



DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

BOOK OF ABSTRACTS

**THE 5th DeKUT INTERNATIONAL CONFERENCE ON SCIENCE TECHNOLOGY,
INNOVATION & ENTREPRENEURSHIP**



DATE: 13th – 15th NOVEMBER 2019

VENUE: *DeKUT MAIN CAMPUS, NYERI*

CONFERENCE THEME

Leveraging Science, Technology, Innovation and Entrepreneurship for Sustainable Development

CONFERENCE SUB-THEMES

- 1. Engineering Technologies and Innovations for Industrialization**
- 2. Business Management and Entrepreneurship for Sustainable Development**
- 3. Basic and Applied Sciences for Advancement of Research and Innovations**
- 4. Agricultural Sciences and Technologies for Sustainable Food and Nutrition Security**
- 5. Water, Energy, GIS and Remote Sensing, Environment, and Climate Change**
- 6. Health Sciences and Community Development**
- 7. Information and Communication Technology for Sustainable Development**
- 8. Tourism, Wildlife and Hospitality Management**
- 9. Policy, Culture and Governance for Sustainable Development**
- 10. Security Management and Innovations**
- 11. Trends in Technical Education and Training**
- 12. African Development and Harnessing Traditional Knowledge**
- 13. Data Science**

Conference Announcement

The 5th DeKUT International Conference on Science, Technology, Innovation and Entrepreneurship

Dates: 13th – 15th November, 2018

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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 4th DeKUT International Conference on Science, Technology, Innovation and Entrepreneurship. The conference theme is “Harnessing Science, Technology, Innovation and Entrepreneurship for Sustainable 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: basic and applied sciences for advancement of research and innovations; business management and entrepreneurship for sustainable development; engineering technologies and innovations for industrialization; health sciences and community development; information and communication technology for development; innovative agricultural sciences and technologies for sustainable food production and food security; trends in technical education and training; and water, energy, environment and climate change.

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.



Prof Fredrick Waweru
Chairman, Conference Organizing Committee

CONFERENCE ORGANIZING COMMITTEE MEMBERS

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BASIC AND APPLIED SCIENCES FOR ADVANCEMENT OF RESEARCH & INNOVATIONS

Recovery of Collagen Hydrolysate from Chrome Leather Shaving Tannery Waste through Two-Step Hydrolysis using Magnesium Oxide and Bating Enzyme

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Abstract

Chrome-tanned solid waste emanating from leather industry is usually disposed of to the environment through landfill which not only pollutes the environment but also wastes the protein resource contained in it. Protein recovery for use in secondary industry presents the best strategy for its re-utilization. Dechroming by hydrolysis is the most practiced method of recovery of collagen and chromium from tanned solid waste. The alkali-enzyme two step hydrolysis methods are commonly utilized for improved recovery efficiency. However, enzyme cost and temperature dependence of the heat stable alkali enzyme has made the process economics difficult and therefore unattractive. The objective of the present work is to recover collagen hydrolysate through a two-step hydrolysis. The method of treatment involved a first-step denaturation and degradation with alkali followed by inoculation with bating enzyme. The ash content, total kjeldahl nitrogen, dry matter and chromium content of the collagen hydrolysates obtained are reported. 58.20% and 50.76% protein recovery efficiency were obtained for the separate alkali and enzyme hydrolysis respectively. A combined protein recovery rate of 79.45% was obtained for the two-step process. Hydrolysis dechroming employing the use of bating enzyme could offer a low-cost alternative for the effective treatment of tanned solid waste.

Key words: *Dechroming, chrome shavings, bate enzyme, collagen hydrolysate, protein recovery efficiency*

Change Point Estimation in Volatility of a Time series
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A major problem that is likely to be encountered by a scientist when analyzing data is lack of homogeneity in the stochastic structure of the data. Meaning, there may be non-stationarity in the conditional variance function as it is the case in this paper. Undetected discontinuities within the structure of the data can easily make the results of any analyses to be invalidated. Detection of structural change in volatility of a time series is very important for understanding volatility dynamics and the stylized facts observed in financial time series. Using the Nadaraya-Watson kernel estimator of the mean function, the conditional mean function is obtained and residuals extracted. The conditional variance function is also obtained using a kernel estimator of the conditional variance. A Kolmogorov-Smirnov type estimator for change point estimation in volatility of a time series is developed and its consistency shown through simulations. This change point estimator is then used to detect the point of change in the squared residuals. The developed estimator is then applied to KES/USD exchange rate data set to estimate a single change point .

Keywords: *Change point Kernel, Nonparametric, ICSS, GARCH.*

Regulation and Control of Temperature using a Microcontroller
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Abstract

Climatic conditions and weather have been drastically changing in the past years due to global warming. Some areas now experience extreme cold temperature while other areas experience the extreme opposite and these conditions are detrimental to the human body. This can make

people feel uncomfortable or cause illness if not prepared for such kind of conditions. It is essential to come up with solutions of convection to regulate room temperatures to normal ranges of about 20 to 25 degrees Celsius. The smart coat will enable regulation and control of temperature within it to suit the user's needs. Regulation and control of temperature using a microcontroller system, especially during winter is going to be studied.

Keywords — *Convection, Microcontroller, Regulation, Smart coat, Temperature*

Physical Properties of Chrome-Tanned Nile Perch (*Lates niloticus*) Fish Leather

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ABSTRACT

The aim of this study was to utilise the Nile perch fish skins which are usually a waste from fish filleting companies to make leather and then to determine its physical properties. The skins were processed into leather using chromium (III) sulphate. The physical properties of leathers were determined using standard IUP methods which include: Tensile strength, Tear strength, Flexing endurance, Shrinkage temperature, Grain crack and Grain burst tests.

The results demonstrated that the tensile, tear strength and elongation of the leather varied depending on the direction and location of the collagen fibres. The properties of the Nile perch leather were satisfying enough for the material to be used in the manufacture of high grade leather products.

The study showed that the fish skins can supplement sources of raw materials in the leather industry and reduce the environmental pollution caused by disposing of the skins to the environment.

Key words: *Fish leather, Shrinkage, Collagen, Properties*

Manufacturing of novelty leather from ovine stomach using oil tannage

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Abstract

Leathers made from exotic skins or rare part of animal have very good market value. The exotic leathers are usually preferred because of their patterns, natural occurring marks and their unique structures. Processing of these material require a non-conventional approach in order to preserve the natural characteristics of the skin after converting into leather. The present work exploits a new raw material source for its utilization as exotic leather. The ovine stomach was converted into finished leather by using suitable tanning methodology and the resultant leather produced quality exotic leather with a grain, which has a different variety from the ordinary leather. The stomachs were taken through pre-tanning, tanning and post-tanning operation. Then mechanical operations like drying, toggling and staking were done. Physical properties of the rumen and the reticulum leathers were analyzed by determining their thickness, tensile strength, elongation at break, tear strength, flex endurance and ball burst extension test. The grain structure of the leathers was analyzed using a Light Microscope. The results of physical tests were poor compared to the grain leather as the composition of raw outer coverings of animals and the stomachs are different. The leathers were used for making leather product such as *coin purse, key holders, purses and wallets*.

Key words: *Exotic leather, Ovine stomach, Tanning*

An Investigation on the Properties of Rabbit Leather from Different Tannages

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Abstract

The non-conventional sources of raw materials, i.e. exotic skins are skins obtained from animals such as crocodiles, alligators, snakes and rabbits. Rabbit farming in Kenya has emerged as a good source of supply of raw materials to the exotic leather industry. However, there lacks detailed knowledge on the structural and physical properties of rabbit leather and specifically from different tannages. The knowledge would be of benefit to tanners in designing their processes as well as leather goods designers in designing products to meet the

desired end-use. For this reason, a study was undertaken to analyse the structural and physical properties of the rabbit leather tanned using chrome and mimosa. The skins were collected from a local slaughterhouse and subjected to standard pre-tanning beamhouse processes followed by the respective different tanning processes. Physical properties of the crust leathers from the two tannages were analysed by determining the thickness, shrinkage temperature, tensile strength, tear strength, ball burst and flex endurance in accordance with IUP official methods. The statistical results for the two tannages were analysed using excel. From the study, the average shrinkage temperature of mimosa tanned leather was 83°C and chrome was 100°C. Notably, chrome tanned leather recorded higher tear strength value (37.4 N) than that of mimosa tanned leather (28 N). The other physical parameters were comparable for both tannages. Based on the results both tannages produced leather with physical properties that can be used in production of lining as well as fancy products such as watch strap

Keywords: *Exotic skins, rabbit skin, tannages.*

The Analysis of Foreign Exchange Markets in Kenya Using the Markov Chain Analysis

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ABSTRACT

The implications of real exchange rate changes for economic growth have become a growing focus of attention in the recent policy implementation debate. Existing empirical evidence reveals that fluctuations in exchange rates can potentially generate distortions in the economy. An understanding of the foreign exchange market trend in-terms of predicting price movement is important for economic decisions. However insufficient empirical evidence on the long –run scenarios of these movements in the Kenyan economy is the empirical contribution this paper wishes to highlight. Markov chain models have been widely applied in predicting group stock markets. In this study Markov chain model was applied on the time series data from the Central Bank of Kenya (CBK).

