121 countries in terms of food security. Economic theory point that effective investing practices contributes to sustainability of an entity. Guided by the stakeholder theory this study examined the influence of investing practices on sustainability of WASCO in Kenya. The study adopted conservatism research philosophy and a descriptive design. From a population of 91 WASCOs regulated by WASREB a sample size of 46 companies was purposefully selected. Primary data was collected using a questionnaire while secondary data collected from the annual WASREB reports. A pilot study was carried out to test the reliability and validity of the data collection instrument. Cronbach's Alpha coefficient

was used to assess reliability of the instrument and Keiser-Meyer-Olkin (KMO) and Bartlett's Chi-Square test of Sphericity in the case of validity. Tests of regression assumptions of linearity, autocorrelation, homoscedasticity and normal distribution were carried out using; Pearson's correlation coefficient, Durbin-Watson ( $d$ -statistic), P-P plot and Q-Q plot respectively. Bivariate linear model was utilized for inferential analysis. The findings showed that investing practices explained approximately 75.2% of WASCO sustainability. ANOVA's F-statistics of 133.485 and associated  $p=0.000$  indicating that investing practices has a statistically significant influence on sustainability of WASCO. The results for beta coefficient of 29.108 and  $p=0.000$  implies that a unit change in investing practices would result to a 29.108 units change in sustainability measures. The study recommends the focused deployment and deepening of strategic investing practices since they have a strong bearing on sustainability of these firms.

**Keywords:** Sustainability, Expansion, Replacement, Modernization.

---

**STI07-BME-003**

## **The Impact of Adaptive Behavior on Employee Performance in the Ministry of Education Kenya**

Naomi Nkirete<sup>1</sup>, Dr. Susan Ngure<sup>2</sup>, Dr. David Magu<sup>3</sup>

<sup>1</sup> PhD Candidate, Dedan Kimathi University of Technology

<sup>2</sup> School of Business Management and Economics, Dedan Kimathi University of Technology

### **Abstract**

Agility of an employee has been theorized to have linkages with employee performance in commercial business' setting. Employees who possess adaptive behaviour attributes are professionally flexible, use multiple competencies, have the ability to multitask and normally are able to collaborate with others. When job requirements change, people need to adjust adaptively because it takes more than just picking up new knowledge and abilities. This study investigated the influence of adaptive behavior on employee

performance in the Ministry of Education Science and Technology (MoEST) in Kenya. The study was founded on Ability, Motivation and Opportunity (AMO) theory; adopted a positivism research paradigm and a descriptive research design. From a target population of 2116 employees, a sample of 416 employees was drawn using purposive sampling technique. A pilot study was conducted from MoEST employees in Laikipia, Isiolo and Meru counties to pretest data collection instrument. Principal Component analysis (PCA) and test of regression assumptions were carried out before hypothesis testing using a simple linear regression analysis. PCA generated six quality measures for employee adaptive behavior with factor loadings between 0.712 and 0.873. The results indicated that adaptive behavior was associated with R - Square of 0.320, F - statistic of 139.429 and p-value of 0.000, a beta coefficient value of  $\beta=0.685$  and associated p - value of 0.000.

**Keywords:** Adaptive Behavior, Employee Performance, Principal Component Analysis, Regression Analysis

---

**STI07-BME-004**

## **Combined Influence of Selected Predatory Loan Practices on Loan Performance Among Commercial Banks in Kenya.**

Majory Wangari<sup>1</sup>, Prof. David Kiragu<sup>2</sup>, Dr. Allan Kuria<sup>3</sup>, Dr. Beth Kariuki<sup>3</sup>

PhD Candidate<sup>1</sup>

<sup>23</sup>School of Business Management and Economics, Dedan Kimathi University of Technology

### **Abstract**

As in most economies worldwide, commercial banks are crucial in the Kenyan economy. Their importance stems from the various functions and services they provide, which contribute to economic growth, financial stability, and the country's overall development. In Kenya, the Government aspires to achieve an economic growth rate (GDP) of 10% p.a., as enshrined in Vision 2030 and beyond, which can only happen in a stable financial economy. Equally, the attainment of the Kenya Kwanza Bottom-

Up Economic Transformation Agenda (BETA) plan is also dependent on a robust financial sector. In 2022, the commercial banks in Kenya contributed approximately Kes. (Million) 13,368,340, about 5% of the Gross Domestic Product in Kenya. A vibrant banking sector depends on good loan performance, the primary source of bank income. Sound loan performance enables banks to maintain adequate capital reserves, meet operational expenses, and provide essential financial services. However, loan performance has deteriorated over the last decade from a ratio of non-performing loans to gross loans of 4.96% in 2013 to 14.5 % in June 2023. The gross non-performing loans stood at Kes 541 billion by June 2023. The risk categorization indicated a deterioration of 41 billion from December 2022 to June 2023. This is a cause of great concern for the sustainability of commercial banks in Kenya. This study aimed to analyze the combined influence of the selected predatory loan practices (borrower, lender, and loan processing practices) on loan performance among commercial banks in Kenya. The study adopted a positivist research philosophy and a descriptive research design.

The sampling frame and unit of analysis were the 39 commercial banks in Kenya (CBK,2022). The unit of response was 234 managers of these 39 commercial banks. A closed-ended questionnaire and a secondary data collection sheet were used to collect data for the prediction. A pilot test was carried out to assess the instrument's internal consistency using managers of three Micro Finance Banks in Nairobi, Kenya. Further, Confirmatory Factor Analysis (CFA) was utilized to enhance construct validity by generating the Kaiser-Meyer-Olkin coefficient and Bartlett's Chi-square for factorability analysis. Total variance explained scree plot and rotated component matrix were generated and further interpreted. After testing the data for Gaussian distribution, linearity, and autocorrelation, simple linear regression was used for inferential analysis. The study found that the three (3) predictors, borrower practices, lender practices, and loan processing practices, respectively, jointly explained approximately 58.5% of the variations of loan performance among commercial banks in Kenya. Borrower practices and lender practices were found to have a positive and statistically significant influence on the loan performance of commercial banks in Kenya. Loan processing practices were found to have a positive but no statistically significant influence on the loan

performance of commercial banks in Kenya. For borrower practices, the study recommended that commercial banks review the borrower-driven predatory loan practices leading to weak loan performance and incorporate them in the Know Your Customer (KYC) tool for loan evaluation(s) and pricing. The interventions include assessing the borrower's financial literacy, providing financial counselling services, and strengthening loan processing practices within the banks. For lender practices, the study recommended that commercial banks review or develop a profiling tool that identifies customers who have been on loan without a break, a customer who might need financial counselling, analyze the possibility of managing loan appetite for customers with questionable ability to repay, reevaluate certain products associated with relatively higher default rates, review policy on recharging securities successively and allow potential borrowers to review all the loan terms and conditions before loan award.

**Keywords:** Borrower, lender, loan processing, predatory, loan performance.

---

**STI07-BME-005**

## **Effect of Financing Practices on Sustainability of Water and Sanitation Companies in Kenya**

David Ndumo<sup>a</sup>, Prof. David Kiragu<sup>b</sup> and Dr. Mohamed Shano<sup>c</sup>

<sup>a</sup> PhD Candidate, School of Business Management and Economics, Dedan Kimathi University of Technology, P.O Box Private Bag, Dedan Kimathi, Kenya. E-mail: [dndumo@gmail.com](mailto:dndumo@gmail.com)

<sup>b</sup> Professor, School of Business Management and Economics, Dedan Kimathi University of Technology, P.O Box Private Bag, Dedan Kimathi, Kenya, E-mail: [david.kiragu@dkut.ac.ke](mailto:david.kiragu@dkut.ac.ke)

<sup>c</sup> Senior Lecturer, School of Business Management and Economics, Meru University of Science and Technology, P.O. Box 972-60200, Meru, Kenya, E-mail: [mohamedshano@gmail.com](mailto:mohamedshano@gmail.com)

**Abstract**

Sustainability of water and sanitation services is categorized as a global problem. Water and sanitation is number six of the worlds' seventeen sustainable development goals and an enabler to the achievement of all the other SDGs. Watsan sustainability involves improved access, acceptable water quality against growing demand. Access to watsan is a primary challenge globally due to its multifaceted use. Africa has the lowest freshwater resources (9%), while America has the highest (45%) at the global level. Asia follows (28%) and Europe (15.5%) in that order (Mugagga, 2016). Water scarcity exacerbated by climate change and increased demand will cost an estimated 6% of the GPD by 2050 due to impacts on agriculture, health and employment. Kenya with an estimated population of 53 million people has been classified as a water scarce country. Approximately 53% of the Kenyan population lack access to safe water while 77% have no access to improved sanitation thus making watsan access a national problem. Government spending on water development has significantly reduced from approximately Kshs46b in 2021 to Kshs.45b in 2022. The achievement of sustainability in the watsan, financing of up to 5 times the present level is needed. WASCOs continue registering high water loss annually resting at Kshs.11.2b in 2022. These statistics makes sustainability of water and sanitation in Kenya a national problem. Empirical studies shows that effective financial management practices contributes to firm sustainability. This study examined the influence of financing practices on sustainability of WASCO in Kenya guided by the pecking order theory. A positivism research philosophy was adopted with a descriptive research design. A sample of 46 companies was purposely selected from the 91 licensed WASCOs in Kenya. A likert scaled questionnaire was used to collect primary data. Secondary data was obtained from the annual impact reports by WASREB. Reliability was assessed using the Cronbach's alpha coefficient while validity was assessed through Kaiser-Meyer-Olkin test and Bartlett's Chi-Square test of Sphericity. Diagnostic tests included; normality, outliers, autocorrelation, multicollinearity and Gaussian distribution using Q-Q plot, box plot, Durbin-Watson  $d$  statistics, Tolerance & VIF statistics and Pearson's correlation coefficient respectively. A bivariate linear model was employed for inferential analysis. Results show the model explained approximately 45.1% of WASCO sustainability. ANOVA show F-statistics of 36.080

with a p-value of 0.000 indicating existence of a statistically significant influence of financing practices on sustainability of WASCO. Beta coefficients results for financing practices show  $\beta=27.834$  and p-value of 0.000 which was significant. The study recommends the strategic deployment of financing practices as they strongly influence the sustainability of water and sanitation companies in Kenya.

**Keywords:** Sustainability, Tariff, Government Financing, Debt

---

**STI07-BME-006**

## **Effect of Autonomy on Growth of Microfinance Institutions in Murang'a County, Kenya**

Dr. Ruth Muriithi<sup>a</sup>; Dr. Florence Kariuki<sup>b</sup>

<sup>a</sup>School of Business and Economics Murang'a University of Technology, P.O Box, 75,  
Murang'a,

E-mail: [rmuriithi@mut.ac.ke](mailto:rmuriithi@mut.ac.ke), [fkariuki@mut.ac.ke](mailto:fkariuki@mut.ac.ke)

### **Abstract:**

Microfinance institutions (MFIs) have emerged as crucial players in fostering financial inclusion and economic development in many regions, including Murang'a County, Kenya. Microfinance remains a powerful tool for development since it has made people self-sufficient. In particular, empowerment of vulnerable groups and the inculcation of financial training and discipline amongst the poor will undoubtedly have long-term socioeconomic benefits. This study investigates the effect of staffs' autonomy on growth of micro finance institutions. Specifically, the extent to which MFIs allow subordinate staff to come up with new ways to enhance customer satisfaction and set independent goals, on growth of these institutions in Murang'a County. Murang'a County in Kenya serves as an ideal location for this study due to its diverse economic activities and the presence of various microfinance institutions catering to financial needs of the local population. The study was anchored on Resource Based theory. Questionnaires were used to collect primary data while a data collection sheet was used for secondary data. Data was analyzed using Descriptive statistics and panel regression analysis to establish

the relationship between autonomy and growth. Findings show that when autonomy is held constant, growth of microfinance institutions will be 1.625 units. At the same time, increasing autonomy by 1 more unit would lead to an increase in growth by 0.593 units. This implies that autonomy has a positive relationship with growth of microfinance institutions. The relationship is significant given that  $p\text{-value}=0.000<0.05$ . The study established that there is a significant positive relationship between autonomy and growth of MFIs in Murang'a County. MFIs that encourage their staff to innovate and set independent goals experience higher levels of growth. The study highlights the importance of fostering a culture of autonomy within MFIs as a means of achieving sustainable growth. These findings have practical implications for the management and policymakers involved in the microfinance sector in Murang'a County, emphasizing the need to promote autonomy as a strategy for enhancing the growth and impact of MFIs.

**Keywords:** Autonomy, Microfinance Institutions, Growth, Financial Inclusion, Kenya.

---

**STI07-BME-007**

## **Effect of Technology–Organization–Environment Framework and Entrepreneur Practice in Kenyan Public Universities**

Monica Njeri Kibui

### **Abstract**

The main aim of the paper was to determine the effect of Technology– Organization– Environment (TOE) Framework and Entrepreneur Practice in Kenyan Public Universities. The study was anchored on institutional theory. The target population comprised of 2863 academic staff from 5 chartered public universities in Nairobi County. The study used stratified and random technique to choose a sample 342 university's academic staff from 5 strata's representing each university in Nairobi County, Kenya. Finding showed in technology and organization context positively affect entrepreneurial practices in university. However, environmental context had insignificant effect on entrepreneurial practices in university. The study concludes that advancements in technology and supportive organizational structures can promote entrepreneurship and help university students and faculty develop their entrepreneurial

skills and bring new ideas to market. However, external factors, such as the regulatory environment or local market conditions, may not have a major influence on entrepreneurial activities within the university setting. The results of the study provide important insights into how universities can support and encourage entrepreneurship among their students and faculty. These findings highlight the importance of universities investing in technology and organizational support to promote entrepreneurship among their students and faculty. By doing so, they can help foster a culture of innovation and drive economic growth and development in their communities.

**Keywords:** Technology context, Organization context, Environment context, TOE Framework, Entrepreneur Practice, Public Universities

---

**STI07-BME-008**

## **Effect of Sustainability Reporting on Financial Performance of Listed Financial Firms in Kenya**

Omollo Joel Agutu and Wanyoike Charles Githira

School of Business, KCA University

Corresponding Author: [joelagutu@gmail.com](mailto:joelagutu@gmail.com)

### **Abstract**

Traditionally, financial and investment decisions have been motivated by the financial considerations. This is harmony with the theory of the firm which was more focused on profit maximization. Since profitability gauges a firm's performance, high profits in the financial sector signals resilience and enables economic survival. Exposure normally arises in the absence of profits thus making a business to lose its key goal which ultimately poses a direct risk to its survival. Financial sector stability is critical since it supports a thriving, sound, and inclusive financial sector which is essential ingredient in facilitation the attainment of Kenya's objectives for sustainable national development. In reality, Kenya's financial sector is struggling, occasioned by numerous downside risks and poor financial performance. This has resulted in financial sector players collapsing or being put in statutory management. This poor performance can be attributed to lack of sustainability considerations which has been linked to corporate failures. The

Global Financial Crisis in 2008, was greatly influenced by governance lapses at financial institutions. Adoption of sustainability practices is thus essential in the financial sector since sustainability risk stifles financial performance. Applying mixed research design, this study evaluated the impact of ESG adoption and reporting on firm's financial performance gauged through Return on Asset (ROA). The study was anchored on legitimacy, stakeholder, agency, stewardship and institutional theories. Through census method, the study population of twenty-three financial sector players listed in the Nairobi Securities Exchange (NSE) Kenya were obtained and secondary data collected for seven years (2015-2021) on annual basis. Descriptive and inferential statistics were utilized to analyze data. Feasible General Least Squares (FGLS) was applied to overcome the constraints of autocorrelation in the study. The findings indicated a positive relationship between ESG reporting: environmental sustainability reporting, social sustainability reporting and governance reporting and financial performance of listed financial companies in Kenya. Social reporting and governance reporting were statistically significant in the model. Environmental Reporting showed positive but not statistically significant effect on ROA. The findings imply that companies should embrace sustainability to increase earning potential and firm value to safeguard the going concern.

**Keywords:** Sustainability, ESG, Environmental Sustainability Reporting, Social Sustainability Reporting, Governance Reporting, Return on Asset.

---

**STI07-BME-009**

## **Effectiveness of Covid-19 Crisis Management Strategies on Business Continuity of Tour Operators in Nairobi County**

Benazir Ongarora

### **Abstract**

The Covid-19 pandemic has proved to be a crisis that has affected the global tourism industry. Many countries in the world came up with strategies to prevent further effects of the crisis and ways to cope with the dynamic state of the tourism businesses. As a result of the crisis, even with a slow return to normal, some tour operators sacked their

employees and others made to close down their businesses as they were not equally prepared to operate in such environment punctuated by the Covid-19 pandemic or were new in the business among many other factors. The main objective of this study was to explore the effectiveness of the covid-19 crisis management strategies on the business continuity of tour operators in Nairobi County. The specific objectives sought to; examine the effectiveness of crisis preparedness strategies, determine the effectiveness of crisis response strategies, assess the effectiveness of recovery strategies and examine the probable mitigation strategies on business continuity of tour operators in Nairobi County. The study was based on the Theory of Change and the Relational Model for Crisis Management. The study adopted the exploratory research design and targeted a population of 518 tour operators from which 226 operators were randomly selected as the sample size. A questionnaire was used to collect data which was analyzed using both descriptive and inferential statistics. Majority of tour operation businesses were not prepared for a global health crisis and more so the Covid-19 virus. Majority of the businesses however responded by early environmental scanning and timely delivery of information to both employees and customers on how to handle the crisis. On the other hand a Disaster Recovery plan was put up as a strategy to get back to business as soon as possible. Finally, the research found out that the businesses that survived the first three stages carried out a post covid-19 crisis impact assessment and further resource and fiscal evaluations and from these they modified their operations to curb further adverse effects if any such crises occurred in future. In conclusion, it was evident from the study that tour firms were not well prepared to handle a crisis, however with quick training and presence of a matrix for crisis management, a business can bounce back to operations as soon as possible. From the study, it can be recommended that the government documents a crisis management plan to be used as a tool of reference in future in case another crisis comes up. Further research can be carried out to compare results with other industries and tourism sectors as a way of understanding how the Covid-19 crisis has affected different businesses.

---

## **High Performance Work Practices and Performance of Level 4, 5 And 6 Public Hospitals in Kenya**

Ogola Pharel Omondi<sup>a</sup>, Ngure Susan<sup>b</sup> and Sang Anne<sup>a</sup>

School of Business Management and Economics, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: farel.ogola@gmail.com

### **Abstract**

Performance of hospitals is vital in addressing health related challenges. The key objective of this study was to determine the effect of High-Performance Work Practices on the performance of level 4-6 public hospitals in Kenya. Specifically, it sought to determine the effect of the following practices: performance appraisal, employee participation, employee training, and compensation. It also sought to analysis the moderating effect of Human Resource Management Professionals act, 2012 perceived compliance on the relationship between High Performance Work Practices and performance of level 4- 6 public hospitals in Kenya. The study was anchored on Strategic Human Resource Theories, Ability Motivation and Opportunity model, Resource Based View theory, Equity theory and Theory of regulatory compliance. Descriptive survey research design was used while sampling was done through stratified random sampling techniques. The research philosophy was based on positivism and the targeted population was 180 level 4-6 public hospitals in Kenya. A sample size consisted of 123 public hospitals. Data was collected through questionnaires while data analysis was done descriptively using mean and standard deviation. Inferential statistics analysis used analysis of variance, and Pearson correlation. Diagnostic analysis was done using multicollinearity, normality, outliers, homoscedasticity, and autocorrelation tests. Data was presented through frequency distribution tables and charts. Regression of coefficients showed that all the variables had a positive and significant effect on public hospital performance with the following values: performance appraisal practices ( $\beta=0.410$ ,  $p=0.000$ ); employee training practices ( $\beta=0.456$ ,  $p=0.000$ ); employee participation practices ( $\beta=0.113$ ,  $p=0.029$ ); and, compensation practices ( $\beta=0.145$ ,  $p=0.000$ ). The results also showed that Human Resource Management Professionals

act 2012 perceived compliance is a good moderator of the relationship between High Performance Work Practices and performance of public hospitals, with F statistic of 226.908 and the reported p-value 0.000. Study conclusion: All the variables had a positive and significant effect on public hospital performance with employee training practices having the highest impact. Study recommendation: Policy makers should formulate policies that reinforce the need for training, networking skills and employee's specific jobs. Additionally, managers should focus more on employee training practices for optimum performance.

**Keywords:** Performance, Public hospitals, High performance work practices.

# ENGINEERING TECHNOLOGIES AND INNOVATIONS FOR INDUSTRIALIZATION (ETI)

**STI07-ETI-001**

## The Use of UAV Derived Data for Tree Height Estimation

Viola K. Orina<sup>a</sup>, Arthur W. Sichangi<sup>a</sup>, Mark K. Boitt<sup>a</sup>, Ciira Maina<sup>b</sup>, Dennis Theuri<sup>a</sup>

<sup>a</sup> Institute of Geomatics GIS and Remote sensing, Dedan Kimathi University of  
Technology, Private Bag, Nyeri, 10100, Kenya, E-mail:

[viola.orina23@students.dkut.ac.ke](mailto:viola.orina23@students.dkut.ac.ke)

<sup>b</sup> Center for Data Science and Artificial Intelligence (DSAIL), Dedan Kimathi University  
of Technology, Private Bag, Nyeri, 10100, Kenya.

### Abstract

Kenya, facing a forest cover of only 7% compared to the recommended 10% for sustainable development, contends with severe deforestation attributed to forest fires, unsustainable human activities, and settlement expansion. Afforestation and reforestation initiatives have been implemented by organizations and government agencies to combat deforestation, enhance soil health, and sequester carbon. Kieni forest encapsulates this crisis, exemplifying rampant deforestation's adverse impact on ecosystems and local well-being. The ensuing extended droughts and unpredicted rainfall patterns have led to depleted water sources, affecting agriculture and daily sustenance. Notably, the decline in the African elephant population underscores the loss of biodiversity. This research focuses on the utilization of a novel methodology that leverages remote sensing data from Unmanned Aerial Vehicles (UAVs), in combination with ground-based measurements. The primary objectives of this study include estimating tree height using UAV-derived Digital Terrain Model and Digital Surface Model data, as well as tree species identification from UAV-derived images. The methodology entails the derivation of Digital Terrain Model and Digital Surface Model from aerial images. The estimation of tree height was done by the creation of a Canopy Height Model (CHM) through the subtraction of DTM from DSM. To ensure the precision of the CHM model, it was subjected to validation by comparing it against the field measurements obtained during data collection. The accuracy of the estimated tree heights was 0.9979 for  $R^2$  and RMSE at 0.9748. This study underscores the effectiveness of UAV-derived data in accurately estimating tree height. The results demonstrate the potential of UAV technology to revolutionize forest monitoring and management, offering a cost-effective and efficient solution for tree height estimation. The findings presented in this abstract contribute to the growing body of knowledge supporting the integration of UAVs in forestry and environmental research, paving the way for improved resource management and ecological studies.

**Keywords:** Deforestation, UAV, Canopy Height Model, Digital Surface Model, Digital Terrain Model Orthophoto.

---

**STI07-ETI-002**

## **Low-cost Particle Image Velocimetry as an additional tool for Fluid Dynamics Trainers**

Godfrey Kabungo Gakingo, Dalmas Gulema Chavasinya, Shepatia Langat Kipkorir and Joseph Njenga Disho

<sup>a</sup>School of Engineering, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [godfrey.gakingo@dkut.ac.ke](mailto:godfrey.gakingo@dkut.ac.ke)

### **Abstract**

Fluid Dynamics is a core course within several engineering disciplines including Mechanical, Chemical and Civil Engineering. It is, however, a difficult course to teach as it involves concepts that can often be viewed as abstract by the students - concepts such as, for example, rotational versus irrotational flows. Teaching of Fluid Dynamics also involves the use of high level mathematics that is usually difficult to associate with physical flow situations. To aid in the breaking down of these conceptual barriers, simple experiments are often used to complement classroom teaching. While a number of such experiments already exist (eg wind tunnel experiments), this study proposes the use of low-cost particle image velocimetry (PIV) as an additional tool. PIV is an established non-intrusive velocity measurement technique that is mainly used within the research space as opposed to the educational space due to the associated high costs and need for high-level expertise. However, recent efforts have been geared towards making PIV more affordable and accessible. Such efforts have included, for example, replacing high-end cameras with mobile phone cameras, replacing high-end lasers with cheaper light sources and the development of open-source software for analysis (both computer-based and phone-based). Building on these efforts, this study seeks to illustrate how low-cost PIV can be easily incorporated into a typical undergraduate Fluid Dynamics laboratory. A simple flow set up was assembled using a beaker, a magnetic stirrer, water-glycerine mixture and a relatively inexpensive laser and optics system. The flow was recorded using a mobile phone camera and the subsequent analysis done using the open-source PIVlab software. Velocity data has been obtained and additional analysis done to illustrate concepts such vorticity within the flow. It is envisioned that this work will help to stir conversation and research around context-relevant or discipline-relevant uses of low-cost PIV as a tool to enhance the delivery of Fluid Dynamics.

**Keywords:** Particle image velocimetry, low-cost, Fluid Dynamics

---

**STI07-ETI-003**

# Model Development for Predicting Carrying Capacity of Concrete Filled Bamboo Columns

Shitabuleh Stephen<sup>1</sup>, Bruce kandie<sup>2</sup>

<sup>1</sup> Department of Civil and Structural Engineering University of Eldoret

<sup>2</sup> Department of Civil and Structural Engineering Masinde Muliro University of science and Technology

<sup>1</sup>shitabstephen@gmail.com

## Abstract

In recent years, many researches around the world have begun to explore the use of low-cost and low-energy substitute construction materials. Among the many possibilities for such substitutions, bamboo, one of the fastest growing plants, has got a great economic potential. Bamboo has been widely used as a rapidly renewable structural material to build permanent and temporary structures in past decades. However, the compressive bearing capacity of bamboo is relatively low, which limits its applications only in the structures under very light loads. This study investigates the composite effect of bamboo when filled with concrete and subjected to axial compression. A model is then developed to predict the carrying capacity of concrete filled bamboo columns based on modification of ritchart et al and mander et al equations. A linear equation is developed through regression analysis of the experimentally obtained values. Concrete mix C30 and C20 were used to fill bamboo of diameters 55mm, 75mm and 100mm and slenderness ratio of 2, 3 and 4 and then cured in a water tank for 28 days. The specimens were then tested in a universal testing machine (UTM) under a loading rate of 31kN/s as per the ASTM standards to produce experimental data. Results obtained were compared with the regression model equation. The proposed model revealed almost fairly estimation capability for all of the data samples. The main aim was to increase the knowledge of structural behavior of such composite column and give practical information for design purpose.

**Key words:** Bamboo concrete infill, axial compression, regression model, carrying capacity behavior.

## **Development of a Virtual Environment-Based Electrooculogram Control System for Safe Electric Wheelchair Mobility for Individuals with Severe Physical Disabilities**

Phoebe Ogenga<sup>a</sup>, Waweru Njeri<sup>b</sup> and Joseph Muguro<sup>c</sup>

<sup>a</sup> Center for Robotics and Biomedical Engineering, Department of Electrical & Electronic Engineering, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [ogenga.achieng19@students.dkut.ac.ke](mailto:ogenga.achieng19@students.dkut.ac.ke)

**Keywords:** Electrooculogram; Wheelchair; Classification; Virtual Environment; Safety; Control.

### **Abstract**

Conventional wheelchairs are predominantly manual or joystick-operated electric wheelchairs. However, operating these wheelchairs can be difficult or impossible for individuals with severe physical disabilities. Due to losing control of their physical limbs, they depend on an attendant for assistance. As a remedy, bio-signals may be used as a control mechanism since they are readily available and can be acquired from any body part. This research proposes to use EOG signals to vail a control mechanism and test it in a virtual and actual electric wheelchair. The main contribution of the study is an investigation of the use of EOG to control an electric wheelchair in a virtual environment to determine safe control parameters for wheelchair use in complex environments. A customized data acquisition circuit was developed to acquire single-channel EOG signals using wet electrodes. The acquired signal was filtered and processed using feature extraction and classification techniques in MATLAB software. Two customized control environments were developed in Unity 3D, one with equally partitioned sections and the other with sections decreasing in size as the robot wheelchair approaches the target. Twenty-two test subjects (mean age 24.5, std 1.5) participated in the study, controlling the robot wheelchair in real-time with non or least instances of collision and oversteering. The system achieved an accuracy of 96.5% with a response time of 0.7s, translating to an ITR of 70.6 bits/min. Overall, the participants

managed to navigate the virtual environment with a completion time of  $101.94s \pm 19.71$  and  $109.07s \pm 13.25$  for the male and female participants, respectively. In the scene with decreasing section sizes, 72% and 54% instances of collision and oversteering were reported, respectively, highlighting the need to consider the complexity of the control environment and the sufficiency of the participants' control skills to ensure safety in operations. The results confirm the usefulness of EOG as a control interface, with little or no need for recalibration. It provides a promising avenue for individuals with severe physical disabilities to operate wheelchairs independently in complex environments, enhancing their quality of life.

**Keywords:** Electrooculogram; Wheelchair; Classification; Virtual Environment; Safety; Control.

---

**STI07-ETI-005**

## **Fundamental Study on Neural Network based Forward Kinematics Model for a 6-DoF Parallel Link Robot**

Samuel Kariuki<sup>a</sup>, Yoshiyuki Hatta<sup>b</sup> and Kazuaki Ito<sup>b</sup>

<sup>a</sup>Graduate School of Natural Science and Technology, Gifu University, Japan, E-mail:

[kariuki.samuel.kiragu.n5@s.gifu-u.ac.jp](mailto:kariuki.samuel.kiragu.n5@s.gifu-u.ac.jp)

<sup>b</sup>Faculty of Engineering, Gifu University, 1-1 Yanagido, Gifu City, 501-1193, Japan

### **Abstract**

One of the technologies that has revolutionized industrial automation is the high precision motion control of robotics. Robots which can be categorized as either open chain or closed chain manipulators have seen wide application in most repetitive tasks. This is especially true for the open chain manipulators which have a large reachable workspace and have been widely applied in manufacturing industries such as the automotive industry. As a next step towards automation of skilled work, the real-time and high precision simultaneous force and position control becomes important. The closed chain manipulators (parallel link robots, PL) have received attention for their

higher accuracy and rigidity leading to both a high precision and increased load bearing capacity. The main challenge limiting this real time application is the complexity in obtaining the forward kinematics (FK) and a corresponding, undesired, high computational time requirement especially with increased degrees of freedom. This study proposes a solution to the high computational time requirement in determining FK for the PL robot using Neural Networks (NN). This is by aiming to realize a computational time of under 1ms which will pave the way for more advanced motion control applications requiring real-time force and position information at a 1ms sampling time. FK is necessary to compute position and orientation of a robot based on the input joint angles. It is especially useful in force control where a force applied to the robot generates controlled motion leading to a specific robot position and posture. To determine the FK for a system, the iteration methods are used in conventional methods[1]. The complex geometry and non-linearity of PL robot systems makes this process very time consuming and results in a high lag time leading to the challenge of real-time application mentioned above. The NN will be used as an alternative to the mathematical model providing more efficient and faster computation. The Extended Kalman Filter (EKF), a useful tool in robotics is then used in estimating the nonlinear motion of the robot through determining states such as position, orientation, velocity and acceleration. The integration of the NN and the EKF model will lead to a significantly efficient and faster computation of the FK without compromising on the accuracy. This timebased optimization using the proposed neural network-based FK model will therefore enable the application of the 6-DoF PL robot to real-time applications. This contribution will lead to reaping the benefits of high torque output, high precision and high-speed operations associated with the PL robots; potentially leading to higher efficiency and cost reduction in industrial automation.

**Keywords:** Parallel Link Robot, Forward Kinematics, Neural Network, Extended Kalman Filter.

---

**STI07-ETI-006**

# Development of Geocapillary Barrier System for Water Retention in Highway Landscaping

Binti Mohamed Haji, Dr Joseph Thuo, Dr. Achieng K. O

Department of Civil Engineering, Dedan Kimathi University of Technology, Nyeri,  
Kenya

## Abstract

This study investigates the potential use of geosynthetic materials as capillary barriers to enhance water retention in landscaping soils. Soil was first classified using Unified Soil Classification System (USCS), then Van Genuchten model was used to model and compare unsaturated hydraulic characteristics of the soil and geosynthetic materials. Five different materials; gravel, sand, Needle Punched 50 (NP 50) geotextile, Thermally Bonded (TB) 9 and (TB) 21 geotextiles were used together with silty clay to create capillary barriers in five different 500mm deep soil columns to determine how each of the materials influences the amount of water stored. Water infiltration was allowed into each of the columns constructed as capacitive moisture sensors tracked change in moisture content in the soil. The air entry pressure and residual matric suction for the materials was determined from Water Retention Curves (WRCs) and compared to water content retained in each column. This study concluded that properly designed capillary barrier can be used to increase water retention in landscape soils. It was also demonstrated that geosynthetic materials with the higher residual matric suction (NP 50 and sand) stored more water compared to the ones with the least (TB 21 and TB 9).