Assessment of the Quality of Leather Footwear for School Children made by SMEs in Kariokor Kenya

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Footwear is the man-made outer covering of human foot. It is an assembly of top and bottom parts and each part is composed of various components. They are mainly produced from various materials such as textile fabric, leather and synthetics. Leather shoes contain an upper made of leather and the sole varies from leather, rubber, PVC, PU or other material. Various component plays a vital role in the quality and performance of the shoe and failure of one may affect the overall performance of the shoe.

The quality of footwear is evaluated based on whether or not the shoe carries out its intended function, its effects on the wearer, and the extent to which it meets the requirements of the user. Poor quality shoe can result from poor quality of inputs, lack of quality control of the shoe during fabrication process and poor workmanship. The shoe made by SMEs in Kariokor are often not subjected to quality check hence their quality is unknown.

A study was conducted to assess the quality of school children's leather shoes produced by SMEs of Kariokor market in Nairobi, Kenya. Shoe samples were collected from SMEs for laboratory analysis. Samples were analysed using IUP/IUC methods. The tests carried out were tensile and tear strength, elongation, flex endurance, thickness, distension and strength of grain, pH, sole hardness, abrasion resistance, total chromium among others. The findings indicated that the samples tested failed Kenya Bureau of Standards (KEBS) standards. Although the majority of the shoe uppers met KEBS requirements, the soles for the samples tested failed to meet the requirements. In conclusion, the shoes failed the quality tests as per the KEBS requirement. In line with the outcome, there is a need for a strategy to improve the quality of leather footwear fabricated by the SMEs in Kariokor Market.

Keywords: footwear, leather, SMEs, KEBS, quality

Helminthiasis, pneumonia and enteritis prevalence and livestock production constraints in Manyatta sub-county, Embu

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Abstract

Livestock production of cattle, goats, sheep and pigs is the most common agricultural practice of small scale farmers in Embu county. It is however hampered by common livestock diseases. Herein we set out to investigate common livestock diseases production constraints. To understand health constrains of animals reared by small scale farmers, we used administrative data collected in the past five years. Data was collated from both zero grazed animals and free range animals in Manyatta subcounty. Helminthiasis, pneumonia and enteritis are the most common livestock diseases in Manyatta subcounty and Helminthiasis cases were the most prevalent in cattle and peaked in 2014 attributed to drought and water scarcity. The data implies lack of portable drinking water for the livestock and absence or ineffectiveness of Anti-helminthiasis drugs being administered in the sub county. Most farmers do not vaccinate their livestock and only seek treatment drugs when the animals become sick. The data proposes the need for alternative prescription drugs for treatment of helminthiasis. We also propose the need for regular sensitization strategies informing livestock farmers of the need to regularly deworm and vaccinate their animals.

Keywords: *livestock, production, constraints, helminthiasis, pneumonia, enteritis.*

Computational Investigation of Threshold Moisture Content for Slope Stability using BP-FF Artificial Neural Networks: A Case of Sergoit Swamp Soils based on Laboratory Flume Tests

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ABSTRACT

Slope stability problems have become rampant in Kenya in the past few decades. The effects of slope failures and other unexpected mass movements have impacted negatively on both human life and infrastructure. Majority of the failures are triggered by increased water levels originating from intense rainfall storms or irrigation events. Entry of water into a soil mass serves to increase the groundwater level and induce a decrease in matric suction (negative pore water pressure) that may cause slope failure. However, the minimum soil moisture content capable of triggering slope failure is unknown. In this study we propose a constitutive model linking the threshold soil moisture content to other slope parameters. A solar-powered monitoring (SPM) system comprising of moisture sensors and optical strain/displacement transducers in combination with a rainfall simulator has been fabricated to aid in data collection. The collected data is then used to train, test and validate a back-propagation feed-forward (BP-FF) artificial neural network model. Three trial tests were carried out for each of the eight slope angles ($30 - 65^\circ$) investigated. The threshold moisture content was established when displacement of the soil mass was detected. Comparison of computational and experimental results shows excellent agreement. Conclusions from the results indicate that instead of complex state-of-the-art monitoring systems on slopes involving measuring several physical factors requiring enormous technological know-how in programming and installation, a set of soil moisture probes only would be relatively cheaper, but yielding satisfactory results, as long soil lithological parameters are known. Secondly, feeding the data in a neural network model for purposes of forecasting can aid in the design of inexpensive early warning system for disasters associated with slope instabilities.

Keywords: *Soil stability, solar-powered monitoring (SPM) system, soil moisture content, artificial neural network*

Determination of Effect of Land Use on Distribution and Abundance of Ground Dwelling Macroinvertebrates in Kimeri Forest in Embu County, Kenya

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Abstract

Ground dwelling macro invertebrates are essential for soil functions and other significance ecological process such as nutrient cycling. The distribution and ecological role of crawling macro invertebrates may be influenced by anthropogenic factors. Human factors such as deforestation and agricultural activities that destroy the habitat pose great threat for the survival of macro invertebrates. Most of the natural ecosystems including forests in Kenya have been encroached, segmented and reduced in size by the rapidly growing population. However, studies on the impact of such destructive activities on the abundance and distribution of ground dwelling macro invertebrates are limited. Thus, there exist information gap on macro invertebrate composition and their distribution in different ecosystem and habitat segments in Kenya. Such studies are necessary in generating knowledge and creating wholesome understanding to facilitate policymaking, habitat management and conservation of crawling macro invertebrates. Based on the above highlights, this study was conducted to determine the effect of land use on the distribution and abundance of ground dwelling macro invertebrate in Kimeri forest in Embu County, Kenya between January and April 2016. The Napier grass plantation, Tea plantation and indigenous intact forest were evaluated for their macro invertebrates. In every habitat of studied, crawling macro invertebrates were caught using the pit fall traps set in 50 m by 50 m grid subdivided into six rows at equidistance gap of 8 m. The pit holes comprised of 100 (250 ml capacity) clear plastic containers filled with 50 ml mixture of ethanol and liquid soap. Macro invertebrates were identified using their morphometric features and then stored in 70 % Ethanol for further laboratory identification at the National museums of Kenya headquarter in Nairobi, Kenya. The data collected was subjected to the analysis of variance using Scientific Analysis System (SAS) version 9.4 and significance means separated using Least Significance Difference (SLD). The indigenous intact forest habitat recorded the highest mean of macroinvertebrates with family of *Polydesmidae* being the most abundant (mean=17.33). Tea plantation had the second largest mean (4.59) of macro invertebrates, and the family *Gryllidae* was the most abundant group with mean of 12.667. Napier grass plantation had a mean of 3.94 and the family *Platydesmidae* was the most abundant group (mean=12.833). The disparity in abundance and distribution of terrestrial macro invertebrate observed in this study may have resulted from micro and microenvironment shift influenced by human activity along and within the forest.

Keywords: Macro invertebrates, Habitat effect, Kimeri forest, Embu, Kenya

**Assessment of Wild Rodents Endoparasites in Kimeri Forest in Embu County, Kenya
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Abstract

Rodents are reservoirs and hosts of zoonotic diseases. Rodents' pathogenic parasites can be introduced onto soils, water supplies, vegetables and fruits thus playing significant role in human infection. Though studies on rodents and their parasites are necessary to understand and managing zoonotic disease cycle, knowledge gap of endoparasite composition of wild rodents that interact with domestic animals and human still exists in Kenya. This study was carried out to determine the prevalence of rodents' endoparasites in Kimeri forest, Embu County in Kenya between January and May 2016. Wild rats were caught by laying traps in 100 m x 100 m grid of 50 Sherman and 50 victor traps. Rodents' morphometric data was used for their identification. Necropsy was performed for gastrointestinal tract (GIT) and endoparasites extracted, counted and prevalence determined. Three species of rats totaling to 355 rats comprising of 199 males and 156 females were captured and identified. A total of 533 endoparasites extracted. Rate of endoparasite prevalence was significantly higher in *Rattus spp* a peri-domestic rodent than forest rodents' species (= 57.791, P = < 0.05). *Asyphalia obvelata* (44.79 %) had higher prevalence while the *H. dinimuta* had lowest prevalence (6.20 %). Prevalence based on forest patches, GIT and was different. The current study highlights the importance of rodents as potential vectors for intestinal parasitic infections.