---

**STI07-ETI-007**

## Overcoming wireless communication bottlenecks by leveraging the IRS

Anne N. Munira\*, Joseph Muguro and Waweru Njeri

School of Engineering, Dedan Kimathi University of Technology, Private Bag, Nyeri,  
7381, Kenya, E-mail: \*anne.njeri@dkut.ac.ke

## Abstract

Massive MIMO (mMIMO) and Holographic MIMO are some of the approaches used for performance improvement in wireless communication networks. However, these approaches are limited by high power consumption and little control over the propagation environment. In the case of a blocked Line of Sight (LOS) scenario, the above-mentioned approaches would be less effective due to the multiple paths formed by the signal from the transmitter to the receiver. An Intelligent Reflecting Surface (IRS) is a 2D array of subwavelength metamaterials that has emerged as a potential solution to these challenges. It provides an alternative path for propagating signals resulting in an SNR that increases squarely with the number of IRS elements. The main objective of this work is to demonstrate how the IRS offers unmatched performance, particularly in blocked LOS scenarios. Blocked LOS scenarios interfere with data transmission especially where there is a need for high data rate transmissions. Current approaches to overcome the blocked LOS problem have not been cost effective due to their high-power consumption and cost. The performance of a passive IRS is investigated through MATLAB simulation and compared with the performance of mMIMO and half-duplex relays. A comparison is done for the data rate increase with the number of antennas/IRS elements for the three systems. Results indicate that the data rate of an IRS-aided system increases squarely with the number of IRS elements while that of mMIMO relay increases linearly with the number of antennas. Although the IRS can outperform the relay only if the number of IRS elements exceeds the number of relay antennas, previous studies have shown that the power consumption of an IRS is significantly lower than that of a relay with a similar number of antennas [1]. This makes the IRS an attractive solution for data rate and SNR issues in communication systems. This work shows that the IRS is a novel solution to performance bottlenecks, making it vital for current and future wireless communication systems.

**Keywords:** Wireless Communication, IRS, data rate, performance bottlenecks.

---

**STI07-ETI-008**

## **Enhancing Child Safety through Wearable IoT Devices: Real-Time Monitoring and Reporting of Distress Levels using Machine Learning.**

Elizabeth Wairimu<sup>a</sup>, Dianne Chemutai<sup>a</sup>, Job Munene and Joseph Muguro<sup>a,\*</sup>

<sup>a</sup>School of Engineering, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [joseph.muguro@dkut.ac.ke](mailto:joseph.muguro@dkut.ac.ke)

## **ABSTRACT**

Child safety and well-being remain paramount concerns in today's world. To address the pressing issues of child abuse and missing child cases, we introduce a wearable Internet of Things (IoT) device designed to provide parents and guardians with real-time tracking and comprehensive monitoring capabilities while addressing privacy concerns. Several of such monitoring devices have been commercialised internationally utilising location beacons. The drawback is that the devices in use are predominantly location-based. GPS locators do not have a mechanism to provide context whether the device is still worn by the child and other significant aspects of monitoring like distress levels. Further, there are no such devices available and fabricated locally in spite of the looming challenges. The proposed wearable IoT device is equipped with sensors to monitor essential physiological parameters, including heart rate, audio and location. The overall goal in this approach is to provide a general state of the child's well-being without transmitting sensitive information unless the system so deems. The wearable IoT device incorporates sensors to monitor key physiological factors such as heart rate, audio, and location, allowing for an assessment of the child's well-being and surroundings. Heart rate monitoring serves to detect distress, ensuring the device's constant connectivity for emergency response. Audio analysis provides insights into the child's activities and overall condition, while geofencing using location data enables the establishment of safe zones. If the child strays from these predetermined safe areas, the device promptly notifies the caregiver, enhancing child safety and providing peace of mind. The work involves designing and fabricating the wearable device. Similarly, Machine learning algorithms will be trained for different levels of distress detection from the sensors. Development of applications (App) will also ensue to convey the information to guardians/parents. All data, including general state information and distress context, is securely transmitted to a cloud server for easy access and historical analysis while maintaining privacy through edge processing. In conclusion, this wearable IoT device offers a holistic solution to child safety concerns, enabling parents and

guardians to track their child's real-time location, monitor vital signs, and receive selective contextual alerts when distress is verified, all while safeguarding privacy. Its use of SMS and app communication, geofencing, and advanced privacy measures make it a valuable tool for enhancing child safety in today's world.

**Keywords:** Child safety, wearable devices, Machine Learning, Distress, Internet of Things (IOT).

---

**STI07-ETI-009**

## **Development of A Drone with A Robot Hand for Doing Light Works at High Places**

Minoru Sasaki, Joji Imai, Kojiro Matsushita

Department of Mechanical Engineering, Gifu University

1-1 Yanagido, Gifu, 501-1193, Japan

E-mail: [sasaki.minoru.n3@f.gifu-u.ac.jp](mailto:sasaki.minoru.n3@f.gifu-u.ac.jp)

### **Abstract**

Mobile phone: +weight-clamping hand for landing and taking off at the ceiling. The proposed hand requires power from one motor when closing but enables to grasp and release the beam with any power due to the functional mechanism. The drone with the lock-mechanism hand demonstrated landing and taking off the beam with minimum motor power.

---

**STI07-ETI-010**

## **Collaborative space engineering project between Gifu University, high schools and Gifu Prefecture**

Minoru Sasaki, PhD

Professor

Center for Collaborative Study with Community

Gifu University

Tokai National Higher Education and Research System

1-1 Yanagido,

Gifu, 501-1193

Japan

\*Corresponding author. Email: [sasaki.minoru.n3@f.gifu-u.ac.jp](mailto:sasaki.minoru.n3@f.gifu-u.ac.jp)

## **Abstract**

The Chubu region is Asia's number one aerospace industry cluster formation special zone, and Gifu Prefecture is home to many aerospace-related companies. Therefore, there is a high awareness of aerospace science in this region. For this reason, research and educational institutions such as universities are providing highly specialized aerospace education opportunities for elementary and junior high school students who have developed an interest in aerospace science in order to develop human resources who can contribute to the aerospace industry. We offer Gifu University, Gifu Prefecture, and Kakamigahara City launched the "Space Engineering Course" in 2016 as a high school-university collaboration project that utilizes the video conferencing system of the Gifu University Regional Collaboration Center COC and COC+ programs. Currently, Gifu Prefecture's aerospace industry boasts a high concentration rate, ranking second in the nation in terms of number of establishments and number of employees, and third in the value of manufactured goods shipped. Furthermore, in order to develop the prefecture's economy and expand employment, Gifu Prefecture has positioned the aerospace industry as a priority growth field in the "Gifu Prefecture Growth and Employment Strategy" formulated in March 2014. Under these circumstances, in the aerospace industry, there is an extremely high need for human resources education to develop and secure excellent human resources and leaders for the industry. With a sense of crisis in this situation, and in order to convey the appeal of the aerospace industry to the next generation, we provided students attending high schools in Gifu Prefecture with the opportunity to experience Gifu University's cutting-edge education and research. The purpose of this course is to acquire basic knowledge about space engineering and to develop human resources who will play an active role in the satellite, rocket, and aviation industries in the future, as well as to foster and

increase motivation for employment in industry. The unique feature of this course is that students scattered throughout the prefecture can attend lectures at their respective institutions using a video conference system, as well as visit the Japan Aerospace Exploration Agency (JAXA) and the National Astronomical Observatory of Japan. We provide cutting-edge space education with the cooperation of related organizations. Students who complete this course will go on to various career paths, including promotion to higher grades and higher education. In either direction, I believe that the true science experience I gained through this course, especially the attitude of thinking scientifically, will be of great help in the future. I would like to see it utilized in various fields and areas.

**Keywords:** High School–University Cooperation, STEAM education, CanSat, CubeSat, Space Engineering Remote Course, Industry–government–academia collaboration.

---

**STI07-ETI-011**

## **Influence of Methyl Linolenate and Methyl Palmitate on Soot nucleation rates in Biodiesel Flames**

R. M. Kiraithe<sup>a</sup>, J. K. Tanui<sup>a</sup> and P. N. Kioni<sup>a</sup>

<sup>a</sup>School of Engineering, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [royston.kiraithe19@students.dkut.ac.ke](mailto:royston.kiraithe19@students.dkut.ac.ke)

### **Abstract**

Currently, there is a growing focus on extremely tiny soot particles because of their extensively documented negative impacts on both human health and the environment. More specifically, understanding the nucleation of soot particles is one of the most important aspect in achieving more regulated and environmentally friendly combustion. This study focused on establishing the influence of methyl esters on the overall nucleation rates and soot volume fraction of biodiesel flame by simulating and comparing the nucleation rates of Methyl Linolenate (MLe) and Methyl Palmitate (MP) flames. The study was based on Moss-Brooke's soot model using biodiesel surrogates (FAME) reduced mechanism with 177 chemical species and 2904 chemical reaction. Fuel and air inlet conditions were set at normal room conditions (101325 Pa and 300 K).

Stationary walls were applied to the left and right plane of computational domain while zero gradient conditions at the outlet. Specified velocities for the fuel and air were 0.4 m/s. According to the computation, MLe has a greater influence in nucleation and soot volume fraction as compared to MP due to higher aromatic content and higher production of soot precursors with carbon rings in the flame.

**Keywords:** Soot Nucleation; Biodiesel; Methyl Linolenate; Methyl Palmitate; Precursor.

---

**STI07-ETI-012**

## Performance Evaluation of Biomass Dryer

J.W Wainaina<sup>a,b</sup>, I.O Otieno<sup>a,b</sup>

*<sup>a</sup>Centre for Biomass Energy Studies, Dedan Kimathi University of Technology, Nyeri, Kenya*

*<sup>b</sup>Department of Mechanical Engineering, Dedan Kimathi University of Technology, Nyeri, Kenya*

### Abstract

The need to meet rising global energy demands as well as the requirement to cut carbon emissions has prompted research into renewable energy sources, with a particular emphasis on biomass-derived biofuels. This abstract gives a comprehensive overview of a biomass dryer project that addresses these crucial problems and offers a practical way to handle agricultural product and waste. The biomass dryer's complete lifecycle is covered by this project, from conceptualization to construction through thorough testing. The choice of the best materials must be made at the design phase, taking into account elements like availability, thermal conductivity, and durability. In order to maximize performance, aspects like the dryer's capacity and energy efficiency are carefully taken into account during the design process. Fabrication entails building the dryer in accordance with the chosen design, guaranteeing accuracy and compliance with safety regulations. Its functionality, energy efficiency, and performance under varied operating situations are rigorously tested. An important factor considered in this stage

is the dryer's ability to effectively remove moisture content. Additionally, this project includes a cost analysis that covers material acquisition, manufacturing costs, and ongoing operational costs. The biomass dryer's financial sustainability is evaluated in relation to its potential advantages in terms of decreased moisture content, increased biofuel production efficiency, and environmental impact. The biomass dryer's importance in the handling of agricultural products is further shown by this project. This 4.5-meter-long, 2-meter-wide, and 2-meter-high biomass-fueled dryer's layout is intended to effectively dry agricultural products like fruits, vegetables, and cereals. To provide reliable and controlled drying processes, this dryer includes efficient insulation, airflow management, and a durable exterior.

**Keywords:** Biomass-derived biofuels, biomass-fuelled dryer

---

**STI07-ETI-013**

## **Assessment of the Cooking Environment in Kenya**

### **Designing Biosensors Integrated with Biomolecular Machines**

Nitta, T.

*Applied Physics Course, Gifu University, Japan*

#### **Abstract**

Motor proteins, such as myosin and kinesin, are biomolecular machines which drive muscle contractions and intracellular transports, respectively. Their small size and biocompatibility make them attractive motive powers for nanoscale bioengineering. Integration of the motor proteins may offer a new way of powering MEMS and biosensors. By developing and using computer simulations, as well as experiments, we are pursuing the integration. Cytoskeletal filaments were modeled as inextensible elastic rods. Time evolutions of conformations of the filaments were computed with a Brownian dynamics simulation. Kinesin and myosin motors were modeled as linear springs. Once bound, motor heads were assumed to move toward designated ends of the cytoskeletal filaments. In addition, normal forces were applied when the filaments collided against the microfabricated guiding walls and the track surfaces. The filaments

were also subjected to external forces. The external forces induced by electric field and fluid flow are used for directing gliding movements of the filaments. The simulation we developed reproduced previous experimental results. More importantly, the simulation revealed detail mechanisms of the gliding movements of the filaments. For example, at chemical edges, zipping of motor proteins located at the edges was found to occur. Such findings were difficult to obtain in experiments due to their limited spatial and temporal resolutions. Insights obtained here would be useful in designing microdevices integrated with motor proteins.

**Key words:** Biosensors, biomolecular machines, motor proteins, computer simulation, microfabrication.

---

**STI07-ETI-014**

## **A techno-economic feasibility study of hybrid energy PV/biogas/battery for Mara Serena Safari Lodge**

Victor Munene and Sylvia

School of Engineering, Dedan Kimathi University of Technology, Private Bag,  
Nyeri, 10143,

Kenya, E-mail: [mati.victor22@students.dkut.ac.ke](mailto:mati.victor22@students.dkut.ac.ke)

**Keywords:** Techno-economic, hybrid energy, LCOE, economical.

### **Abstract**

This study presents a comprehensive techno-economic evaluation of Mara Serena Lodge's current means of electricity generation infrastructure consisting of a PV/LPG/Battery and a hybrid system that would incorporate PV/Biogas/Battery, incorporating literature from various authors on the subject matter. The data used was acquired from the site by means of a data logger and the simulations performed were done using HOMER pro software. The analysis indicates a higher cost implication associated with the utilization of biogas energy in terms of LCOE, NPC, and initial capital, and operating capital. Biogas presents values of the above at Ksh 63.41, Ksh 979 million, Ksh 463 million, and Ksh 39.9 million, respectively. In contrast, diesel

generators exhibit Ksh 57.92, Ksh 846 million, Ksh 51.4 million, Ksh 61.4 million of the same. However, the fuel consumption of diesel generators is at 282,277 liters annually whereas that of biogas is at 272,822 liters. Despite the economic advantages of using diesel, there exists the drawback of the substantial amount of carbon dioxide emissions which are detrimental to the climate.

---

**STI07-ETI-015**

## **The Effect of Different Insulation Layer Materials on Cookstove Efficiency**

E. K Likare<sup>a</sup>, M.Njeri<sup>b</sup>, P.M.Kimari<sup>c</sup>

Dekut Centre for Energy Studies, Dedan Kimathi University of Technology,  
Private Bag 10143, Nyeri, Kenya, E-mail: [khasialaeugine@gmail.com](mailto:khasialaeugine@gmail.com)

<sup>b</sup>Mechanical Engineering Department, Dedan Kimathi University of Technology,  
PrivateBag10143, Nyeri, Kenya.

### **Abstract**

Cooking is a fundamental aspect of daily life, and in many parts of the world, traditional cookstoves remain the primary means of food preparation. However, the inefficiency of these cookstoves can lead to a range of environmental and health issues. In an era where sustainability and energy efficiency are paramount, improving the performance of cookstoves is not only a matter of convenience but also a crucial step towards reducing energy consumption and mitigating indoor air pollution. This research paper delves into the fascinating realm of cookstove efficiency by exploring the impact of different insulation layer materials. Insulation is a pivotal component in cookstove design, as it plays a vital role in retaining heat and ensuring that energy is utilized efficiently during the cooking process. By investigating various insulation materials and their effects on cookstove performance, this study aims to contribute to the ongoing efforts to develop more sustainable and efficient cooking solutions. In doing so, it aspires to offer insights

that can enhance the livelihoods of millions while addressing the global challenges of energy conservation and indoor air quality.

**Keywords:** cookstoves, traditional cookstoves, inefficiency, sustainability, energy efficiency, performance

---

**STI07-ETI-016**

## Integration of Solar Energy into Milk Processing

Sylvia Muriithi<sup>a</sup>, Benjamin Mugambi<sup>b</sup> and Patrick Kimari<sup>a,b</sup>

<sup>a</sup>Centre for Energy Studies, Dedan Kimathi University of Technology, Private Bag, Nyeri, 10143,

Kenya, E-mail: [sylviacmuriithi@gmail.com](mailto:sylviacmuriithi@gmail.com)

<sup>b</sup>Department of Mechanical Engineering, Dedan Kimathi University of Technology, Mweiga, 657, 10100, Nyeri.

### Abstract

Milk processing plants are huge consumers of power because of the process heating and cooling required in the different processes e.g., pre-heating, pasteurizing, refrigeration and other processes like bottle filling and sealing. Take pasteurizing, for example, heating litres of water to 90°C using Kenya Power grid-tied electricity is costly leading to high operation costs. This poses a threat to the future of such industries. An evaluation of the total energy consumed in the Kiwama milk processing plant, located in Nanyuki, was done. For the pre-heating process of the milk, wood fuel and electricity are used. The use of wood fuel may not be sustainable due to the current climate change being experienced with one of the causes being deforestation. Other processes such as pasteurizing and cooling use grid-tied electricity which cost them a monthly average cost of KSh130,926 in 2021. To reduce energy costs, the installation of solar panels and a solar water heating system was recommended. For the solar PV system, 24 solar panels each rated 400 W would meet 57% of the facility's power demand. This translates to an average monthly savings of KSh74,181. For the solar water heating system, two solar water heaters are required each with a hot water tank capacity of

200L and flat plate collectors of area 2.5m<sup>2</sup>. This will save the facility a monthly average energy cost of KSh6,726 and eliminate reliance on wood fuel. This way the facility will also be contributing to Kenya's Vision 2030 goal of having zero carbon emissions.

**Keywords:** milk processing, solar, pasteurizing

---

**STI07-ETI-017**

## **ENVIROGUARD: Machine Learning-Powered Detection of Air-Polluting Vehicles in Kenyan roads using IoT.**

Benjamin Macharia Muthui<sup>a</sup>, Kelvin Michuki Mwangi<sup>a</sup>, Monicah Wanjiku Njoroge<sup>a</sup>  
and Joseph Muguro<sup>a,\*</sup>

<sup>a</sup>School of Engineering, Dedan Kimathi University of Technology, Private Bag,  
Nyeri, 7381, Kenya, E-mail: [joseph.muguro@dkut.ac.ke](mailto:joseph.muguro@dkut.ac.ke)

### **Abstract**

This work delves into the urgent issue of air pollution caused by unroadworthy vehicles, particularly in light of the growing concerns about climate change. In Kenya, UNEP estimates that 90% of urban air pollution in rapidly growing cities like Nairobi comes from motor vehicles. Through the application of cutting-edge IoT systems, our aim is two-fold: first, to pinpoint these vehicles and, second, to mitigate their detrimental environmental impacts. By seamlessly integrating advanced sensor technologies with real-time monitoring, our proposed solution advocates for sustainable transportation practices, ultimately leading to improved air quality and reduced greenhouse gas emissions. The system comprises of; proximity sensors (PIR sensor and NDIR sensor), ESP32 OV2640 board with built in microcontroller with a ttgo camera, WIFI module and Bluetooth module, A GSM module and a trained machine learning model. The motion sensor (PIR sensor) acts as a switch as once triggered it activates both the camera and carbon monoxide sensor (NDIR sensor) which collect data and send it to a central database. Need for implementation of machine learning is crucial based on a number of reasons: Majority of the roads in third world countries are A2 roads and congestion is the norm as there is high level emission within the small area allocated for the road. In addition, the roads are at times occupied by other parties such as pedestrians, animals crossing the roads or even

still, cyclists. Due to the challenges mentioned above, our proposal goes miles ahead by incorporating k-means clustering CNN machine learning model for image processing. This will enable differentiation between motor vehicles and non-motor vehicles. Our project is not only justified but also crucial in the face of the substantial health and environmental risks posed by air pollution. Traditional inspection methods have proven inadequate, necessitating the integration of IoT technology for a more robust approach. By utilizing IoT devices and image processing, we're enabling continuous monitoring of vehicle emissions and roadworthiness, leading to timely intervention measures.

**Keywords:** IOT, Machine learning, environmental monitoring systems, pollution

---

**STI07-ETI-018**

## **Data Quality Control and Validation Techniques in IoT**

Jason Kabi<sup>1</sup>

<sup>1</sup>Centre for Data Science and Artificial Intelligence, Dedan Kimathi University of Technology. P.O. BOX - PRIVATE BAG – 10143, Dedan Kimathi - Nyeri, Kenya.

Email: [jason.kabi@dkut.ac.ke](mailto:jason.kabi@dkut.ac.ke)

### **Abstract**

Recently, the utilization of IoT systems in data gathering has greatly increased. This can be credited to factors such as low cost in the establishment and maintenance of the said systems, demand for machine learning modelling data, and also the fact that automation in data gathering can be realized. Broadly, an IoT system can be divided into 3 layers, the perception (data collection/ monitoring) layer which include actuators and sensors nodes such as temperature sensors used in data gathering, the network layer involving network servers and wireless networks which facilitate data transmission and storage and the application layer where a user can interact with the data. The success of all monitoring practices is highly dependent on the proper operation of the sensor nodes in the IoT perception layer. Since sensing elements are fragile and prone to damage which leads to malfunction, there are always anomalous data points in the data collected. The presence of outliers in raw data raises the need to ensure high quality data output from the sensor nodes. Sensor nodes generate large volumes of data hence

the data quality control methods utilized have to be automated extensible and quick enough for real time use. Outlier detection is one of the operations which fall under the quality control category. It is a widely studied area in machine learning and data acquisition. Nowadays, it is being utilized extensively in areas such as IoT. This work considers anomaly detection in time series sensor node data. The focus is on the performance-evaluation of various unsupervised classical machine learning algorithms such as Kernel Density Estimation in time series outlier detection. The aim is to test the robustness of known classical models which act as baselines in anomaly detection. IoT offers flexibility for various anomalies detection algorithms to be tested since the data collected is voluminous and the types of anomalies found are diverse. By deploying fine-tuned, long-established models, researchers can improve on the quality of the data they release from or use in various studies. This work also provides an insight into how time series data properties such as non-stationarity can affect anomaly detection and how operations such as windowing can be used to mitigate the effects and achieve desirable results. The experiments done show that, with some fine-tuning and data pre-processing, classical outlier detection methods' performance can be enhanced and utilized in IoT data quality control. This work also considers IoT data validation as a crucial step in building the needed confidence around data generated by IoT devices. When a temperature sensor deployed in the wild is generating data, a validator for the sensor is needed. The validator can be a separate dataset generated by standard instruments or manual records taken using a standard instrument. The validators instills confidence into data users interested in utilizing the data in different fields of study.

**Keywords:** Outlier Detection, Sensor Nodes, Time Series, Internet of Things,

---

**STI07-ETI-019**

## **Polymer-bound gold nanoparticle as a switch for a reversible biomolecular artificial muscle**

Takahiro Nitta

Applied Physics Course, Faculty of Engineering, Gifu University, Gifu, Japan

E-mail: nitta.takahiro.y6@f.gifu-u.ac.jp

## Abstract

Animal skeletal muscles scale up the molecular scale actions of myosin motor proteins, a biological molecular motor, into macroscopic ones via its hierarchical structure. Inspired by this scaling-up of the molecular actions, we developed an artificial muscle driven by an engineered kinesin biological molecular motor which can be efficiently integrated into and actuate millimeter scale mechanical components. The force generated by the actuator reached the micronewton range, which is sufficient to actuate mechanical components on the millimeter scale. A shortcoming of the artificial muscle mentioned above is that it can contract only once. To enable repeated cycles of contraction and extension, we aim to make the artificial muscle able to relax as animal muscles do, by developing and implementing an optically controlled switch on interactions between kinesin motors and microtubule cytoskeletal filaments. To this end, we are working on to make a gold nanoparticle-based optical switch conjugated with thermos-responsive polymers which activates interactions between kinesin motors and microtubule cytoskeletal filaments upon light illumination and otherwise hinders the interactions. At the conference, I would like to report our current efforts to develop the switch.

**Keywords:** gold nanoparticle, biomolecular motor, artificial muscle, actuator

---

**STI07-ETI-020**

## Analysis of women representation in STEM in Africa

Gabriel Kiarie<sup>a</sup>, Lorna Mugambi<sup>a</sup>, Jason Kabi<sup>a</sup> and Ciira wa Maina<sup>a</sup>

<sup>a</sup>Centre for Data Science and Artificial Intelligence, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [gabriel.kiarie@dkut.ac.ke](mailto:gabriel.kiarie@dkut.ac.ke)

## Abstract

Girls and women have consistently been underrepresented in most Science, Technology, Engineering, and Mathematics (STEM) professions, necessitating research [1]. There is a need to define and execute measures and policies to help reduce this gap [2]. The Centre for Data Science and Artificial Intelligence (DSAIL), in collaboration with Gender Justice in STEM Research in Africa (GeJuSTA), is conducting studies to analyse

the representation of women in STEM in Africa. The study will be used to guide the development of policies and curricula aimed at bridging the gap of women representation in STEM. The methods used in this study are analysing the genders of members of staffs in STEM faculties from African universities; analysing the genders of STEM-papers' authors from African universities and; conducting literature review to evaluate existing measures that have been put in place to encourage and enable women to join STEM professions. Preliminary results show that women are underrepresented in STEM fields in Africa.

**Keywords:** STEM, gender representation.

---

**STI07-ETI-021**

## Introducing a Data Pipeline for The Tahmo Network

Austin Kaburi<sup>a</sup>, Jason Kabi<sup>a</sup> and Ciira Maina<sup>a</sup>

<sup>a</sup>Centre for Data Science and Artificial Intelligence (DSAIL), Dedan Kimathi University of Technology, Private Bag-10143, Nyeri, Kenya

Email: kibaara.austin20@students.dkut.ac.ke

### Abstract

The Trans-Africa Hydro-Meteorological Observatory (TAHMO) is dedicated to alleviating the data scarcity that has long hampered African farmers' decision-making processes. With the ambitious objective of establishing a network of 20,000 weather stations across Africa, TAHMO currently operates 700 weather stations across 25 African countries. To manage this ever-expanding network efficiently, this poster introduces a data pipeline built on Google Cloud. The data pipeline leverages serverless architectures, Cloud Functions, and App Engine to reduce operational costs. Its primary goal is to collect, store, and analyze data from these weather stations, with a particular focus on precipitation data. The process involves data extraction, precipitation and the TAHMO's flags from the regression model, and integration of ground truth data from on-site technicians. A cloud scheduler triggers the data extraction and loading process on Google Cloud Storage. Dataflow processes this information in batches to ensure conformity with the warehouse's schema. The result is a continuous reporting system

that enables real-time data analysis. This data pipeline simplifies data access, eliminating the need for manual data extraction and transformation. Future work will involve integrating different models to enhance the quality of data provided to farmers, thereby improving agricultural decision-making in Africa.

**Keywords:** TAHMO, Serverless Architecture, Data extraction, Agricultural decision-making, Data Pipeline.

---

**STI07-ETI-022**

## **Data driven maintenance policies optimization for manufacturing systems: A case study**

Peter Nganga<sup>a</sup>, James Wakiru<sup>b</sup> and Peter Muchiri<sup>a</sup>

<sup>a</sup>School of Science, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [ngangap72@gmail.com](mailto:ngangap72@gmail.com)

### **Abstract**

This paper aims to develop a simulation-based framework to identify critical equipment, critical maintenance, and operational factors affecting plant performance (availability and maintenance cost). The study develops a framework that utilizes empirical maintenance data. Pareto analysis is employed to identify critical subsystems, while expert input is incorporated to derive model variables. A full factorial Design of Experiment (DOE) is employed to establish the variables with significant main and interaction effects on the plant's availability and maintenance cost. The framework is applied to a real case study of a manufacturing firm, where a simulation model is developed based on empirical maintenance and operational data, while considering the availability and maintenance cost as the performance measures. Simulation results highlight the bucket elevator as the critical subsystem. At the same time, spare parts importation probability, among other parameters like the preventive maintenance interval and utilization of 'adjust' maintenance action, significantly affects the performance (availability and maintenance costs) as interaction effects. The study provides a pragmatic reference model framework for practitioners to enhance

maintenance decision-making by identifying critical equipment, maintenance and operational parameters and disclosing their effect (main and interaction) on the plant performance (availability and maintenance cost). This study is one of the first to (i) investigate the maintenance and operational factors' main and interaction effects on maintenance cost, and (ii) integrate the spare parts importation probability as a factor affecting plant performance. The developed framework assists in determining critical systems to be optimized and considers various maintenance strategies simultaneously. Additionally, the study discovers the stochasticity of spare parts availability and replenishment and the interactions for decision support.

**Keywords:** Maintenance, availability, simulation, maintenance cost.

## HEALTH SCIENCES AND COMMUNITY DEVELOPMENT AND POST COVID – 19 DYNAMICS (HSC)

STI07-HSC-001

### Predictors of Psychological Well-Being among Parents with Visually Impaired Children in Post Covid-19 Era in Nigeria

Imhonde, H. O. and Imonigie, A. U. J

Department of Psychology, Faculty of Social Sciences, Ambrose Alli University,  
Ekpoma Edo State, Nigeria

[himhonde@aauekpoma.edu.ng](mailto:himhonde@aauekpoma.edu.ng) [odhianos@gmail.com](mailto:odhianos@gmail.com)

+2348056732523

#### Abstract

The study examines resilience, social-support, age and parental status as predictors of psychological well-being among parents with visually impaired children in post covid-19 era in Nigeria. Fifty-eight (58) parents of visually impaired children participated in the study. 18 of the participants were drawn from parents whose children are in Special schools in Benin, Edo State while the remaining 40 parents were drawn from across Benin and Ekpoma in Edo State. Objective scales were used for the collection of data. Four hypotheses were stated and tested using the regression analysis and the independent t-test. Result confirms three out of the four hypotheses tested. Resilience and Social support, positively predicted psychological well-being among parents of children who are visually impaired ( $R = 0.657$ ,  $R^2 = 47\%$ ,  $F(35.525) = ; P < 0.001$ ). Moreover, mothers scored higher on the psychological wellbeing scale than the fathers ( $t = 3.521$ ,  $df 56$ ,  $P < 0.05$ ), Results also indicate a positive prediction of resilience, social support, age and parental status on psychological wellbeing ( $R = 0.546$ ,  $R^2 = 40\%$ ,  $F(30.345) = ; P < 0.05$ ). However, age did not significantly independently predict psychological well-being among parents with visually impaired children. From the findings, it is concluded that resilience, social support, and parental status are significant predictors of psychological well-being amongst parents with visually impaired children. Therefore, relevant authorities should facilitate programmes that will enhance resilience

and encourage social support for parents with children who have visual impairment in order to enhance their psychological wellbeing.

**Key words:** *resilience, social support, psychological well-being, parents with visually impaired children, Parental status*

---

**STI07-HSC-002**

## **Effects of Dietary Regimens on The Development of Cart-Associated Metabolic Syndrome**

Boniface. M. Chege<sup>1,2\*</sup>, Peter. W. Mwangi<sup>2</sup>, Charles. G. Githinji<sup>2</sup>. Frederick Bukachi<sup>2</sup>

<sup>1</sup> School of Nursing, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, bmchege87@gmail.com

<sup>2</sup> Department of Human Anatomy and Medical Physiology, University of Nairobi. Postal address: 30197 Nairobi, Kenya, dept-medphys@uonbi.ac.ke.

### **Abstract**

**Background & Aims:** This study investigated the interactions between a low protein high calorie (LPHC) diet and an integrase inhibitor- containing antiretroviral drug regimen in light of evidence suggesting that the initiation of cART in patients with poor nutritional status is a predictor of mortality independent of immune status.

**Methods and Results:** Freshly weaned Sprague Dawley rats (120) were randomized into the normal LPHC or normal protein high calorie (NPHC) diet groups (n=40/group) initially for 15 weeks, after which the experimental animals in each diet group were further randomized into four treatment sub-groups (n =10/group): Control (normal saline), Test group 1: (TDF+3TC+DTG and Tesamorelin), Test group 2: (TDF+3TC+DTG), and Positive control: (AZT+3TC +ATV/r) with treatment and diets combined for 9 weeks. Body weights (weekly), glycemic control (fasting blood glucose and oral glucose tolerance tests), lipid profiles, liver weights, hepatic triglycerides and adiposity were assessed.