Keywords: Rodents, Endoparasites, Kimeri Forest, Kenya

BUSINESS MANAGEMENT AND ENTREPRENEURSHIP FOR SUSTAINABLE DEVELOPMENT

***From Ivory Tower to Entrepreneurial University: A transformation agenda
for sustainable job creation and development among university
graduates in Uganda.***

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Abstract

This paper stresses the importance of entrepreneurial university towards enhancing sustainable job creation and development among university students. The problems facing the country ranging from high rate of poverty, youth and graduate unemployment; overdependence on foreign goods and technology; as well as low economic growth and development are partly caused by the education system especially at the university level. Currently many people believe that university education in Uganda is primarily for its own sake – to impart knowledge and a love of learning with higher paper qualifications. University education is for academic superiority disconnected from day-to-day realities, a closed environment in which knowledge and intellect is the preserve of the self-selecting, privileged few – no understanding of what is important for ordinary people. Yet, the reality of university education is about helping people make progress in their lives in the more specific sense of helping them to get better job and position in life.

This paper therefore argues that transformation of universities in Uganda, from ivory tower to entrepreneurial universities, will equip the students with the behaviour, attitudes and skills with which to be self-reliant and contribute to sustainable job creation and development. The paper begins by highlighting the concept of university as an ivory tower. The objectives and framework for designing entrepreneurial university are also presented. The paper recommends that educational programmes at all levels of university education should be made relevant to the community so as to provide the youth with the needed entrepreneurial and employable skills.

Key words: *ivory tower, transformation, entrepreneurial university, sustainable development, Uganda.*

Stakeholder Management Strategies and Deposit Taking SACCOs' Bottom Line in Kenya

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ABSTRACT

For firm to succeed in a dynamic competitive market place, it has to understand the concerns of its key stakeholders and address them to their satisfaction. This study sought to establish the relationship between stakeholder management strategies and the financial performance of deposit taking Savings and Credit Co-operatives societies in Kenya. The SACCO subsector is part of the Kenyan Co-operative sector comprising of both financial and non-financial cooperatives. Saving and credit co-operative (SACCO) are the financial cooperatives. They are an important part of the financial sector in Kenya, providing savings, credit and insurance services to a large portion of the population. Stakeholder management is paramount in creating trust and confidence to key stakeholder especially in deposit taking SACCOs, and in keeping them satisfied. It has been argued that stakeholder management is decisive in determining whether or not a company is or remain successful and that it has direct environment and bottom line result of an organization. Systematic attention to all parties who affect or may be affected by the organization's behavior is critical to that organizations success. Stakeholder management studies have mostly concentrated on normative branch of stakeholder management theory. It is however important to extend the study to member - based co-operatives. Descriptive research method was employed in this study. Questionnaires ware used to collect primary data. To ensure that the research instrument yields valid data, the researcher engaged expert in the relevant field in scrutinizing it. Pilot study was carried out to check on the reliability and validity of the instrument and a Cronbach's Alpha of 0.915 was obtained. Data was collected from a sample of 64 Deposit taking SACCOs out of a population of 180 licensed DTS. This made a sample of 130 individual respondents. Research findings were that all the five strategies individually and when combined have positive relationship with the performance of deposit taking SAACOs. Data analysis gives a p value of 0.000 for the overall model. The level of significance () is 5% = 0.05. This shows that there is a fit in the overall model. The research contributes to stakeholder management theory by supporting previous studies that stakeholder management strategies have positive relationship with SACCO

societies' performance. Managers should be proactive in managing their stakeholders and to enhance their relationships and financial performance of their SACCOs.

Key words: *Deposit Taking SACCOs, Financial Performance, Stakeholder Management strategies*

Inflation Rate and Performance of the Residential Property Market in Kenya
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Abstract

The purpose of the study was to establish the effect of inflation rate on the performance of the residential property market in Kenya. Swelling of the residential property prices in Kenya vis a vis the inflation rate has ignited concerns about the sustainability of residential property market in Kenya. This study adopted a positivist philosophical attitude using causal research design. The study used secondary data from first quarter of 2005 to fourth quarter of 2018. The study conducted several test statistics and diagnostic tests in order to achieve the most optimal solution. Vector error correction model and auto-regressive distributed lag model were employed to test the hypothesis in the short run and long run respectively. Interestingly, the study results found that inflation rate had a negative effect on performance of residential properties in Kenya in the short run while a positive effect was observed in long run. The study has narrowed down the research gap brought about by the conflicting empirical, theoretical and conceptual literature with regard to the effect of inflation rate on performance of residential property market in Kenya. To investor, the study recommends the need to have varying strategies on the inflation effect on residential property market investments as it has diverse effect depending on whether the relationship is short run on long run.

Keywords: *Inflation Rate, Performance, Residential Property*

Effects of earnings announcements on share prices at Nairobi Securities Exchange

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Abstract

The study comprised of earnings announcements and how they influence share prices at NSE. Event study methodology was followed over a five year period from 2012 to 2016. A census was carried out where 57 companies qualified to examination over the period through positivism approach. Average abnormal returns were tested for significance at 95% confidence level. The results indicated that NSE was efficient in semi-strong form for year 2012, 2013, 2014 and 2016 except for year 2015 where the market was found to be inefficient with regard to earnings announcements.

Keywords: *earnings, semi strong form, efficient market hypothesis.*

Human Capital Development and Economic Growth in Kenya: Best Practices from South Korea and Singapore (2002-2014)

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Abstract

Numerous studies have attributed the differences in the level of socio-economic development across countries to the quantity and quality of human capital. These studies further singled out growth of human capital as the principal source of economic growth for both the developed and some South East Asian countries. Kenya, Singapore and South Korea exhibited similar income levels in the 1960s. However, the gap between Kenya's economic growth and those of South Korea and Singapore has widened tremendously since independence in 1963 with Kenya recording low Gross Domestic Product (GDP) compared to the two Asian countries.

The study examined the role played by HCD in the economic development of Kenya between 2002 and 2014 by interrogating the development models adopted by South Korea and Singapore as a benchmark to determine the gaps in the model adopted by Kenya. Secondary data was collected through a designed recording form. The model variables included GDP as the response variable explained by six predictor variables; government expenditure on education, human development index, average years of schooling as a proxy for percentage of population that has attained education, patents filed by the countries, government effectiveness and government expenditure on research and development. Secondary data was analyzed using hypotheses tests, stationarity tests, granger causality tests, correlation analysis and regression modelling and interpreted in line with the study objectives. Findings revealed that whereas human development index was found to be positively correlated to economic growth in South Korea and Singapore, it was negatively (inversely) correlated to economic growth in Kenya; an indication that the country is not doing very well in terms of developing and deploying her human capital in the three critical areas of education, health and standard of living. Findings further revealed that whereas investment in education, competitive Human Development Index and Average Years of Schooling positively influenced economic growth in South Korea and Singapore, Government investment in Research and Development had a negative influence. The study recommends that the TVET sector be revamped and prioritized as a response to youth unemployment challenge; the government, strengthens linkage between policy makers, universities, research institutions and industry; lays more emphasis on applied R&D; and invests heavily in science, engineering, ICT and mathematics for human capital accumulation in order to realized sustained economic growth. Based on the best practices from South Korea and Singapore a framework for HCD is developed.

Keywords: *Human Capital, Human Capital Development, Education, Economic Growth.*

Effect of Holistic Marketing on Performance of Dairy Processors in Kenya
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ABSTRACT

The purpose of the study was to evaluate the effect of holistic marketing on performance of dairy processors in Kenya. Studies have been conducted but none has, on effect of holistic marketing in dairy business. Kenya dairy processors have been experiencing several challenges in their operation, among them, low quality and quantity of milk, high cost and waste along the production value chain, Poor access to both domestic and export market and unfair competition amongst processors. The study objective was to evaluate the effect of holistic marketing on performance of dairy processors in Kenya. The study was anchored on Partial theory of holistic firm. Descriptive research design was adopted for the study. Purposive sampling technique was used as it allows picking most appropriate cases providing the required information for the study. The study targeted a census of 14 managers of dairy processing firms in Rift valley and Central region of Kenya. Self administered questionnaire of 14 general managers of the processing firms was used to collect data. Correlation of variables; multiple linear regression and overall analysis of variance were computed. Pearson's correlation index showed that dairy processor's holistic marketing variables contributed to performance of each other and that all holistic marketing variables were correlated with performance variable (dependent variable). Social responsibility and discretionary effort for processors had a negative correlation coefficient of -0.63 and -0.93 respectively while all the other independent variables had positive coefficient values. The processor's independent variables were significant apart from relationship marketing which had a p value of 0.055 , slightly higher than $=0.05$. The ANOVA computed F for dairy processors was 0.03 . Thus, there was an overall significant relationship between the processors explanatory variables and performance of the dairy industry. In conclusion, the study showed that, the dairy processors were aware and implemented holistic marketing management practices fairly. However the dairy processors considered social responsibility as an expense and addition to cost hence avoiding it resulting to the negative coefficient value.

Dairy processing managers require training and development in implementing holistic marketing as an approach to performance of the dairy industry as the study found it rewarding.