**Conclusions:** The obesogenic activities of the LPHC diet exceeded that of the NPHC diet and interacted with both integrase-containing and classical cART drug regimens to reproduce cART associated metabolic dysregulation. The effects were however reversed by co-administration with tesamorelin, a synthetic growth hormone releasing hormone analogue.

**Keywords:** Integrase inhibitors: Combined antiretroviral therapy: Low protein high calorie diet: Normal protein high calorie diet: Metabolic dysregulation: Tesamorelin.

STI07-ICT-001

### Enhanced OpenCV for Text Detection Using Multi-Scale Attention

#### Mechanism

Gedion Njoroge\*, Gabriel Kamau and Anthony Maina

School of Computer Science, Dedan Kimathi University of Technology, Private Bag, Nyeri, 10134, Kenya, \*Email: [gedion.njoroge22@students.dkut.ac.ke](mailto:gedion.njoroge22@students.dkut.ac.ke),

#### Abstract

This research introduces an innovative strategy by merging a multi-scale attention mechanism with the OpenCV framework to enhance text detection. OpenCV, a foundational computer vision library, excels in image preprocessing and feature extraction [1]. Despite emerging deep learning frameworks, OpenCV's prowess in addressing complex text detection scenarios remains limited. To address this, a multi-scale attention mechanism is proposed, enabling the model to decode text features across diverse scales and contexts [2]. This approach improves text detection and recognition, particularly in complex scenes, demonstrated through comprehensive experiments on benchmark datasets [3]. Results highlight its superiority over conventional OpenCV methods, enhancing text-related tasks and bolstering real-time applications [4]. This integration advances text detection by combining OpenCV's processing abilities with a multi-scale attention mechanism, aligning with OCR frameworks such as Tesseract OCR for recognition [5]. The method's potential is underscored in a text-focused technological landscape.

**Keywords:** text detection, OpenCV, multi-scale attention, deep learning, Tesseract OCR.

---

STI07-ICT-002

# Higher Education in Low and Middle-Income Countries: How is AI likely to disrupt the sector?

Anthony Maina<sup>\*</sup>, Jane Kuria

<sup>a</sup>School of Computer Science and IT, Dedan Kimathi University of Technology, Private Bag, Nyeri, Kenya, <sup>\*</sup>E-mail: [anthony.maina@dkut.ac.ke](mailto:anthony.maina@dkut.ac.ke)

## Abstract

Artificial Intelligence (AI) has the potential to revolutionize higher education by enhancing teaching and learning processes, improving access to education, and facilitating administrative tasks. However, the implementation of AI in low and middle-income countries (LMICs) comes with its own set of opportunities and challenges. This study aims to explore the opportunities and challenges of AI in higher education among LMICs, taking into consideration the socioeconomic context and specific needs of these countries. The findings suggest that AI can address the educational inequalities and improve access to quality education in LMICs. However, challenges such as limited resources, lack of infrastructure, and cultural barriers need to be overcome for successful implementation. To fully leverage the potential of AI in higher education, it is crucial for institutions to invest in faculty development, research, and collaboration to ensure responsible and effective implementation.

**Keywords:** artificial intelligence, low and middle-income countries, higher education, technology disruption

---

**STI07-ICT-003**

## Evaluating Public Value Creation Through Electronic Human Resource Management

Gabriel Kamau<sup>1</sup>, Grace Mwangi<sup>2</sup>

Murang'a University of Technology, P.O. BOX 75 - 10200, Murang'a Kenya

Email: <sup>1</sup>gkamau@mut.ac.ke, <sup>2</sup>gmwangi@mut.ac.ke

## Abstract

Public organizations are adopting the use of electronic human resource management (e-HRM) as it is assumed to be a driving force behind HRM value creation. However, empirical evidence is scanty particularly in the public sector to support this assumption. This study sought to evaluate the link between public value creation and e-HRM. The study draws upon public value theory to explore the role of e-HRM in the value creation of public organizations. The study was conducted in Kenya at the Nyeri county government. A quantitative research approach involving a cross-sectional survey design was followed in the study. The respondents were 209 employees of the Nyeri County Government Data were analyzed by means of structural equation modelling (SEM). The results show a significance and positive relationship provision of provision of quality public services, development of trust and public value creation. However, achievable of desirable outcomes was found not significant in this study. In line with study findings, the study recommends that public sector organizations should optimize the use of e-HRM in their operations to create public value.

**Keywords:** e-HRM, Public Value, Evaluation, Public Services, Desirable Outcomes, Trust.

---

**STI07-ICT-004**

## **Role Of Instant Messaging Forensic Investigations on Detection of Corporate Fraud Among Commercial Banks in Kenya**

Peris Kogo

### **Abstract**

Despite ongoing efforts to curb corporate fraud in both the public and private sectors, the prevalence of such fraudulent activity persists. Notably, digital forensics remains a primary focus of research, given its potential for facilitating fraud detection. In light of this, the study investigates the role of instant messaging forensics, specifically conversation data analytics, contact data analytics and unencrypted data analytics, in detecting corporate fraud within the Kenyan banking industry, guided by Locard's Exchange Principal Theory. The research, adopted a descriptive study design, which incorporated responses from a target population of 380 individuals, primarily from 43 banks and the banking fraud investigation department of the central bank. Our sample

size encompassed 114 participants, out of which 100 provided responses through questionnaires and semi-structured instruments. The results indicate that that conversation data analytics ( $\beta = 0.308$ ,  $p = 0.001$ ) and unencrypted data analytics ( $\beta = 0.226$ ,  $p = 0.003$ ) have a significant positive impact on fraud detection in banks while contact data analytics ( $\beta = 0.016$ ,  $p = 0.862$ ) was found to have a non-significant effect on fraud detection. We recommend the that banks prioritize the adoption of conversation data analytics and unencrypted data analytics as a way to increase fraud detection in their systems.

**Keywords:** Digital forensics, Conversation data analytics, Contact Data analytics, Unencrypted data analytics and Fraud detection

---

**STI07-ICT-005**

## **A Python Script for The Homogenization of Nonlinear Properties of Three-Dimensional Metal Matrix Composites Using Abaqus**

Allan Waithira<sup>a</sup> and Eckart Schnack<sup>b</sup>

<sup>a</sup>School of Engineering, Dedan Kimathi University of Technology, Private Bag, Nyeri, Kenya, E-mail: [allancheruh@gmail.com](mailto:allancheruh@gmail.com)

<sup>b</sup>Institute of Technical Mechanics, Karlsruhe Institute of Technology, Karlsruhe, 76131, Germany.

### **Abstract**

Metal Matrix Composites, commonly known as MMCs, have gained popularity and application in different engineering fields due to their good combination of mechanical properties. However, the nonlinear behavior of MMCs under different conditions makes it difficult to predict their mechanical behaviors. Notably, complete methods that fulfil the general modeling requirements of MMCs have not been established yet. This study presents a Python script for the homogenization of nonlinear properties of the metal matrix Aluminum Silicon Carbide using ABAQUS finite element commercial software. The script utilizes the Nonuniform Transformational Field Analysis method (NTFA), which is a widely accepted technique for the homogenization of composite materials on a three-dimensional metal matrix Representative Volume Element (RVE)

and predicts the effective properties under different Periodic Boundary Conditions (PBC). NTFA is based on solving a set of partial differential equations using the finite element method, and the solutions are used to calculate the effective properties of the composite. The main advantage of the script is that it's automated and can be easily modified and applied to different types of MMCs and complex geometries. The results obtained from the study are investigated and found to be in good agreement with experimental data and other existing numerical methods.

**Keywords:** MMCs; ABAQUS; NTFA; Python; RVE; Plug-in.

---

**STI07-ICT-006**

## **Investigating Supervised Learning Models for Enhancing the Precision and Accuracy**

Daniel Mulinge<sup>a</sup>, John Kandiri<sup>b</sup>

<sup>a</sup>ICT Directorate and School of Engineering and Technology, Machakos University,  
Private Bag, Machakos, 136, Kenya,  
E-mail: [danmulinge@mksu.ac.ke](mailto:danmulinge@mksu.ac.ke)

<sup>b</sup>School of Engineering and Technology, Kenyatta University, Nairobi, Kenya  
Email: [jkandiri@ku.ac.ke](mailto:jkandiri@ku.ac.ke)

### **Abstract**

Supervised machine learning encompasses the development of algorithms that leverage externally supplied data instances for the purpose of discerning underlying patterns and formulating hypotheses, thereby facilitating the prediction of forthcoming instances. Specifically, supervised machine learning classification algorithms are designed to classify data based on pre-existing knowledge. Classification tasks are pervasive in data science, and various effective methodologies have been proposed to address these challenges, including rule-based, logic-based, instance-based, and stochastic techniques. This paper undertakes an empirical assessment of the performance of supervised machine learning algorithms, with a particular focus on their accuracy, learning rate, computational complexity, and susceptibility to overfitting. The principal objective of this research is

to provide a comprehensive comparative analysis vis-à-vis cutting-edge machine learning algorithm.

**Terminologies:** Supervised Machine Learning, Artificial Neural Networks (ANN), Bayesian Network (BN), Decision Trees (DT), k-Nearest Neighbors (k-NN), Logistic Regression (LR), Support Vector Machine (SVM), Random Forests (RF)

**Keywords:** Recommender Systems, Supervised Learning, Precision, Diversity, Predictive Accuracy.

## SECURITY MANAGEMENT, FORENSICS AND CONTEMPORARY CRIMES(SMF)

STI07-SMF-001

### Personal Data Security Syndrome, Kenyan Desperate Economic Search: Philosophical Perspective on the Worldcoin.

Michael Mabururu<sup>a</sup>, Cosmas Knowen<sup>b</sup>

<sup>a</sup>School of Arts and Social Sciences, Rongo University, Rongo, 104, Kenya, E-mail:  
[michealntabo@gmail.com](mailto:michealntabo@gmail.com)

<sup>b</sup>School of Information, Communication and Media studies, Rongo University, Rongo,  
103, Kenya, Email: [cosmasknowen@gmail.com](mailto:cosmasknowen@gmail.com).

#### Abstract

The current world sophisticated personal data security landscape has raised great concerns on the nations' cyber security maturity levels. Despite the adoption and use of vigilant technical cyber security measures, the humanistic value chain and the rational motives are sometimes beyond imaginable control; hence, control and mitigation of cyber related acts may be difficult. Human beings are driven by various desires and values such as financial gain, political gain, religious gain, cultic gains, and economic gains. Factors such as employee's unjustifiable mass or individual resignations may lead to insider cyber related attacks, geopolitical espionage, and dedicated cybercrime attacks. Such attacks may be dedicated by desire for profitability which may not be beneficial to the global community. The global economic depression which has a bearing in Kenya's economic status has opened up another phase of personal data exposure in the recent economic search from the worldcoin without any positive values like data protection attached to it. Therefore, the authors of this paper are of the view that technology is a product of human creation which should be used for the welfare of humanity.

**Keywords:** Personal data security, philosophical values and economic depression.

---

STI07-SMF-002

# Evaluation Of Identity Access Management and Maintenance Frameworks on The Safety of Mobile Money Transactions Used by Fintechs In Nairobi, Kenya.

Dennis Mwangi Ng'ang'a, Bonface Ratemo, George Musumba,  
Institute of Criminology, Forensics and Security Studies  
Dedan Kimathi University of Technology, Kenya. P.O. Box Private Bag, 10143, Nyeri,  
Kenya  
Email: [ngangadennis67@gmail.com](mailto:ngangadennis67@gmail.com)

## Abstract

Smartphone technology improved access to mobile money which enabled FinTech companies successfully deploy service systems bringing massive benefits to those with limited access to banking. Embracing its usage has many security issues and challenges and the need to evaluate identity access management and maintenance associated with the safety of mobile money transactions. A descriptive research design was used with the target population in Fintech companies. Data collection techniques used were primary data through questionnaires while secondary sources of data were document reviews, official documents, publications, journals, reports, and online repositories. SPSS software was used on both qualitative and quantitative data to grasp the intent and rate at which physical access to IT assets, remote access management, users and devices authentication, access permissions; how authorization and network security are managed. Statistical techniques such as percentages, correlation and regression analyses were used. Findings revealed that key security issues were identity theft, authentication attack, phishing attack, vishing attack, SMiShing attacks, personal identification number (PIN) sharing, and agent-driven fraud. The use of better access controls, customer awareness campaigns, agent training on acceptable practices, strict measures against fraudsters, and high-value mobile money transaction monitoring, were some recommendations given. This study helps mobile money operators, mobile money decision makers, and the government to identify and evaluate key security issues associated with the safety of mobile money transactions in Fintech companies and recommendations proposed to address security gaps.

**Keywords:** Mobile money, security issues, network operators

## **Social Media Users' Willingness to Report Cyberhate to the Police: An Exploratory Study**

Samuel Mung'ale Wafula, Peterson Mwai Kariuki

<sup>1</sup>Institute of Criminology, Forensics and Security Studies, Dedan Kimathi University of Technology, Kenya.

### **Abstract**

Cyberhate has emerged as a significant problem primarily manifesting on social media platforms in Kenya. Among the most exposed to cyberhate are young people, especially university students, due to their extensive social media usage. Although the country acknowledges cyberhate as a criminal offence, there is a concerning trend of underreporting such incidents to the police. The precise reasons behind this underreporting phenomenon are unclear, despite the well-documented detrimental effects of cyberhate on individuals and society. While studies have shown the impact of crime type on reporting decisions, there has been insufficient attention given to studying cyberhate reporting specifically. It is on this premise that the present study aimed at investigating social media users' willingness to report cyberhate to the police, discern the reasons for non-reporting, and explore alternative reporting options beyond the police. In this descriptive survey, we utilised a quantitative approach to investigate undergraduate students at a public university in Kenya. A sampling frame comprising 5,121 undergraduate students was constructed from this population by concentrating on three specific faculties. Stratified sampling was employed to ensure proportional representation from all strata within this frame. The data collection instrument was a questionnaire administered to a randomly selected subset of 378 respondents, of whom 261 returned completed questionnaire. Participants in the study displayed neutral feelings when it came to willingness to report cyberhate to the police. The study identified the perception of inaction by police as the primary obstacle to reporting cyberhate. Respondents also favored alternative options such as reporting to social media companies or confiding in friends and family. The study recommends targeted awareness and education initiatives involving law enforcement, social media

companies, and the National Cohesion and Integration Commission to address cyberhate on social media platforms in Kenya and establish a user-friendly national reporting mechanism. Further research using qualitative methods with diverse social media users is advised to understand the reasons behind neutrality in willingness to report and strengthen efforts to combat cyberhate. The study explored the implications of this finding for law enforcement institutions and suggested directions for future research.

**Keywords:** Cyberhate, police, reporting, social media, victimization.

## TRENDS IN TECHNICAL EDUCATION AND TRAINING (TTE)

STI07-TTE-001

### Integration Of Concept Inventory into Education and Training System

#### Abstract

This paper will entail a Concept inventory which is an assessment tools designed to measure students' understanding of specific concepts or topics within a particular domain. They are commonly used in education research to assess the effectiveness of teaching methods and to identify misconceptions that students may have. The paper will cover the following areas: application of concept inventories in education, development of concept inventories, testing of learners using concept inventories, examples of concept inventories, concept vs skills in concept inventories, form of knowledge and their measure in concept inventories, timely administration of concept inventories, merits and demerits of concept inventories and concept inventories and students' achievement.

**Key terms:** Concepts, Skills, Declarative knowledge, procedural Knowledge.

---

STI07-TTE-002

### Sustainable Development Goals and Quality of Education in Kenya

Dr Milcah Nyaga  
University of Embu, PO Box 6-60100 Embu  
[nyaga.milcah@embuni.ac.ke](mailto:nyaga.milcah@embuni.ac.ke)

#### Abstract

Quality education according to the Sustainable Development Goals (SDGs), is defined as education that is equitable, inclusive and one that provides learners with skills, values and knowledge needed to thrive in the society. The SDGs are a universal call to action to protect the planet, ensure everyone enjoys peace and prosperity as well as to end poverty. The researcher reviewed literature related to the subject matter. Goal 4 in the SDGs aims to ensure that there is an equitable and inclusive quality education which promotes lifelong learning opportunities for all. SDG 4 has set 10 targets that are to be

achieved by 2030. Implementation targets include: expand higher education scholarships for developing countries, increase the supply of qualified teachers in developing countries, build and upgrade inclusive and safe schools. There has been a major progress which has been made access to education especially in vocational, technical, tertiary and education for both men and women. In terms of the global participation in tertiary education had reached 224 million in 2018, which equivalent to a gross enrollment ratio of 38% [according to UNESCO Global Education Monitoring Report 2020: UNESCO. Education is the key to success](#)” has been a significant slogan in Kenya. Those who [have gone through competence based education](#) have had the opportunity to gain ~~ertain~~ skills such as creativity, problem solving, ~~ti~~nnovativeness, fabrication, critical thinking, and conflict resolution [which have helped them](#) ~~can attest to having to~~ secured a better future [as compared to](#) ~~than~~ those who lack ~~such these~~ skills. Kenya has seen the implementation of a new curriculum in the education sector, commonly known as Competency Based Curriculum (CBC) which is a huge step towards achieving SDG 4 goal. The new curriculum provides the opportunity to nurture every learner’s capability through getting a quality education which will contribute to [economic development](#) ~~the world in productive way~~, which is the ultimate goal of education for sustainable development. [The study recommended that:](#)~~The~~ provision of technical education ought to be progressively free to adhere to existing international agreements [and allocation of adequate materials and human resources](#)

**Key words:** Quality, Education, SDGs, Curriculum, Equity, inclusive, schools

# TOURSIM, WILDLIFE HOSPITALITY MANAGEMENT ENVIRONMENT AND CLIMATE CHANGE(TWE)

STI07-TWE-001

## Kitchen Ambience and Kitchen Work Surface Height as determinants of Cooks' Productivity in Hotels in Machakos County – Kenya

Mutunga Florence Wavinya

Masters' student, Department of Tourism and Hospitality, School of Business, Karatina  
University

Email: [mutunga\\_f@yahoo.com](mailto:mutunga_f@yahoo.com) Phone: +254723249098

### Abstract

The purpose of the study was to establish the extent to which kitchen ambience and kitchen heights as aspects of ergonomics affected cooks' productivity. It focused on selected hospitality facilities in Machakos County in Kenya. The purpose of this study was to investigate kitchen ambience and kitchen height as determinants of cooks' productivity in hotels in Machakos County. The objectives of the study were: to investigate the relationship between the kitchen ambience and cooks' productivity in the selected hospitality facilities in Machakos County, and to examine the relationship between kitchen height and cooks' productivity in selected hospitality facilities in Machakos County. Cross-sectional design and mixed research approaches were employed. A survey was carried out by use of a questionnaire and observation checklist among cooks and managers of selected Classes B, C and D hospitality facilities in Machakos County. Research questionnaires were developed and distributed to a sample of 210 hotel workers consisting of managers and cooks. Quantitative and qualitative data were collected from the respondents and by physical observation respectively. Data were analyzed by descriptive statistics of determination of frequencies, percentages, means and by inferential statistics of correlation analysis and multiple regression at .05 confidence level. The findings revealed that the two tested aspects of kitchen workplace environment namely height and ambience had a significant relationship with the productivity of cooks. These findings are important to managers

of hospitality facilities, policy decision makers in the sector, and researchers. Specific implications for theory and practice, and recommendations drawn from the findings include: ways of improving the kitchen height and ambience, and Governments to enhance the enforcement of Occupational Safety Health Act and related legislations. This study recommends kitchen workplace environment to be designed to meet the recommended standards for improved productivity in kitchens in hospitality facilities.

**Keywords:** Cooks Productivity, hospitality facilities, kitchen Ergonomics, kitchen ambience, kitchen work surface height, Machakos county

---

**STI07-TWE-002**

## **Influence of Motivation on Domestic Tourists' Visit Behaviour in Historical Heritage Sites: An Example from An African Heritage Circuit**

Peter Onyonje Osiako

Institute of Tourism and Hospitality Management, Dedan Kimathi University of Technology, Private Bag 10143 Dedan Kimathi, Kenya

Email: [peter.osiako@dkut.co.ke](mailto:peter.osiako@dkut.co.ke)

### **Abstract**

An understanding of the factors that motivate domestic tourists to patronize heritage attractions in the new post-Covid-19 normal, and how these relate to their visit behaviour is critical in promoting domestic heritage tourism. Grounding on motivation theories, this study sought to investigate the types of motivational factors for domestic tourists visiting heritage sites in the Kenya coast region, and their visit behaviour to these attractions. A survey was conducted on a sample of 693 domestic tourists visiting historical heritage sites in the Kenya coast region, where quantitative data was collected through a structured questionnaire and analyzed by descriptive and inferential statistics using the SPSS version 20.0 software. Descriptive analyses involved determination of frequencies, percentages, means and standard deviations, while inferential analyses involved determination of the *t*-statistics by one sample *t*-test and a one-way ANOVA. An alpha level of .05 was used for these statistical tests. The findings revealed that the strongest motivational factor for visiting HHS in the

Kenya coast region was “recreation and enjoyment purposes” ( $M = 5.94$ ,  $SD = 1.283$ ), and the statement with the least score for the motivation variable concerned “boosting self-esteem” by visiting historical heritage sites, which was rated the lowest ( $M = 5.21$ ,  $SD = 1.844$ ). Overall, the motivation variable had a combined mean of 5.65 (high) implying that the domestic tourists had a high motivation for visiting historical heritage sites. There was a significant relationship between motivations for visiting historical heritage sites in the Kenya coast region and the visit behaviour of domestic tourists. Motivational factors significantly influence domestic tourists visit behavior to heritage attractions. These findings are instrumental for theory, policy and marketing management practice among relevant heritage tourism stakeholders in revitalizing the role of domestic heritage tourism.

**Keywords:** African heritage, domestic tourism, heritage sites, Kenya coast, motivation factors, visit behavior

---

**STI07-TWE-003**

## **Effects of the Informal Street Food Vendors on the Nyeri Town Publics**

Asborn J. Misiko<sup>a\*</sup> Rodgers Isaac Kisiang’ani<sup>a</sup>, George M. Githiomi<sup>b</sup>, Mary W Kimamo<sup>b</sup>  
and Zippora N. Gituma<sup>b</sup>

<sup>a</sup>Institute of tourism and Hospitality Management, Dedan Kimathi University of  
Technology, Private Bag-10143 Nyeri, E-mail: [misiko.juma@dkut.ac.ke](mailto:misiko.juma@dkut.ac.ke)

County Government of Nyeri

### **Abstract**

Nyeri town boasts of informal street food vendors found almost in every street, offering products ranging from indigenous to trendy cuisines. During evening hours, the informal street food operators compete for the street space with the town publics. The design and the size of the town’s major streets have not been reviewed to accommodate the increasing informal street food vendors and the growing urban community. This study investigated the effects of the informal street food vendors’ location, products, operating time and *modus operandi* on the urban community in Nyeri town. The researchers combined the Neo-Marxist theory-positing that the

informal sector expands as urbanization increases, and the Neo-liberal theory –arguing that entrepreneurs pursue informal sectors in order to operate outside the official business frameworks to explore the subject of the study. Using the cross-sectional survey design, the study adopted the enumeration and convenience sampling techniques to select vendors and consumers respectively that responded to questionnaire administered face-to-face. The qualitative data was analyzed using the thematic content analysis, and the output transformed into quantitative data to give percentages and frequencies. The informal street ventures inconvenienced street users especially during rush hours. The food related wastes and a cocktail of food aroma made the street ambiance less attractive. The equipment used on the streets and the unsecured fire points posed a great risk to the public. The study concludes that the informal street foods ventures provide employment that sustains livelihoods. The informal street businesses facilitate the flow of resources, and promote the mainstream economies like agriculture, retail and food manufacturing, thus contributing to wealth creation in the county. Study recommend benchmarking to explore ways to change the perception that the informal street foods are unsafe, unhealthy and the ventures make the street look unattractive. In countries like Thailand in the city of Phuket, informal street foods are conducted in an organized manner.

**Keywords:** Informal Street Foods, Vendors, Consumers.

---

**STI07-TWE-004**

## **Digital Security Systems Effect on Market Performance In 3-5 Star Rated Hotels in Nakuru County, Kenya**

Agatha Muthoni Kimingi, Dr. Lilian Mwenda, Dr. Peninah Chege

Institute of Tourism and Hospitality Management, Dedan Kimathi University of Technology, Private Bag, Nyeri, 10143, Kenya, E-mail: [agathakimingi@gmail.com](mailto:agathakimingi@gmail.com)

### **Abstracts**

Digital transformation is gaining traction worldwide with the service sectors being at the centre of adopting digital technology. Studies have attempted to assess the effect of digital security systems on performance. Literature demonstrates a significant gap

between the importance and the usage level of hotel security measures. Many studies focused on digital security systems in Kenyan context but in different sectors and not hospitality. The study sought to assess the effect of digital security systems on hotel market performance in 3- 5 star rated hotels in Nakuru, Kenya. The study reviewed literature from past studies, journals and articles written on the area of study. A descriptive research design was used for the study. Questionnaires were used for data collection. A census for the managers was done while the staff were selected using the cluster sampling technique. A total of 152 questionnaires were usable for the study. The data was analysed using both descriptive and inferential statistics. R squared was calculated to be 0.189 indicating a positive correlation between the utilization of digital security systems and market performance. The study concluded that digital security systems exert a significant influence on the market performance of 3- 5 star rated hotels in Nakuru County. The study concludes that digital security systems are vital components contributing to the improvement of hotels performance. The study recommends stakeholders to enforce digital security standards within the hotel sector and emphasize the importance of digital security systems to enhance guest safety. In addition, hotels should prioritize development of user-friendly systems.

**Keywords:** Digital transformation, market performance, digital security systems, Video surveillance systems, sprinkler systems and Carbon monoxide detectors, Alarm sensor systems, and Access control systems.

---

**STI07-TWE-005**

## **Assessment of Socio-Economic Gender Issues Affecting Women Participation in Alpine Tourism: A Case Study of Mt.Kenya National Park**

Cornelius Kipchirchir, Dr.Juma Misiko, Dr. Dennis Cheruiyot

Institute of Tourism and Hospitality Management, Dedan Kimathi University of Technology, Private Bag, 10143, Dedan Kimathi

E-mail: [koechcor@gmail.com](mailto:koechcor@gmail.com)

**Abstracts**

Tourism plays a vital role in the realization of the UN Sustainable Development goals especially promoting gender equality and empowerment of women. This is echoed in the Africa agenda 2063 under Goal 17 that underscores gender equality and inclusivity in employment. The Kenya constitution and Kenya Vision 2030 recognizes the role of gender equality and equity in promoting a wealthy and cohesive Kenya. Tourism is among the social and economic activities enhancing wealth creation in Kenya. This study sought to investigate the socio-economic gender issues affecting women participation in alpine tourism in Mt. Kenya national park. The study was guided by the following objectives: to assess the social gender issues affecting women participation in alpine tourism and to analyze the economic gender issues affecting women participation in alpine tourism. The study used descriptive research design, and data was collected through structured closed ended questionnaires distributed to 122 women participating in alpine tourism activities. 107 questionnaires were duly filled and returned. Structured interviews were conducted to the officials of KWS and the leaders of Mt. Kenya Guides and Porters Association. Qualitative data was analyzed using content analysis and quantitative data was analyzed using descriptive and inferential statistics. The study established that marital status of female mountain crew was the dominant social gender issue affecting women participation in alpine tourism as most guides, porters and cooks were single and for those who were married, majority of them experienced challenges relating to balancing work and family responsibilities. The study also established that there is wage disparity between men and women working as guides, porters and cooks. The study concludes that the nature of the work in alpine tourism favours women who are single which should not be the case and with appropriate mechanisms in place this can change. The study recommends that female mountain crew who have not joined any association can join so that the issue of wage gap can be addressed.

**Keywords:** Alpine Tourism, Mountain Crew, Equality.

---

**STI07-TWE-006**

# Effectiveness Of Aberdare Electric Fence on Human-Wildlife Conflicts in Amboni Community, Nyeri County, KENYA

Romario A. Morang'a, Fredrick K. Waweru, Juma Misiko

*Institute of Tourism and Hospitality Management, Dedan Kimathi University of Technology, Private Bag 10143 Dedan Kimathi, Nyeri, Kenya*

## **Abstract**

Conflicts between humans and wildlife are a paramount threat to conservation of flora and fauna around the world. For instance, in Kenya, with much of the wildlife living outside protected areas, enhanced and sustainable coexistence between people and wildlife has been a challenge. On the contrary humans expose themselves to wildlife through poaching or settling along wildlife areas hence amplifying conflicts with wildlife. The main objective of the study was to assess the impact of the Aberdare electric fence on human-wildlife conflict (HWC) in Amboni area, Nyeri County, Kenya. The target population was Amboni community with 11 villages. The study used purposive sampling to select three villages (Kiguru, Ex-pages and Mutishieni). A 30% of household from each village was computed giving a sample size (n=195). Data collection involved questionnaires and interviews, with SPSS v25 used for analysis. Results from paired t-test analysis showed that paired sample test had negative t values and, therefore, significant for all the pairs. Only two of the pairs showed non-significant values ( $P > 0.05$ ). It was evident that variable changes for 7 of the paired differences (type of crop damage, animal involved, land size affected, causal wild animal, domestic animal depredated, physical infrastructure destroyed and access to natural resources in the park) were statistically significant with their p-values less than 0.05. However, results of estimated losses ( $M = -0.03$ ,  $SD = 0.67$ ,  $t(155) = -0.445$ ) and income earned ( $M = 0.03$ ,  $SD = 0.43$ ,  $t(155) = -0.686$ ) did not have a statistical significance change as a result of the electric fence installation. The research concluded that the electric fence installed along the boundaries of Aberdare National Park especially at the Amboni community had reduced some of the perennial human-wildlife conflicts than was experienced before. The electric fence has facilitated reduction in the crop damages, livestock depredation, reduction in affected farm coverage and reduction in property

losses. The research recommends the government, travel industry investors, and NGOs to support KWS in establishing a compensation or insurance fund to cover local community losses caused by wildlife damage, particularly from primates which are not covered by the wildlife compensation scheme.

**Key words:** Human-wildlife conflict, Household, Problem Animal Control, Sustainable Development Goals.

---

**STI07-TWE-007**

## **The Contribution of Adventure Recreation Infrastructure Development to Rural Livelihood. A Case of Nyeri County, Kenya**

Bilha Nyambura Gitau<sup>a</sup>, Asborn Juma Misiko<sup>a</sup> and Rayvisic N. Mutinda<sup>b</sup>

<sup>a</sup>Institute of Tourism and Hospitality Management, Dedan Kimathi University of Technology, Private Bag, Nyeri, 10143, Kenya, E-mail:

<sup>b</sup>School of Tourism and Hospitality Management, Murang'a University of Technology

### **Abstract**

It is becoming more common for governments to acknowledge adventure tourism as a strategy for responsible and sustainable economic growth that is beneficial to all levels of the society. This is due to the fact that adventure tourism has been proven to be beneficial to the environment, as well as to the people and host economies of the destination. The aim of the study was to assess the contribution of adventure recreation development to rural livelihoods in Nyeri County. The study adopted an exploratory research design. The target population was 248050 household heads. The sample size was 384 respondents comprising of rural household heads within Nyeri County. Cluster sampling was used for the study to divide the sample size into smaller groups (the Eight sub counties in Nyeri County) while simple random sampling was used to distribute the sample size proportionally among the eight Sub Counties. Primary data was collected through questionnaires where closed-ended questions were used. On the questionnaires, all responses were collected using a 5-point Likert scale where 1

indicated strong disagreement and 5 indicated strong agreement with each statement. Additionally, structured interviews were administered to the respondents who had difficulties reading and writing. In this case, the questionnaire was used as interview guide. The findings revealed that adventure recreation infrastructural development significantly (10.2%) contributed to rural livelihood such as increment in employment opportunities and enabling transportation of farm produce to the nearby markets. In order to improve the rural livelihoods in Nyeri County, there is need for the national and the county governments to develop more adventure recreation infrastructure and upgrade the existing ones.