Keywords: *Holistic marketing, Relationship marketing, Internal marketing, integrated marketing, Social responsibility, Discretionary effort, Performance*

Who Really is the King between Customer and Employee? Comparative Effect of Customer Versus Employee Focus Strategies on Customer Retention by Small and Medium Enterprises in Nakuru town, Kenya

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Abstract

Customer retention is paramount for a business to guarantee continuous and stable revenue flow. Both customer and employee focus strategies are critical impetus in attracting and retaining loyal customers. There is really no point in over emphasising one side at the expense of the other. Although most studies have analysed separate influence of customer and employee focus on customer retention, this study sought to establish the deference in the degree of influence when customer and employee focus strategies are compared. Competing Values model of organizational effectiveness was used as the main theory anchoring the study. Cross-Sectional survey was adopted as the research design. The population of the study comprised fifty seven (57) SMEs in within Nakuru town Kenya. Primary data was collected using structured questionnaires. Correlation and regression analyses were carried out to analyze data and to test hypotheses. Customer Retention Rate (CRR) was used as dependent variable. It was established that although both employee and customer focus strategies significantly predict CRR, employee focus strategies are comparatively greater predictors of CRR than customer focus strategies. However, the combined effect of both employee and customer focus strategies manifested greatest effect on CRR. The significance of employee focus when it comes to customer retention cannot be overlooked. The key recommendation that the study offers as insight to policy makers, body of theory and practitioners is the need to deliberately consider strategies that focus on employee empowerment and not over emphasize

the global buzz phrase the customer is the king. A non-skewed and fair balance between customer and employee focus strategies is critical for customer retention.

Keywords: *Customer Focus, Customer Retention, Employee Focus, Strategies, Small and Medium Enterprise*

Analysis of Strategies for Successful Integrated System Implementation: A case Study of UNIPLUS Implementation at the Co-operative University of Kenya

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Abstract

An integrated system is essential for automation of manual routine tedious organizational processes. It is meant to improve efficiency and effectiveness at work. However, implementation of such systems, if not properly organized and appropriate strategies put in place to ensure its success, may take unnecessarily longer time than anticipated, or the whole system abandoned all together. This study sought to establish the most effective strategies that ensure successful and timely integrated system implementation. Systems theory approach and Resource Based View were used to anchor the study. Case study was adopted as the research design. The population of the study comprised twelve (12) departments within Co-operative University of Kenya where different system modules were rolled out for implementation. Primary data was collected using semi-structured questionnaires. Since data collected was largely categorical in nature, Chi-square was used to analyze relationship between variables. It was established that personal interest and optimism is the most influential strategy in determining success and pace in integrated system implementation. The key recommendation that the study offers as insight to policy makers, body of theory and practitioners is the need to deliberately concentrate on strategies that induce personal interest and optimism among employees so as to ensure success during implementation of a new system or change.

Keywords: *Customer Focus, Customer Retention, Employee Focus, Strategies, Small and Medium Enterprise*

Effects of Integrated Infrastructure on Sustainable Mobility of Matatu Sacco's in Public Transport in Nairobi County

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ABSTRACT

Road transport is the most widely used means of transportation in Africa. Maintenance of physical infrastructure is the key to rapid economic growth and poverty reduction. Road network infrastructure connectivity plays a significant role in allowing for a mobile town in which passengers can fluidly move on time with a reduction on fare and also enhancing decongestion in towns. As a result of the increasing movement trends passengers are demanding for more integrated infrastructure in transport sector specifically in the Matatu Sacco. In response to these demands, this study guided by positivism theory and employing the mixed research design set out to evaluate the effects of integrated infrastructure on sustainable mobility of Matatu Sacco's public transport sector in Nairobi County. The population of the study was all 177 Matatu Sacco's registered by NTSA in 2015 located in Nairobi County. The respondents were the Sacco Managers of the 177 Matatu Sacco's. Census design was employed since all the registered Sacco were used in the study. A semi-structured questionnaire was used to collect both quantitative and qualitative data from the 177 Sacco managers, while an interview schedule was used to collect data from the representatives from both the ministry of transport and vehicle owner association respectively. Quantitative data was analyzed using SPSS. Pearson's correlation indicated that integrated infrastructure had a positive effect on sustainable mobility of Matatu Sacco's in public transport sector ($r_{Ho} = 0.808$, $p < 0.05$ with beta coefficients; $\beta = 1.095$ $t = 15.796$, $p < 0.05$). The study recommends that integrated infrastructure is instrumental for the effective functioning of Matatu Sacco's in the transport sector and that the Ministry of Transport and all other stakeholders should adopt

an integrated infrastructure, one which is accessible to transfer points, route planning, clean and secure. The Ministry should also develop and mainstream policies on strategic transport integration that would influence sustainable mobility of Matatu Saccos in public sector. Similar studies are recommended in other Counties since public transport is experienced in all Counties. The study further proposes that if the government structures and reorganizes the Matatu Sector and embrace integrated infrastructure accordingly, it can provide the much needed employment to the youth and also enhance other modes of transport for low income households.

Keywords: *Integrated Infrastructure, Sustainable Mobility, Matatu Sacco's, Public Transport Sector*

Effects of Financing Structure on Financial Performance of Saccos in Kikuyu Sub-County, Kiambu County, Kenya

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ABSTRACT

No one forgets the tremendous responsibilities that SACCOs convey by providing financial services. They appeal funds inside and outwardly enabling continuous lending services. Nevertheless due to extraordinary cost of capital, SACCOs experience financial anguish restraining their financial performance. This research study aimed at analyzing the effects of financing structure on the financial performance of SACCO's registered in Kikuyu Sub-county Kiambu, Kenya. This descriptive quantitative study, unearthed the financing structure pattern and the effects it has on financial performance of SACCOs. The dependent variable was measured by dividing surplus with equity while the independent variable was attained by dividing debt with equity. The explanatory research design was adopted to establish contributory properties of an independent variable while a census survey was adopted. Data collection was effected using a data sheet distributed to all the SACCOs. The research was

pegged on trade-off, pecking order and market timing theory. Data obtained was an extract from audited published business reports of all registered SACCOs by end of the year 2017 in Kikuyu Sub-county's Co-operatives Office. It was put in SPSS and analyzed quantitatively using correlation, analysis of variance and regression analysis. Results acquired displayed that SACCOs financing structure had a moderate correlation significantly explaining the variance in financial performance. This research finding applauds an implementation of more combined financing options leading to better-quality financial performance. Research findings called for government becoming more influential in contributing financial assistance to support SACCO's managing intensified rebate charges charged by commercial banks. This attention might heighten SACCOs' entrepreneurial performance principally leading to supporters' wealth enlargement.

Key words: financing structure, Debt, equity, financial performance

The Influence of Capabilities on Adoption of Internationalization Strategies in Chartered Universities in Kenya

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ABSTRACT

Internationalization has grown to be an important force in shaping the higher education sector. It is the intentional process of integrating an international, intercultural or global dimension into the purpose, functions and delivery of post-secondary education in order to enhance quality of education and research for all students and staff, and to make a meaningful contribution to society. Thus the study seeks to examine the influence of capabilities on the adoption of internationalization strategies in chartered universities in Kenya. Specifically, the study seeks to establish the influence of managerial, governance, technological capabilities and financial capabilities on the adoption of internationalization strategies in universities in Kenya. In addition, the study seeks to establish the moderating effect of government legislation on the influence of capabilities on the adoption of internationalization strategies in

universities in Kenya. The study is thus hinged on the Deming's Theory of Quality Management, Resource Based View theory, Dynamic Capability Theory and the Technology Acceptance Model. The study will be conducted in private and public universities in Kenya and will employ the mixed methods research design by integrating both qualitative and quantitative research. A cross-sectional survey that will involve both analytical and descriptive methods to address the objectives of the study will be used. The respondents in each institution will comprise of the Registrar in charge of Academic Affairs, Registrar in charge of Research, the Director of International Programmes and Linkages/International Office and the Dean of Students. The study will conduct a census survey by covering all the units in the population. The study will use both primary and secondary data. Primarily sourced data will be collected by administering semi-structured questionnaires that will be 196 in total. In order to ascertain how valid and reliable the questionnaires are, a pilot study will be conducted. Quantitative design will involve descriptive and inferential statistics. Qualitative data collected from the open-ended part of the questionnaire will be analyzed using content analysis and the results will be presented in prose form. Results will then be presented in tables, diagrams and charts. The study is beneficial to policy makers, academicians and scholars and managers of higher education institutions as it will contribute to knowledge by broadening the literature available. The study will also develop a clear and succinct road map guiding internationalization to other universities in Kenya.