**Keywords:** Adventure recreation, rural livelihood, community involvement, recreation infrastructure, Nyeri County

---

**STI07-TWE-008**

## **Value Proposition Innovations and Sustainability of Restaurants in Nairobi County, Kenya**

Gikonyo, Rita Kathomi<sup>a</sup>, Wachira, Anita Wanjugu<sup>b</sup> and Mwenda, Lilian Karimi  
Mugambi<sup>a</sup>

<sup>a</sup> The Institute of Tourism & Hospitality Management, Dedan Kimathi University of Technology, Private Bag-10143, Nyeri, Kenya, E-mail: [rikonyo98@gmail.com](mailto:rikonyo98@gmail.com)

<sup>b</sup> School of Business Management and Economics, Dedan Kimathi University of Technology, Private Bag-10143 Nyeri, Kenya,

### **Abstract**

To the hospitality industry, the Coronavirus Disease 2019 pandemic increased danger from multiple angles, placing the crucial goal of sustainability at a crossroads. Consequently, value proposition gained traction for hospitality businesses functioning in the unfamiliar business environment. Restaurants quickly adopted value proposition innovations, which promised to provide value that is inclusive of all stakeholders. It was crucial to understand the effects of value proposition innovations and sustainability in maintaining and promoting successful innovation. Consequently, there was need to explore effects of value proposition innovations, on restaurant sustainability in Nairobi County. The main theoretical underpinning of the study was Schumpeter's innovation theory. The study used descriptive research design using Likert scale rating to explain

the relationships between variables. The unit of analysis was 81 full-service restaurants within 54 classified hotels in Nairobi County, where the unit of observation was the restaurant managers. Self-administered questionnaire achieved 70% response rate (57 respondents). Data was analysed using SPSS version 25 and findings presented using descriptive and inferential statistics. The study divulged value proposition innovations and sustainability had a positive and significant relationship. The Pearson correlation coefficient was moderate as  $r=0.364$ , at  $p = 0.05$  level of significance additionally, the Coefficient of Determination (R Square) established that value proposition innovations predicted 11.6% of the variance in sustainability. The findings indicate, a unit of change in value proposition innovations translates in an increase of 0.640 units in sustainability. The finding show that majority of the restaurants introduced new strategies to retain customers and to reach new customer segments, with some introducing new services. The study recommends the formulation of strategies and policies, for instance whitepapers to educate hospitality management on the importance of value proposition innovations for sustainability. For practice, the study recommends restaurants constantly evaluate and redefine their offering in terms of value proposition especially during crises when business survival is critical. Additionally, restaurants ought to think of creative, practical, and efficient distribution channels.

**Keywords:** Value proposition innovations, sustainability, full-service restaurants.

---

**STI07-TWE-009**

### **Management Commitment as a Deterrent of Adopting Food Safety Management Systems by Public Universities Catering Facilities in The Mount Kenya and Aberdare Regional Bloc**

Esther Mugure Macharia<sup>a</sup>, Lillian Mwenda<sup>a</sup>, Dennis Cheruiyot<sup>c</sup>, and Peninah Chege<sup>a</sup>

<sup>a</sup> Institute of Tourism and Hospitality Management, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail:

[esther.macharia19@students.dkut.ac.ke](mailto:esther.macharia19@students.dkut.ac.ke)

<sup>b</sup> School of Science, Dedan Kimathi University of Technology, Private Bag, Nyeri, 7381, Kenya, E-mail: [dennis.cheruiyot@dkut.ac.ke](mailto:dennis.cheruiyot@dkut.ac.ke),

**Abstract**

The general public requires an assurance that the food they are consuming is safe and free from contamination which can be attained through taking adequate food safety measures and adopting food safety management systems that are well documented, uniformly followed and verifiable. However various constraints among them management commitment have led organizations especially public universities catering facilities fail to adapt these systems. The objective of this study therefore was to analyse management commitment as a deterrent of adopting food safety management systems by public universities catering facilities in the Mount Kenya and Aberdare regional bloc. Based on the theory of constraint, a cross sectional survey, on a population of 11 public universities catering facilities in the bloc were purposively sampled whereby 187 catering staff on permanent terms of service were enumerated through census. Cronbach's alpha coefficient for the instrument was 0.79 which was above the minimum threshold 0.7 for a reliability hence verifying that the instrument could be relied upon during data collection process. It was administered on the food handlers resulting to a response rate of 80.7% which was excellent. Descriptive and Inferential analysis was carried out using Statistical package for social sciences version 26. The findings on demographics revealed that majority (56.3 %) of staff working in the facilities were females and that 33.1 % of total staff were diploma holders. Inferential statistics on Correlation analysis revealed that there was a moderate positive association between management commitment and adoption ( $r = 0.590$   $P\text{-value } 0.000 \leq 0.005$ ) and simple linear regression done revealed that 34.8% of the variations in adoption was caused by management commitment leading to a conclusion that management commitment significantly deterred adoption of FSMs with ( $\beta_1 = 0.493$ ,  $t = 8.924$  and  $P\text{-value} = 0.000 \leq 0.05$ ) in the public universities catering facilities in the Mount Kenya and Aberdare regional bloc, It is recommended that management show commitment by providing food safety policies, provide financial resources and coach food safety teams to facilitate adoption of food safety management systems.

**Keywords:** Adoption, Deterrent, Food Safety, Food safety management systems, Management commitment

# **Influence of Hospitality strategic management practices on performance and sustainability of Hotels in Kenya**

Romano Okwi Elingit, Dr Simeo Okello  
Kisii university.

elingitokwi@yahoo.com, simeokelo@yahoo.com

## **Abstract**

Strategy management systems help hotel owners to track how well their hotel operations are doing against a set of pre-defined targets. Its purpose for hotels is to help them manage, analyze, and execute their evolving long-term goals by providing data-driven insights. It can help hotels reach out to more customers Hospitality management is a career path that typically falls under the hotels, resorts, and lodging industry. Professionals in this field create and run many aspects of the guest experience. They also often manage teams that include front desk staff, housekeeping, and sales. This study explored strategic management practices in the hospitality industry on the performance and sustainability of Hotels in Kenya a tourist destination for foreigners and domestic of different classes and tastes. The objective of the study was to explore the influence of strategic hospitality management practices on the performance and sustainability of hotels in Kenya. This study was desk research with online journals of recent publication reviewed for gap identification. The findings revealed that the key strategic management practices that can make hotels competitive and sustain themselves in business past Covid 19 period include building their brand, especially through franchise, increasing customer value, achieving operational excellence and being a good corporate citizen. However, the study found out that hotels being seasonal businesses most of them are not able to institute the above-mentioned strategies and also most of the proprietors do not have the financial muscle to but those who engage professionals are able to stay in business .The study concluded that the hospitality industry being a service industry has the potential to grow in Kenya and continue providing jobs for many unemployed youths The study recommended small and medium hotels to reorganise even through partnership into brand building to increase visibility, value their customers ,be good corporate citizen and achieve operational excellence

**Key words:** Strategic Management Practices, Performance and Sustainability

## The Role of innovative leadership on organizational performance and Sustainability: A Case of SME in Kenya

Romano Okwi Elingit, Dr Simeo Okello  
Kisii university  
elingitokwi@yahoo.com, simeokelo@yahoo.com

### Abstract

Innovative leadership is a style of leadership that involves applying innovation and creativity to managing people and projects. Innovative leaders often inspire productivity in new ways and through different approaches than have typically been used and taken. This study explored the role of innovative leadership on organizational performance and sustainability: A case of SME in Kenya. The objective of the study was to explore the role of innovative leadership on the organizational performance and sustainability of SMEs in Kenya. This study reviewed secondary data and hence took a desk research perspective to conduct the study. The finding reveals that the importance of innovative leadership lies in its ability to extend the longevity of a company, helping it succeed. Innovative business leaders strive to improve a business model with large-scale changes that help it adapt and improve hence its sustainability. Creativity enables leaders to meet the ever-shifting challenges of an unpredictable future. Creative leaders drive innovation and productivity, enabling companies to come up with leading-edge products and services and fostering success. But creativity isn't just important at the leadership level. In the rapidly changing world today, it is crucial for organizations to be innovative in order to stay competitive in the market and ensure continued success. This need for innovation has brought on a requirement for leaders who are capable of influencing and inspiring creative efforts on the other hand the study discovered challenges to innovation which include Impractical expectations for innovation. Unempowered innovation teams. Lack of innovation strategies. Weak innovation culture. Lack of managerial support. Resistance to change. Lack of internal and external collaboration. Difficulty in transitioning from one phase to the next. The study recommended adoption of innovative leadership in promotion of organizations and continuous training on innovative leadership including coaching and mentoring based on technology to remain competitive.

**Key words:** innovative leadership

## WATER ENERGY, GIS AND REMOTE SENSING(WEG)

**STI07-WEG-001**

### Optimization of Rainwater Harvesting Sites Selection Using Geospatial Technologies: A Case Study of Ewaso Ng'iro South River Basin, Kenya

Paul Mwangi\*, Arthur Sichangi and Moses Ngigi

\*Institute of Geomatics, GIS and Remote Sensing, Dedan Kimathi University of Technology, Private Bag, Nyeri, 10143, Kenya, E-mail:

[paulmwad18@gmail.com](mailto:paulmwad18@gmail.com)

#### Abstract

Water scarcity poses a critical challenge to socio-economic development and ecosystem services in the East African region, with recent years witnessing severe droughts. In particular Ewaso Ng'iro South River Basin, in the southwest of Kenya has been severely influenced with pastoralists and small holder's farmers being the hardest hit. To address the pressing issue of water scarcity in this region, the study employed a Geographical Information System (GIS)based approach with coupled remote sensing to identify the optimal sites for rainwater harvesting in 2023. The study aimed to establish appropriate criteria for selecting site locations and subsequently utilize these criteria to map potential sites. In the study the site selection criteria integrated both physical and socio-economic variables. Ten variables were identified: Precipitation, land use, soil texture, potential runoff depth, slope, topographic wetness index, Lineament density, drainage density, and considerations for distance from road and town constraints. Potential runoff depth which was an intermediate input was calculated using the Soil Conservation Service Curve Number (SCS-CN) model. A multi-criteria decision-making approach, Analytical Hierarchy Process (AHP) was used to identify viable rainwater harvesting (RWH) sites. Weighted overlay analysis was then used in scaling sites that are potentially suitable for rainwater harvesting. Based on the hydrological and geomorphological standards of the study area, suitable sites for harvest areas were identified and it was divided into five classes in terms of their suitability for water harvesting, namely very low, low, suitable, moderate, and highly suitable for water harvesting. The results indicate five suitability

classes: highly suitable, Suitable, moderately suitable, less suitable and very low suitability. The results indicated that in 2023, 4.30% of the area was highly suitable, 30.12% suitable areas, 25.84% moderately suitable areas, 18.64% less suitable areas and 21.1% very low suitable areas. These results indicate it is possible to harvest and store rainwater in the study area to meet increasing water demand. It can be concluded that the findings of this research can be used to assist in water resources management as an efficient planning tool to ensure sustainable development of the water in Ewaso Ng'iro South river subbasin an area which suffers from water shortages.

**Keywords:** Rainwater harvesting, Analytical Hierarchy Process, Soil Conservation Service Curve Number, Weighted Overlay

---

**STI07-WEG-002**

### **Sr/Ca ratios sclero-thermometer developed from *Porites ssp.* coral skeleton for monitoring Sea Surface Temperature**

Nyinge N. Mwadzombo<sup>a\*</sup>, Mwakio Tole<sup>b</sup>, Paul Guyo<sup>a</sup>, and Florence Le Cornerc<sup>c a\*</sup>

<sup>a</sup>School of Pure and Applied Science, Pwani University, P.O. BOX 195-80108, KILIFI, Kenya. E-mail: n.mwadzombo@pu.ac.ke

<sup>b</sup>School of Environmental and Earth Sciences, Pwani University, P.O. BOX 195-80108, KILIFI, Kenya.

<sup>c</sup>Laboratoire d'Océanographie et du Climat: Expérimentations et approches numériques, LOCEAN, UMR 7159 (IRD, SU, CNRS, MNHN, Délégation Régionale d'Ile-de-France, 32, Avenue Henri Varagnat, F-93143 Bondy, France).

#### **Abstract**

In the current global warming challenge, the frequency of heat wave related events is on the rise within the Kenyan coral reef ecosystems. Previous experiences have witnessed heat wave episodes that have resulted in coral bleaching, and in some cases in severe coral mortality. To monitor sea surface temperatures, a Sr/Ca-sclero-

thermometer is developed from *Porites spp.* coral using reduced linear regression model, to monitor seasonal variability of sea surface temperatures at monthly resolution of the Kenyan coral reef environments at Tana Delta, Watamu and Shimoni. The calibration of the Sr/Ca monthly thermometer was done using the IGOSS nmc Reyn\_Smith Olv2 monthly SST satellite data, and was settled at Sr/Cathermometer;  $Sr/Ca = -0.053(\pm 0.006) * SST + 10.43(\pm 0.16)$ . The temperature sensitivity of the developed Sr/Ca ratios sclero-thermometer was  $-0.053 \text{ mmolmol}^{-19}\text{C}^{-1}$ , and reliability results test revealed that, there was no significant difference between the Sr/Ca ratios sclero-thermometer and results of the local instrument ( $p > 0.05$ ).

**Key words:** Climate Change; Coral Reef Ecosystems; Global warming; Coral bleaching; Temperature sensitivity

---

### STI07-WEG-003

## Developing a Novel Soil Moisture Content Index under the Effects of Droughts Using Deep Learning Techniques

Simon Wachira Muthee<sup>a</sup>, Bartholomew Thiong'o Kuria<sup>a</sup>, Arthur W. Sichangi<sup>b</sup> and Duncan Maina Kimwatu<sup>b</sup>

<sup>a</sup>Remote Sensing Research Group, Institute of Geomatics, GIS and Remote Sensing, Dedan Kimathi University of Technology, Kenya. P.O. BOX, Private Bag - 10143, Dedan Kimathi, Kenya, Email: simonmuthee26@gmail.com

<sup>b</sup>Institute of Geomatics, GIS and Remote Sensing, Dedan Kimathi University of Technology, Kenya. P.O. BOX, Private Bag - 10143, Dedan Kimathi, Kenya.

### Abstract

Soil moisture is important for the survival of plants and living organisms in the soil. It plays an important role in the movements of minerals and nutrients in the soil surface. Additionally, it is important in understanding the land surface processes such as soil erosion, evaporation, soil topography and runoff generation [2]. However, the availability of water has been greatly affected by prolonged and often occurring drought events caused by rapid changes in the climatic conditions, Land Use and Land Cover (LULC) and socio-economic systems in ecosystems. This has led to loss of crop

harvest and vegetation, causing loss of human lives, death of livestock and wildlife. This study seeks to develop a novel soil moisture content index under the influence of droughts. The novel index could be used to detect and monitor soil moisture and form an early warning system in arid and semi-arid ecosystems. Muringato basin located in the Upper Tana River basin in Nyeri County in Kenya will be used as the test site. Recurrent Neural Network-Long Short-Term Memory (RNN-LSTM) deep learning algorithm will be utilised to develop the index through linear and non-linear regression, fitting, iterations and adjustments. The algorithm is preferred due to its ability to handle both non-linear and linear data depicting seasonality and cyclic nature, multiple variable consideration and provide reliable results [1]. The input variables will be Biophysical Composition Index (BCI), Topographic Wetness Index (TWI), Solar Incidence Angle Index (SIAI), Bareness Index (BI), Normalized Difference Vegetation Index (NDVI), and a multiple combined drought index made up of the Standardized Precipitation Index (SPI), Streamflow Drought Index (SDI), Evaporative Stress Index (ESI), and Waters Supply Capacity Index (WSCl) [1], [3]. The expected results will be a comprehensive soil moisture index capable of giving reliable soil moisture simulations especially in dry environments. The novel soil moisture content index will be of benefit to the local community and the scientific world as it will foster droughts monitoring, inform policies and measures towards food security and irrigation. Additionally, it presents a perfect application of the artificial intelligence in environment monitoring and conservation.

**Keywords:** drought, recurrent neural network-long short term memory (RNN-LSTM), soil moisture index

---

**STI07-WEG-004**

## **The Characteristics and Impacts of Streamflow Variation: A Review of The Influence of Climate Change and Anthropogenic Activities**

Johanna A. Wanjala<sup>a,b</sup>, Bartholomew T. Kuria<sup>b</sup>, Arthur W. Sichangi<sup>b</sup>, David N. Kuria<sup>b</sup>, Charles N. Mundia<sup>b</sup> and Andreas Rienow<sup>c</sup>

<sup>a</sup>Remote Sensing Research Group, Institute of Geomatics, GIS and Remote Sensing, Dedan Kimathi University of Technology, Private Bag 10143, Nyeri, Kenya

<sup>b</sup>Institute of Geomatics, GIS and Remote Sensing, Dedan Kimathi University of Technology, Private Bag 10143, Nyeri, Kenya.

<sup>c</sup>Ruhr University Bochum: Ruhr-Universität Bochum, Universitätsstraße 150 44801 Bochum, Germany.

Email: [johannawanjala@gmail.com](mailto:johannawanjala@gmail.com)

## **Abstract**

The unpredictable climate change and increased anthropogenic activities cause continuous streamflow variations, impacting the socioeconomic characteristics of many regions relying on stream water for sustenance. This paper extensively reviewed the literature on streamflow variation in the Upper Tana River Basin (UTRN) in Kenya, highlighting the characteristics, causes and impacts of streamflow variability. The review also looked at proposed resilience and coping strategies and stakeholders' engagement in Kenya towards reducing streamflow variability. Twenty studies on streamflow characteristics in the UTRB were reviewed following a systematic search using the google scholar engine. Six of the identified studies looked at the impact of climate change, three at water abstraction, and three at land use changes, while eight analysed the combined effects of climate change and anthropogenic activities on streamflow variations. The studies showed a positive correlation between climate change and streamflow and a negative correlation between water abstraction and streamflow. An overall gradual decrease in streamflow was identified. Based on the studies reviewed, climate change and anthropogenic activities govern streamflow characteristics in the UTRB. Analysis, however, showed in-situ data gaps and the paucity of scientific knowledge on the actual measurements, monitoring and prediction of streamflow variation. Future research should consider combining land use and hydrological models to evaluate better the effects of land use changes on streamflow variation. Satellite and reanalysis datasets should complement the scarce in-situ meteorological data and regionalisation of hydrological model parameters employed in ungauged river basins to increase the efforts geared towards monitoring and managing streamflow variations.

**Keywords:** Streamflow Variability, Climate Change, Water Abstraction, Land Use Changes, Upper Tana River Basin

## **Spatial Monitoring of River Discharge Using Low-Cost Sensors**

Martin W. Chege<sup>a</sup>, Kuria B. Thiong'o<sup>a</sup>, Arthur W. Sichangi<sup>b</sup>, Moses M. Ngigi<sup>b</sup>, Simon W. Muthee<sup>a</sup>, Wisdom Kipkemboi<sup>a</sup>, Johana A. Wanjala<sup>a</sup>

<sup>a</sup> Remote Sensing Research Group (RSRG), Institute of Geomatics GIS and Remote Sensing, Dedan Kimathi University of Technology, Private Bag, Nyeri, 10143, Kenya,

<sup>b</sup> Institute of Geomatics GIS and Remote sensing, Dedan Kimathi University of Technology, Private Bag, Nyeri, 10143, Kenya.

E-mail: [martinchegee@gmail.com](mailto:martinchegee@gmail.com)

### **Abstract**

Water scarcity is increasingly becoming a major and worrying concern in various global locations. In many rural regions within Kenya, the provision of reticulated water supply derived from reservoirs is either unavailable or inadequate, leading a significant proportion of households to rely on groundwater, precipitation, river runoff, or a mix thereof for their water needs. Nevertheless, the impacts of climate change have significantly diminished the accessibility of this vital resource. In recent years, there has been a noticeable global increase in population growth, resulting in high demands for both surface and groundwater extraction. This phenomenon has led to increased pressure on water resources through increased abstraction of river water, especially in the upper Tana basin, leading to diminished water availability downstream in certain streams. The escalation of abstraction rates presents a substantial peril to the economy, social, environmental, and ecological equilibrium of ecosystems. The primary objective of this research is to optimize river water abstraction spatially within the hydrological reference units. This study presents a novel river discharge monitoring system that enhances the efficiency, size, reproduction, deployment approach, and data transmission capabilities of existing systems. The primary components of the system consist of the flow velocity sensor, temperature sensor, and water level sensor. The system utilizes an Arduino Nano, which is a programmable microcontroller using an ATmega328P chip. This microcontroller is connected to a GSM SIM800L module,

enabling the transmission of data in real time to the server. The river discharge monitoring system is deployed across the hydrological reference units just before the confluence points within the Muringato catchment. In conclusion, this study integrates GIS and IoT technologies to produce low-cost prototype hardware that improves the efficiency and effectiveness of water resource abstraction by measuring discharge at various hydrological reference units. The research has the potential to provide crucial real-time data on river discharge, which contributes to the expansion of the national spatial data infrastructure and enables the efficient and sustainable extraction of water resources. Moreover, this will facilitate the informed decision-making of relevant stakeholders. The information gathered will be used to assess the applicability of the deployed system in accurately facilitating abstraction within the Muringato catchment.

**Keywords:** Water abstraction, Geographic Information System (GIS), IoT, and Monitoring

---

**STI07-WEG-006**

## **A Framework for Implementing Participatory GIS For Environmental Conservation of The Muringato Catchment**

Wisdom Kipkemboi<sup>a</sup>, Bartholomew T. Kuria<sup>a</sup>, and David N. Kuria<sup>b</sup>

<sup>a</sup>Remote Sensing Research Group, Institute of Geomatics, GIS and Remote Sensing, Dedan Kimathi University of Technology, Private Bag, Nyeri, 10100, Kenya,

<sup>b</sup>Institute of Geomatics, GIS and Remote Sensing, Dedan Kimathi University of Technology.

E-mail: [kipwizzdom@gmail.com](mailto:kipwizzdom@gmail.com)

### **Abstract**

The recent decades have seen a growing interest in applying Geographic Information Systems (GIS) to community empowerment and policy formulation. This has been made possible through approaches like participatory design, data collection, and effective implementation strategies. The limitations of traditional GIS alienated the local and marginalized communities. This paved the way for the evolution of traditional GIS to participatory GIS (PGIS) which has reshaped the way community engagement is conducted. In environmental conservation, PGIS has been applied in various areas

including mapping naturally occurring harmful species to alert the general public and monitoring river water levels to improve hydrologic forecasts. The Muringato catchment, one of the River catchments within the Greater Tana basin, and is important for the water recharge of the Greater Tana basin, has been faced with numerous environmental challenges. These challenges include deforestation, water abstraction, and riparian encroachment which have reduced the natural resources ability of the catchment to support the growing population. PGIS approach needs to be implemented within the catchment to identify and visualize the location of the incidents for the appropriate agencies to act and thus curb the environmental destruction within the catchment. This research sought to implement a PGIS approach to identify and visualize the environmental incidents within the catchment in near-real-time for its conservation. The approach utilized a mobile crowd mapping platform and a web-GIS platform PGIS tools for effective engagement. The crowd-mapping platform was custom-developed, using Android studio, PHP scripts, and PostgreSQL database, for reporting environmental disturbance incidents within the Muringato catchment. The web-GIS platform was also custom-developed using Django and GeoDjango frameworks and PostgreSQL Database, to visualize the reported incidents data from the crowd mapping platform in near-real-time. With the Government of Kenya enshrining public participation in the constitution of Kenya, 2010, the study hypothesized that implementing PGIS for environmental conservation would stir the Muringato catchment stakeholders to conserve the catchment. These stakeholders included; the Muringato water resource users' association (WRUA), Water Resource Authority (WRA), and Kenya Forest Service (KFS) among others. Because of their local knowledge of the environment including knowledge of the environmental disturbance incidents within the catchment, the Muringato WRUA were targeted to utilize the crowd mapping platform to report the various incidents within the catchment. The other stakeholders, since were involved mainly in policy formulation and implementation for environmental conservation were targeted to utilize the web-GIS platform to monitor the reported incidents by the Muringato WRUA. This ensured collaboration among the various stakeholders who were all interested in the catchment conservation. A total of 85% (18) WRUA members attended the mobile PGIS tool training and fieldwork

sessions, while 71% (15) WRUA members attended the evaluation session conducted 16 weeks after the training session. A total of 53% (16) review responses of the web-GIS platform were received from the 30 sampled stakeholders. 26 users had utilized the crowd mapping platform to report various environmental disturbance incidents within the catchment at the time the evaluation session was being conducted. The incidents included deforestation (25 incidents), dam construction (7 incidents), and soil dumping (2 incidents). Thus, the PGIS tools developed aided the reporting and visualization of the incidents in near-real-time. The near-real-time reporting of the incidents was crucial for environmental conservation stakeholders to make preliminary assessments and draft action plans to curb the incidents. Thus, the use of the PGIS tools aided the implementation of the PGIS approach to the environmental conservation of the Muringato catchment. The framework of implementation could be adopted for the conservation of other river catchments as well.

**Keywords:** Participatory GIS, Environmental conservation, community engagement

---

**STI07-WEG-007**

## **Modeling of Water Level Trends and Characterization of Its Potential Factors in Lake Baringo in Kenya**

Doreen Jelangat

### **Abstract**

The fluctuation of the water levels in lakes is influenced by both natural and man-made factors within the water basin. Lake Baringo has no visible outlet, and like any other lake in the Rift Valley has been swelling at an alarming rate thus causing panic among native communities and businesses on the shores of the Lake. In this study, we characterize the probable factors that led to the changes in the water level, assess its causes over the years, and predict the possible water level in the next 10 years; 2030. The study utilized land use land cover maps to determine the influence of human activities while the Revised Universal Soil Loss Equation (RUSLE) was used to quantify the siltation in the Lake Basin. The correlation of the land surface temperature, rainfall, and water balance with the water levels was extracted from the Automatic water

extraction index (AWEI) with respect to the Database for Hydrological Time Series of Inland Waters (DAHITI) water level data. The prediction of the water level for 2030 was done using the MOLUSCE tool and the results show that the water level will continue to increase exponentially. There are visible increased human activities like agriculture, deforestation, settlement, and urbanization within the basin that played a major role in the swellings. The land use land cover changes coupled with the recent increase in rainfall have led to accelerated surface runoff, which has intern caused high siltation. By understanding and predicting water levels in lakes, informed decisions ensure the sustainable use of this precious natural resource.

**Keywords:** Land Use Land Cover· DAHITI· Cellular automata· Lake Baringo· Water Level

---

**STI07-WEG-008**

## **Satellite-Based Analysis of 20-Year Trends in Water Levels and Land Cover Change in Key Kenyan Lakes**

\*Ann W. Gichuhi<sup>1</sup>, Kevin O. Achieng<sup>2,3,4</sup>, Nashon J. Adero<sup>1</sup>

*<sup>1</sup>Department of Mining and Mineral Processing Engineering, Taita Taveta University, Voi*

*<sup>2</sup>Department of Crop & Soil Sciences, University of Georgia, Athens, GA 30602*

*<sup>3</sup>Civil Engineering Department, Dedan Kimathi University, Private Bag, Nyeri,*

*<sup>4</sup>Center for Water Resource Management, Dedan Kimathi University, Nyeri,*

*\*Corresponding author: e-mail: [anne32ciku@gmail.com](mailto:anne32ciku@gmail.com)*

### **Abstract**

Lakes play a pivotal role in supporting biodiversity and serving as reservoirs of easily accessible surface water resources, making them integral components of both the blue economy and local livelihood systems. In recent times, the water levels of Kenyan lakes have exhibited fluctuations, with a noteworthy upward trend observed over the past two decades. This increase in water levels has led to shoreline flooding, displacing communities residing in proximity to these lakes. The repercussions have been

profound, encompassing human and animal casualties and a loss of biodiversity within these regions. This study centers its focus on ten economically significant Kenyan lakes: Baringo, Bogoria, Elementaita, Jipe, Magadi, Naivasha, Nakuru, Olbolosat, Turkana, and Victoria. Leveraging geospatial data derived from satellite remote sensing and hydrological information sourced from spaceborne platforms, the research employs trend analysis techniques to scrutinize the temporal evolution of lake water levels and to pinpoint their likely determinants. The study's findings reveal a substantial transformation in lake water levels over the last decade, manifesting a distinct and consistent upward trajectory during the study period. Climate change, intricately connected to environmentally degrading human activities such as land clearance for agriculture and infrastructure development, emerges as the primary catalyst behind these fluctuations. The implications of these findings extend to various domains, including integrated water resources management, environmental monitoring, and property development within Kenya and the broader region. This study and its future endeavors stand to gain from the recent advancements in space technologies for earth observation, notably exemplified by Kenya's recently launched Taifa-1 earth observation nanosatellite. These innovations facilitate enhanced spatial-temporal monitoring capabilities, crucial for the sustainable management of natural resources. In light of the study's outcomes, it is recommended that similar methodologies and data sources be employed to establish a systematic and ongoing monitoring and assessment framework for lake water levels. Such an approach holds the potential to inform evidence-based policies and decisions, safeguarding critical natural resources and ensuring their sustainable stewardship for generations to come.

---

**STI07-WEG-009**

## **Assessment of stream flow Variability in Response to the Changes in Climate, Rainfall and Water Demands**

<sup>1</sup>Abel M. Omanga\*, <sup>1</sup> Arthur W. Sichangi, <sup>2</sup>Godfrey O. Makokha.

<sup>1</sup> Institute of Geomatics, GIS & Remote Sensing (IGGRoS),  
Dedan Kimathi University of Technology, Nyeri-Kenya

<sup>2</sup>School of Science and Informatics, Taita Taveta University, Voi

Correspondence author: [omatech.geodimension@gmail.com](mailto:omatech.geodimension@gmail.com)

## Abstract

Water availability is facing intricate climate change and anthropogenic risks that have worsened the deteriorating water resource quality and quantity. Long term streamflow and groundwater monitoring in various catchments has shown seasonal and long-term variation in water levels. This occurrence can be attributed to several events among them: recession of water sources, increasing water demand, erratic changes in land use, changing precipitation patterns and frequencies. The study assessed the current (2020) and future (2050) spatial-temporal water variability within Thiba sub basin. The historical trends in climate, rainfall and water demands were characterised and their influence on water availability assessed using the Water Evaluation and Planning (WEAP) model. Stream flow variability was evaluated in response to changes in climate, rainfall, and water demands. Water Evaluation and Planning system with monthly timesteps calculations was used to compute water situation, and Parameter Estimation Tool used in calibration of the model. Model was calibrated using; Nash-Sutcliffe efficiency, coefficient of determination and Percent Bias, attaining values of 0.86, 0.85 and 6.64 while the validation coefficients were 0.90, 0.88 and 1.08 respectively. Climate evaluation scenarios under Representative Concentration Pathway 4.5 and 8.5 predict mean rainfall to be 1420.1 mm and 1332.2mm and mean temperatures of 18.8°C and 19.1°C respectively at the end of 2050. The results show a non-significant increase in rainfall and significant increase in temperatures. Both pathways predict greatly variable decreasing mean discharge by the end of 2050. This variability is attributed to the increase in water demand and temperatures in the face of decreasing rainfall. The best-case and worst-case scenario predicts total water demands to increase to 201,903 and 204,302 billion cubic meters per year respectively. Water consumption will increase from 77.0 m<sup>3</sup> per capita per day in 2021, to 85.2 m<sup>3</sup> per capita per day, and a 30% increase in unmet demands in all sectors. Results indicate climate change will significantly impact water resources under the rising water demands, change of land uses and varying discharge. Mitigation efforts will result in better flows compared to no intervention. Detailed study linking groundwater to surface water will help understand better the problem. The study recommends the development of groundwater resources

to take care of the expected rise in water demand in the face of dwindling surface water resources.

---

**STI07-WEG-010**

## **Modelling Rural Food Deserts in Agro-Pastoral Tharaka Constituency using Composed Index of Critical Accessibility to Open-air Food and Livestock Markets**

Kinoti Kibetu

Geography Section, Department of Social Sciences, Chuka University

### **Abstract**

Most of the households in agro-pastoral livelihood zone sell their produce after harvesting leading to dependence on local markets and distribution channels for food needs. This creates food deserts scenarios as most regions in the constituency suffer from insufficient and less affordable foodstuff. Open-air food and livestock markets are geographically isolated from the users in most cases limiting markets physical accessibility which in turn adversely affects sale and purchase of foodstuff through market channels. The aim of this study was to generate a Composed Index of Critical Accessibility (CICA) to aid map village to markets accessibility risk. From the generated accessibility surface map, food markets and food-livestock markets occur in densely populated very-low to low accessibility risk areas. Livestock markets exists in lowly populated very-high to high accessibility risk areas. As for the population with access to markets based on equal travel distance, 80% of residents lived within 6 kms to nearest market. The average distance covered by most households trekking to an open-air market was 2.3 kms. For Tharaka Constituency, spatial concentration as well as population distribution reached peak at 2.4 kilometers and 4.2 kilometers respective. The study therefore found rural food deserts to be cyclic and prevalent in the north and south eastern marginalized regions of the constituency earmarked by poor road network and lack of food markets. The County Government of Tharaka-Nithi should reconsider opening these regions through creation of an open-air food-livestock market and importantly expand road network to facilitate intra-regional food mobility from the food glut areas in the north and eastern regions of the constituency.

**Key words:** CICA, food desert, Market accessibility, road network