Keywords: *Internationalization, Internationalization Strategies, capabilities, adoption, chartered universities.*

Effects of Horizontal Public Procurement Practices on Supply Chain Performance in Kenya Owned State Corporations

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Abstract

Public Procurement, which accounts for 15-18 % of the country's GDP, is a major policy tool which the Kenyan government is using to pursue "horizontal" objectives- of social

transformational and development in addition to the “functional” objectives - of obtaining goods, works and services in the best terms. Despite the widespread utilization of public procurement’s “buying power” to realize horizontal outcomes, pertinent literature on supply chain performance has paid much attention to functional aspects of supply chain performance, to the exclusion of horizontal issues. This study sought to determine the relationship between horizontal public procurement practices and supply chain performance in Kenya owned State Corporations using public value theory as analytical framework. Specifically, the study examined the effect of Socially Responsible Procurement, Environmentally Responsible Procurement and Protectionist Public Procurement on Supply Chain Performance of Kenya owned State Corporations. The study employed a positivist research paradigm and a cross-sectional census survey design and targeted the 187 Kenya owned State Corporations. Closed and open ended questionnaires were distributed to procurement practitioners and interview guides were conducted with accounting officers to gather primary data, whereas secondary data was retrieved from existing reports of the public procurement Regulatory Authority website. Descriptive statistics, correlation and multiple regression analysis were used to analyze the data. The results indicated that Socially Responsible Procurement, Environmentally Responsible Procurement, Protectionist public Procurement, and Public Procurement of Innovation had positive and statistically significant effect on supply chain performance. The study had two major implications for theory, and for practice. First, the study revealed the robustness of public value theory as an analytical framework for horizontal public procurement hence further extending the theoretical discourse of the theory. Second, the study showed that pursuit of functional and horizontal objectives in public procurement is critical to supply chain management practice.

***Board Gender Diversity and Financial Performance of Commercial Banks
Evidence from Kenya***

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Abstract

This paper examines the influence of board gender diversity on return on equity on the 34 commercial banks in Kenya during the years 2008-2017. The results found board gender diversity had a negative but significant influence on return on equity across peer and across banks. However, in regard to time, board gender diversity had insignificant influence on return on equity across time. In regard to individual years, board gender diversity had a positive and significant variability on return on equity across time, across peer and across banks. This imply that board gender diversity had generally a negative influence on return on equity across time, across peer and across banks. Whereas, in regard to individual years, peer and bank, board gender diversity had a positive and significant variability on return on equity across time, across peer and across banks.

Key words: Board gender diversity, return on equity, Kenya

Effect of Heuristic Factors and Real Estate Investment in Embu County, Kenya
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Abstract

Investment decisions are deemed as a deliberate and rational process based on availability of information. Though at times people are usually found to hold little information but yet end up making general decisions. Heuristics factors are simple rules of the thumb which explain how people make decisions, arrive at judgments and solve problems when faced with complex situations or in cases where the available information is incomplete. This study sought at

assessing the influence of the heuristic factors on real estate investment in Embu County. The study was guided by Heuristic Theory. A census of 126 registered real estate investors from Embu town, Runyenjes and Siakago Urban centers was undertaken. Primary data was collected through a self-administered questionnaire composed of closed ended questions. Cronbach alpha coefficient of 0.7 was used to ascertain test of the reliability of the data collection instrument. Descriptive and regression analysis were used to analyze data with the help of statistical package. Inferential statistics was also carried out to establish the nature of the relationship that exists between heuristic factors and real estate investment. Data was interpreted with the help of 0.05 significance P-values. Model fitness R^2 , ANOVA statistics and regression coefficient were generated. Prior to running a regression model, normality test was conducted. The study findings indicated heuristics factors have a positive and statistically significant relationship with real estate investment in Embu County. This study concludes that real estate investors in Embu County sometimes do not make investment decisions rationally but are influenced by heuristic biased decisions. The study recommends that Embu County Government should establish a mechanism to ensure that the prices of real estate in specific regions are availed to enable investors evaluate price changes as it may influence their decision to buy or sell the investment.

Business incubation Imperatives in Technology Based New venture creation: An evaluation of Business Support Value Proposition in Kenyan Business Incubators

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ABSTRACT

Globally, business incubation has emerged as a popular mechanism for supporting new venture creation. Given this backdrop, the objective of this research was to assess the effect of business Support on technology based new venture creation in Kenya. This study was based on Co-production Theory and Smilor's Incubation Model. The study used descriptive research

design. The population of study was 9 business incubator managers and 364 incubatees located in Nairobi Metropolitan. Stratified sampling was undertaken to obtain strata based on each business incubator involved in the study. For the incubatees, simple random sampling was then applied to obtain a sample size of 186 incubatee. A Semi-structured questionnaire was used to collect both quantitative and qualitative data from the incubatees. An interview schedule was used to collect data from incubator managers. Quantitative data was analyzed using SPSS that generated both descriptive and inferential statistics. Pearson's correlation coefficients indicated a positive correlation between business incubation components and technology based new venture creation with correlation coefficient for business support (0.390, $p < 0.05$). Bivariate analysis indicated business support had a significant effect on technology based new venture creation, with the beta coefficients; $\beta = 0.348$, $p < 0.05$). Data obtained from incubator managers was analyzed through a qualitative analysis process. The study recommend integration of incubation theories and incubation models in the configuration of an effective business support services configuration in Kenya Business incubators. This Study recommends that business incubators need to model business support services that encompass the four elements of business support; business coaching, training, business plan support and provision of subsidies. Business incubation managers and practitioners need to improve these elements to increase new venture creation success. The incubation service provider should also be customer-centric, implying that it should be tailored to meet the specific needs of the incubatees that most of the times depend on the stage of development of the new venture.

Keywords: *Business Incubation, Technology-Based New Venture Creation, Business Support and Value Proposition.*

Banks' Portfolio Diversification and Financial Performance of Commercial Banks in Kenya

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Abstract

It is complicated to efficiently manage bank's portfolio, simultaneously maximize returns and minimize risks while being subject to managerial and regulatory constraints. This paper has discussed pertinent issues in bank portfolio diversification in the banking industry while focusing on the elimination of the existing classes of risk. The banks' portfolio diversification as a strategy in the context of a country like Kenya is assessed on the fundamentals of available theoretical supported by empirical literature with a bias to all commercial banks in Kenya. The 43 commercial banking institutions having official license from CBK by December 2017 were the target population of this study. The study analyzed Time Series Cross Sectional unbalanced secondary panel data obtained from KNBS, World Bank website, CBK, published financial accounts statements of all the 43 commercial banking institutions in Kenya, and the Banking survey publications for fifteen years ranging from 2003 to 2017. Four hypotheses were estimated using Panel data techniques of fixed effects and random effects. Generalized Method of Moments (GMM) was used to estimate short run model and to purge unobserved firm specific time-invariant effects and also to help to mitigating presence of endogeneity problems. GMM revealed short run significant effect of ROE and ROA on financial performance of commercial banks. Sectoral credit diversification, income services diversification, deposits portfolio diversification and investment portfolio diversification had significant positive effect on financial performance respectively.

Key words: Portfolio Diversification; Sectoral credit; income streams; deposits portfolio; investment portfolio; Dynamic Panel Model; Fixed Effects

ENGINEERING TECHNOLOGIES AND INNOVATIONS FOR INDUSTRIALIZATION

A Numerical study of Volatile Matter Generation from Wood Combustion in a Fixed Bed under O₂/CO₂ Environment

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Abstract

In this study, the influence of bed porosity on volatile matter generation was investigated in a fixed bed under O₂/CO₂ environment. Wood particles of various sizes were arranged in a fixed bed to form different bed porosities that ranged between 0.51 and 0.74. Numerical simulations of combustion of wood in fixed bed were carried out using a commercial software CD-Adapco (STAR CCM+ version 11.04). Wood burning in a fixed bed was simulated using Lagrange-Euler method, where gas-phase was calculated using Computational Fluid Dynamics (CFD) while solid-phase was tracked in Lagrange phase (Discrete Element Method - DEM). Species generation and depletion in the fuel bed were analyzed along the axial length of the fixed bed for different fuel particle type. It was established that the amount of CH₄, H₂, CO and tar at any height of the bed decrease as porosity is increased. Furthermore, for all conditions tested, unburnt volatiles exited the top of the fuel bed. Therefore, under such conditions, a well-designed combustion chamber with a secondary air supply is required in order to complete the oxidation of unburnt hydrocarbon.

Keywords: CFD-DEM; Wood combustion; Volatiles; Fixed bed; Oxy-fuel

Plastic Shape of the Future

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Abstract

Plastic production is growing and is an important economic factor in many countries. Plastics used in industrial and consumer goods have a broad spectrum of optimized properties and in many cases are difficult to replace. Their low weight means they are irreplaceable when it comes to resource-efficient products. However, too much plastic waste ends up in the environment at the end of its life cycle. However, the raw material base only slowly opens up for biogenic sources. The aim of contemporary research is develop new competencies, methods and products for the circular plastics industry. The basic idea is simple: to minimize the extraction of fossil resources, minimize end-of-life losses, and at the same time enable real recycling. But the change from today's largely linear global system to an efficient recycling economy requires systemic, technical and social innovations. The diverse range of plastics must be optimized in terms of recyclability without sacrificing functionality. Plastic products must be designed to enable repairability and long lifetimes. At the same time, the cultural practices and value that we place on plastics must be actively reinvented.

Smart collection systems for plastic waste must be in place on a global scale and they must become significantly more efficient and better accepted. Collection, separation and recycling technologies need to be enhanced to avoid downcycling. Where the release of microplastics is unavoidable, for example due to weathering and abrasion, or not feasible for reasons of resource efficiency, it must be ensured that they can rapidly degrade in the environment. Recycling losses should be replaced exclusively by renewable – not fossil – sources. This vision requires a »plastics revolution along the entire value chain«, which can only succeed with a multi-stakeholder approach. From the beginning scientists work together with marketing experts and business development managers.

Keywords: *Circular Economy, Recycling, Sustainability*

Robust posture tracking control of stable coaxial two-wheeled AGV using an approximate inverse system and LMI

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Abstract

This report describes the design of the posture controller for two-wheeled AGV. The objective is to improve the posture stability when running on ramps by balancing between vehicle body attitude angle and wheel angular velocity target value. We confirmed the effectiveness of the controller by simulation and experiment.

Key Words: *coaxial two-wheeled AGV, LMI, inverse system, robust control.*

Simulation of Feedforward and feedback controller for Cone Dielectric Elastomer Actuators

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Abstract

Conventional actuators based on metal and ceramics are limited in applications where service and welfare robots must work in collaboration with human workers. Dielectric Elastomer Actuators (DEAs) are a promising alternative to the conventional hard actuators because they can realize motions which more resemble those of human muscles. Innovating practical fabrication techniques and conducting and compliant materials can enable the realization of DEAs of different sizes and force requirements, with reproducible behavior and fast responses. Large scale and modular production of low voltage driven practical DEAs by low-cost methods and materials is still a challenge. Furthermore, the dynamic characteristics and controllability of DEAs need to be well understood. In this paper, experimental data for the input voltage and the resulting displacement of the cone DEAs were subjected to system

identification and a transfer function was determined. The identified model was validated against the voltage input and it well reproduced the output of the cone DEA. The DEAs was found to be stable in terms of the location of the pole. Four kinds of controllers were designed for the model DEA; linear quadratic regulator (LQR), the linear-quadratic integral (LQI), inverse controller and PID controller. The LQR, LQI, and inverse controllers managed to eliminate the overshoots. Overall, the inverse controller tracked well the desired trajectory. On the closed-loop simulation of the DEA, the LQR controller having a Luenberger observer well reproduced the results of its simulation and the overshoot was eliminated.

Key Words: *Dielectric Elastomer Actuators (DEAs), linear quadratic regulator (LQR), the linear-quadratic integral (LQI), inverse controller, PID controller*

Effective Biosensors based on Whispering Gallery Modes

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Abstract

Whispering gallery modes are specific resonances of a wave field confined inside a given cavity with smooth edges based total internal reflection phenomenon. Practical electromagnetic whispering gallery modes posses many unique properties, for example, ultra-high Q -factors, low mode volumes, small sizes of resonators supporting them and its operation at optical and telecommunication frequencies of light, it is easy to fabricate and intergrate on-chip of devices using them, make them ideally suited for a vast array of applications, such as biosensors. In this poster we will look at some of the main factors regarding whispering gallery modes and resonators. These include its wave theory, resonator performance parameters, resonator geometries, coupling of whispering gallery modes to and from resonators and at some practical applications of whispering gallery modes with emphasis on biosensors.

Keywords : Resonators, Whispering gallery modes, Biosensors, Optical metrology/telemetry

Maintenance data analytics architecture for decision support considering heterogeneous data

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Abstract

The advent of Industry 4.0, has promoted significant evolution of maintenance decision support systems (MDSS) and is expected to shape how maintenance strategies are developed and implemented, with an emphasis on decision support models and methods leveraging on integrated data analytics. Many industrial installations generate different historical and real-time data from operational and maintenance activities, envisaged to retain vital information that may enhance maintenance, ultimately improving the uptime of the assets. However, the data sets are not readily analyzable due to several characteristics among others; heterogeneity due to industries integrating electromechanical systems, different domain origins hence, lack standardized formats to enable amalgamation for comprehensive analysis and finally, embeds different structure and formats (structured and unstructured). This study sets out to address the aforementioned challenges, by developing a model for aggregating, integrating and deriving optimal decision support from such data (knowledge discovery), which includes data analysis and evaluation (knowledge extraction) to generate an applicable and comprehensible output (knowledge application).

This study firstly, advances a methodology that develops an architecture for integrating, structuring, exploration and standardizing the heterogeneous (different) data sets, making the data analysis-ready for statistical analysis and ultimately, derive decision support solutions from the integrated analysis-ready data. The methodology is validated by an application scenario, by developing a data-driven decision support model that integrates different types of maintenance data like condition monitoring (e.g. vibration analysis), production and failure data, where information embedded in the data (through knowledge discovery models) is derived and used for decision support. This study aims to contribute to this growing area of

research, provide input for maintenance optimization and serve as a reference for reliability and maintenance managers, not only deriving predictive MDSS, but also developing maintenance data management architecture that reduce time and effort spent on preprocessing.

Keywords: *Maintenance decision support, data exploration, data mining, data integration, big data analytics*

A Study on the Performance of LoRa: Connectivity and Range Evaluation

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Abstract

Low-power wide-area networks (LPWANs) are gaining the attention of industry due to their potential applications in automotive and intelligent transportation systems, various metering and smart home systems among others. Recently, there are several competing technologies in the market including Sigfox, LoRa and Weightless.

The main features of LPWANs technologies are low consumption of power, low transceiver chip cost and broad coverage. Out of these goals, the two former ones are much easier to attain. Having a base station makes it efficient to move all network complexities to its side. This way, the nodes are made simple and sufficiently affordable for mass production. Reaching the ten years lifetime can be made possible by limiting the number of messages sent each day by every node, even if the range of applications becomes naturally limited.

Despite the traditional wireless sensor networks (WSNs) and LPWANs having much in common, mainly in terms of networks requirements and devices, their approaches have significant critical differences. Firstly, while the traditional WSN employs mesh or ad-hoc topology, the current LPWAN technologies require setting up the base stations (concentrator/gateway) to serve the end-devices. The latter communicates to the base stations only by forming around them a star network. Depending on the technology, the area of coverage of a base station may cover several kilometres, which is never a predetermined parameter.

Consequently, this study focuses on the third problem, connectivity and range evaluation. LoRa technology shall be used, and a set of real-life experiments will be conducted using commercially available hardware. A battery-powered mobile node located on the ground (attached on a 3m tall stand) reporting their data to a base station, will be the main execution of measurements. The main parameter of consideration will be the Received Signal Strength (RSSI). Then, there will also be a presentation of a channel attenuation model derived from the measurement data obtained. In an area similar to the chosen station of study, the model can be used for estimation of the connectivity and range of operation (path loss) in 868 MHz ISM band.

Keywords: LPWANs, WSNs, LoRa, connectivity, range, RSSI, path loss model

Thermal Energy Balance of a Black CTC Tea Factory

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Abstract

Tea processing is an energy intensive process. Approximately 85% of energy input into a kilogram of made tea is thermal energy. Electric energy comes second at about 14% while manpower accounts for 1%. A typical tea factory thermal energy system comprises of steam generator (boilers), steam transmission, distribution and recovery system (pipeline and fittings), and heat exchangers (steam radiators). The primary energy source for steam generation in tea factories in Kenya is biomass in the form of firewood. Briquettes and furnace oil are also significant source of primary energy sources for steam generation. Steam is mainly used to provide process heat in tea withering and drying processes. About 2,400,000 trees are cut down per year to meet the factories thermal energy needs. Considering there are 125 tea processing factories in Kenya, approximately 4.1 million trees are felled every year to meet

their thermal energy demand. Firewood consumption by the tea factories is a significant contributor to deforestation and environmental degradation in tea growing regions of Kenya. Wood plantations plays an important role in sequestration/storage of carbon dioxide by removing it from the atmosphere through photosynthesis process. When trees are felled, the stored carbon in them and in the soil is released into the atmosphere. The increased carbon in the atmosphere contributes to global warming which in turn leads to climate change. It is therefore important to have a fundamental understanding of thermal energy flow of a tea factory. This understanding will reveal opportunities that exist for tea factories to improve their thermal energy efficiency and by extension reduce their consumption of firewood and other primary energy sources such as briquettes and furnace oil. The approach involved defining a tea factory thermal energy system. The factory thermal energy consumption is determined and quantified using energy flow analysis (EFA) method. Environmental inputs such as temperature and humidity associated with tea processing are also evaluated. The tea factory thermal energy system considered is defined with regard to system properties such as mass flow rate, pressure and temperature. Data analysis includes determination of energy inputs and outputs at each stage of energy flow. The empirical data for this study is from a Kenyan tea factory. Finally, thermal energy balances for a tea factory is established using mathematical modelling.

Keywords: *Thermal, Energy, Steam, Firewood, Tea factory, Carbon dioxide*

Use of Doppler Radar Interfaced with ATMEGA16 for Accident Detection and Collision Avoidance in Dedan Kimathi University, Nyeri, Kenya

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The research paper will outline how Doppler radar sensors can be implemented in Dedan Kimathi University to detect accidents and hence avoid collisions. Information regarding speeds, movements of people and distance from other objects shall be availed in the research. The sensors are placed on the neck, back, arms, and chest of the users for the provision of

information regarding objects relative to the Doppler radar sensors. If movement is noted within 8m of the user, the vibration motors send information regarding the object relative to the user of the Doppler Radar. In case the object is moving at a high velocity towards the user, all the motors are activated at a high intensity and a corresponding emergency notification is sent to the user. The primary objective of the research is to reduce the amount of collisions experienced and hence avoid the possibility of accidents occurring. The research hence aims at improving the safety of the users in cases as when a person is walking in a dark alley with minimal to no lighting, they can be notified of moving objects. When walking along a road, the users are notified of bicycles or objects that may be approaching from behind [1]. The exploratory research methodology shall be used for data collection and analysis. It is recommended that the development and implementation of the Doppler Radar Sensors interfaced with the ATMEGA16 shall facilitate safety improvement through accident avoidance.

Keywords: Doppler Radar, ATMEGA16, Accident Detection, Collision Avoidance.

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Elevator System Modelling Focusing on Security Using Digital Twin Approach for Real-Time Monitoring and Control

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Abstract

Real time monitoring and control of non-direct observable systems such as transportation used in buildings and mining operations pose a unique challenge especially during emergency situations, specifically security breaches or natural disasters. During such periods, lack of

adequate information concerning the actual state of the system hinders quick rescue of passengers involved. This is evident from the 489 fatalities experienced globally due to mining accidents since the year 2000. Kenya has also seen a rise in terrorism attacks since the year 2011 with 88 recorded death where terrorism occurred in business and shopping complexes. The ability to observe the real-time location and to remotely control the operations of such system can mitigate such risks, save lives, and improve system efficient. This paper presents the design and implementation of a digital twin model of a 3 floor elevator system. The system was modelled in Siemens NX and programmed via Total Integrated Automation (TIA) portal software. Programmable logic controller (PLC) S7 1200 was used as the hardware to interface Siemens NX and TIA portal. The digital model was programmed to match the normal operations of a typical elevator system used in a commercial or residential building setting. This was done using the OPC (open platform communications) protocol. The resulting digital twin was tested and performed in a manner similar to Mixed Reality (MR) systems, where the virtual system, duplicated actual operations of the physical counterpart through the use of sensor data as opposed to cameras or virtual head-sets are in the cause of Virtual and Augmented Reality systems. The system was taken through performance tests where the time delay between virtual and physical systems operation was observed and found to be less than one second. This result can be improved through the use of operation computers with higher processing power and implementing faster communication channels between the physical system and digital twin.

Keywords: *digital twin, elevator system, real-time monitoring and control, Siemens NX, open platform communication (OPC)*

Evaluation of The Surface Finish of Titanium Alloy, Ti-6Al-4V During Surface Grinding under Different Cooling Techniques Using Vegetable oil-based and Water based Cutting Fluids

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ABSTRACT

Ti-6Al-4V alloy is used widely in biomedical industries and its surface finish is critical in medical components. In this research, the surface finish of medical grade Ti-6Al-4V alloy was evaluated to understand the effects of cutting fluids, cooling techniques, and grinding depth after surface grinding with alumina wheel. Three cutting fluids were applied to the grinding zone using two cooling techniques: minimum quantity lubrication and wet cooling techniques. They were sunflower oil, sunflower oil-based cutting fluid, and conventional cutting oil. The grinding was undertaken at three different grinding depths of 0.005, 0.010, and 0.015 mm to determine the surface roughness of the ground surfaces. The design of the experiment was done using Taguchi L₉ orthogonal array using Minitab 17 software. The surface roughness of the ground surfaces was determined using a surface profiler. The results showed that the lowest surface roughness was obtained in minimum quantity lubrication systems. In terms of cutting fluid type, sunflower oil-based cutting fluid generated the lowest surface roughness. The analysis of the signal-to-noise ratio showed that grinding depth was the most influential input factor on the surface roughness of ground Ti-6Al-4V. The analysis of variance show that the three input parameters individually have no significance statistically on the surface roughness. But through interactions with other input parameters, they influence surface roughness. From the study, it is possible to obtain the good surface finish of Ti-6Al-4V under favourable grinding conditions.

Keywords: *Ti-6Al-4V; Cutting fluids; MQL; Taguchi; Signal-to-noise; ANOVA; surface roughness*

Facility Redesign and Optimization of Printing Press Operations

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Abstract

Printing industry has benefitted from technological advances in the field of automation coupled with advances in storage and retrieval of raw materials, work in progress and finished work. These advances combined with a good printing factory layout maximizes production with minimum investment in new equipment. However, a good factory layout alone cannot achieve the intended objectives unless tightly coupled with production process monitoring and improvement, which entails monitoring of Overall Equipment Effectiveness (OEE) to pinpoint areas of production losses and identify areas of performance improvement. This research focused on carrying out a process and facility layout analysis with the aim of identifying gaps, bottlenecks and challenges in productivity that contributed to poor production throughput and to redesign the layout and optimize the production capacity.

Input variables considered were: number of departments, flow matrix, floor area for each machine, design speed, actual speed, losses and rate of failure. Output variables were: dual graph and layout proposition, availability, performance, Quality, OEE. The facility layout add-in that implements the Computerized Relative Allocation of Resources (CRAFT) was used for layout redesign. ARENA was used, for the design of experiment (DoE), simulation, analysis, and optimization. Pareto chart was developed using Minitab statistical software. The Pareto analysis established that 69.6% of the distance covered was taken up by movement between machine and store and 78.2 % of the print volume was taken up by three printing machines, (Web, Print master and Speed master). Failures, breakdowns and setup times were found to have a less significant effect on the performance and hence OEE of the factory. The quality of paper affected breakdowns for the web whereas run speed significantly influenced the overall performance and OEE. The optimal conditions obtained at about 80% of design speed of each machine that gave OEE of 79% for 3 critical machines and 68% for all five printing machines (only three machines were considered for optimization). Experimental output values obtained during validation were Web printer at 130,000 runs per day (without auto- splicing), Printer master (PM) and Speed master(SM) printers at 70,000 each at runs per day. These results were closer to the software results since some changes in storage location and automation were not yet put in place. The contribution of this research emphasizes the need for government institutions to run production facilities like businesses and to operate basing on industry best standards. In practice the contribution to knowledge is the application of engineering

knowledge to solve industrial problems in a fast and cheap way by use of modern computer based tools.

Keywords: ARENA, CRAFT, Optimization, OEE, Printing, Simulation

HEALTH SCIENCES AND COMMUNITY DEVELOPMENT

Medical Device Integration with Electronic Health Records: A Case Study of University of Nairobi Health Services

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Medical devices provide invaluable information to clinicians on a patient's illness, making them a crucial component in the provision of safe, effective and efficient patient care. Traditionally, in most medical devices data has been secluded in silos, with every device having incompatible data formats, unique physical connections and dedicated communication protocols. Largely most of these devices are not integrated with hospital electronic medical record systems with output information stored in the device or presented and kept in the form of paper reports. In this study, we describe a demonstration in which available Electronic Medical Records system (EMR) was successfully integrated with a wireless Blood Pressure Monitor (BPM). This was implemented by adopting the use of RESTful Application Programming Interface (API) technologies and commonly established standards designed for medical devices interoperability. Before deploying the prototype, we conducted pilot tests at the University of Nairobi, nursing station to get feedback on the time spent using the conventional blood pressure data capture methods and the newly integrated application. Clinical data from the device was exchanged adhering to the HL7/XML standard communication protocol. There was a measurement differential in time for conventional system used and the integrated medical device solution. The duration the blood pressure cuff was on the patient was an average of 123 seconds before the integration and 83 seconds after integration. Additionally, there was an observable substantial reduction in the average time that the medical assistant spent at the intake section from 370 seconds before the medical device was integrated and an average of 240 seconds after the integration. The findings indicate a positive outcome was availed on the time taken for the blood pressure readings, time spent by the patient at the nursing station, doctor's time to search the patients' blood pressure readings as well as the data accuracy fed in the EMR system.

Keywords: *EMR, BPM, Interoperability, RESTful, HL7/XML*

Performance of a Fused Machine Learning Model for Smart Health Care in MANETS.

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Abstract

Mobile Ad-Hoc Networks (MANETs) are prevalent in provision of smart healthcare. The smart devices in MANETS aid in monitoring health like high blood pressure, high cholesterol levels and various heart conditions and cardiac misnomers like syncope, third murmurs and atrial fibrillation. These irregularities that cause mysterious fainting, unexplained stroke, heart palpitations and atrial fibrillation need to be monitored remotely, accurately and effortlessly. However, the growth and provision of MANET based smart healthcare monitoring has faced various security obstacles, primarily security. The characteristic mobility of these health monitoring devices as well as their inherently dynamic network topology, causes the connectivity structure to change frequently and unpredictably. The available security approaches and techniques however fail to capture and take account the physiognomies of MANETs; mainly low processing power, miniature memory and inadequate processor. In the intervening time, usage of MANETs in the provision of smart healthcare is expanding and the inherent risks snowballing. Attacks aimed at MANETs are increasing to an alarming extent. This study employed a fusion of machine learning techniques through both simulation and a running prototype to achieve a more resilient intrusion detection system. The study was implemented and evaluated on a MANET environment on both Linux NS 2 and further implemented on a network of Smart wearable devices and Raspberry Pi. Traffic generated within the network was imported for supervised learning, and thereafter tested for purposes of evaluating the ability to identify similar anomalous activity. The results showed that it is possible to improve intrusion detection for such networks by fusing machine learning algorithms and identifying anomalous activity within a MANET ubiquitously.

Keywords: MANET, Smart Healthcare, Intrusion Detection Systems, Machine Learning, Fused.

Comparative Study on Effect of Holistic Marketing on Performance of Dairy Industry in Rift Valley and Central Regions of Kenya
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Abstract

The purpose of the study was to evaluate the effect of holistic marketing orientation on performance of dairy industry in Kenya. Studies have been conducted but none has, on effect of holistic marketing in dairy industry. Kenya dairy industry has been experiencing several challenges in its operation, among them, low quality and quantity of milk, high cost and waste along the production value chain, Poor access to both domestic and export market, poor terms of trade for dairy farmers, high cost of inputs and unfair competition amongst processors. The study objective was to evaluate the effect of holistic marketing on performance of dairy industry in Kenya. The study was anchored on system and Partial theory of holistic firm. Descriptive research design was adopted for the study. Purposive sampling technique was used as the study guide. The study population was 154, comprising a census of 14 managers of dairy processing firms in Rift valley and Central region of Kenya and 140 dairy farmers categorised as 10 highest milk supplying farmers to each of the 14 dairy processors. Separate self administered questionnaire for 140 dairy farmers and 14 general managers of the processing firms was used to collect data. Correlation of variables; multiple linear regression and overall analysis of variance were computed. Pearson's correlation index showed that both farmers and dairy processors holistic marketing variables were correlated. All holistic marketing variables were correlated with performance variable, the dependent variable. Social responsibility and discretionary effort for processors had a negative correlation coefficient of – 0.63 and -0.93 respectively while all the other independent variables had positive coefficient values. In comparison the dairy farmer's coefficient values were negative apart from discretionary effort with the coefficient value of 0.29 .P value was used to determine the

significance of variables. A p value of a variable 0.05 or less was considered significant. The farmer's independent variables were not significant apart from discretionary effort with a p value of 0.00068, comparatively; the processor's independent variables were significant. The ANOVA computed F value for farmers, was 0.02 and for dairy processors 0.03. Comparatively there was an overall significant relationship between both the processors and farmers explanatory and response variables. The study conducted showed that comparatively, the dairy farmers were not interested or were ignorant about the holistic marketing practices while the dairy processors were aware and implemented holistic marketing management practices. However the dairy processors considered social responsibility as an expense and an addition to cost hence avoiding it resulting to the negative coefficient value. Both dairy farmers and processors require training in Implementation of holistic marketing in the dairy business as the study found it rewarding.

Keywords: *Holistic marketing, Relationship marketing, Internal marketing, integrated marketing, Social responsibility, Discretionary effort, Performance*

The freeze-dried extracts of *Rotheca myricoides* (Hochst.) Steane & Mabb possess hypoglycemic, hypolipidemic and hypoinsulinemic on type 2 diabetes rat model

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Ethnopharmacological relevance: *Rotheca myricoides* (Hochst.) Steane & Mabb is a plant species used in traditional Medicine for the management of diabetes in the lower eastern part of Kenya (Kitui, Machakos and Makueni Counties, Kenya) that is mainly inhabited by the Kamba community.

Aim: This study investigated the antihyperglycaemic, antidyslipidemic and antihyperinsulinemic activity of the freeze-dried extracts of *Rotheca myricoides* (Hochst.) Steane & Mabb (RME) in an animal model of type 2 diabetes mellitus.

Methods: Type 2 diabetes was induced by dietary manipulation for 56 days via (high fat- high fructose diet) and intraperitoneal administration of streptozocin (30mg/kg). Forty freshly-weaned Sprague Dawley rats were randomly assigned into the negative control (high fat/high fructose diet), low dose test (50mg/kg RME), high dose test (100mg/kg RME) and positive control (Pioglitazone, 20mg/kg) groups. Fasting blood glucose and body weight were measured at weekly intervals. Oral glucose tolerance tests were performed on days 28 and 56. Lipid profile, hepatic triglycerides, fasting serum insulin levels and serum uric acid were determined on day 56.

Results: The RME possessed significant antihyperglycemic [FBG: 6.5 ± 0.11 mmol/l (negative control) vs. 4.62 ± 0.13 mmol/l (low dose test) vs. 5.25 ± 0.15 mmol/l (high dose test) vs. 4.33 ± 0.09 mmol/l (positive control): $p < 0.0001$] and antihyperinsulinemic effects [1.84 ± 0.19 (negative control) vs. (0.69 ± 0.13) (low dose test) vs. (0.83 ± 0.17) (high dose test) vs. (0.69 ± 0.10) (positive control): $F(3, 36) = 0.6421$; $p < 0.0001$]. The extracts also possessed significant antidyslipidemic effects [LDL levels: 3.52 ± 0.19 mmol/l (negative control) vs. 0.33 ± 0.14 mmol/l (low dose test) vs. 0.34 ± 0.20 mmol/l (high dose test) vs. 0.33 ± 0.01 mmol/l (positive control): $p < 0.0001$]. RME significantly lowered plasma uric acid levels, as well as hepatic triglycerides and hepatic weights.

Conclusions: The freeze dried extracts of *Rotheca myricoides* possessed significant antihyperglycemic and antidyslipidemic effects. In addition it lowered serum uric levels, as well as hepatic triglycerides and hepatic weight. These results appear to validate the traditional use of this plant species in the management of diabetes mellitus.

Keywords: Type 2 diabetes, Antihyperglycemic, Antihyperinsulinemic, Streptozocin

**AGRICULTURAL SCIENCES AND TECHNOLOGIES FOR SUSTAINABLE FOOD
AND NUTRITION SECURITY**

***Effect of Soaking and Thermal Treatment on Common Beans Pectic
Polysaccharides in relation to the Hard-To-Cook Defect***

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The importance of common beans (*Phaseolus vulgaris*) in addressing food insecurity and protein energy malnutrition cannot be underestimated. However, their utilization is hampered by development of the hard-to-cook (HTC) that is accelerated by elevated storage conditions of temperature (>25°C) and relative humidity (>65%). Although the HTC defect has been studied, detailed molecular insight is incomplete. Therefore, the aim of this research was to gain detailed mechanistic insights into changes occurring during storage and soaking, whether or not followed by a thermal treatment, on common bean pectic polysaccharides in relation to the development and manifestation of the HTC defect. Both fresh or easy-to-cook (ETC) and stored (HTC) bean samples were either soaked or soaked and thermally treated in demineralized water, solutions of Na₂CO₃ and CaCl₂ salts followed by extraction of cell wall materials. The Pectic polysaccharide properties determined included solubility in different solvents, galacturonic acid content, neutral sugars content, degree of methylesterification (DM) and molar mass (MM) distribution. Specifically, the polysaccharides were fractionated into water extractable pectin, chelator extractable pectin, Na₂CO₃ extractable pectin and a hemicellulose fraction. Spectrophotometric methods were used for determination of galacturonic acid content and the DM, while high-performance anion exchange chromatography and high performance size exclusion chromatography coupled with multi angle light scattering and refractive index detection were used for determination of neutral sugars content and MM distribution respectively. The DM of pectin from ETC and HTC beans was similar but low (<50%). Fresh Canadian Wonder beans in general had a good cooking quality; however, soaking and thermal treatment in a Na₂CO₃ solution further improved the quality while treatment in a CaCl₂ solution decreased the quality. The poor cooking quality exhibited by stored beans was improved by soaking and thermal treatment in a Na₂CO₃

solution, while treatment in a CaCl_2 solution hindered softening. With regard to molecular changes, soaking followed by thermal treatment in different brine solutions revealed that thermally induced solubilization of pectic polysaccharides is a key factor in influencing the cooking quality of beans. Treatment in a Na_2CO_3 solution increased the amount of loosely bound pectin (WEP) while on the other hand, it decreased the amounts of strongly bound pectins (CEP and NEP) for both fresh (ETC) and stored (HTC) beans. Therefore, it can be inferred that development of the hard-to-cook defect in Canadian wonder beans during storage and its manifestation during soaking and subsequent thermal treatment is largely reflected by the pectic polysaccharide properties in line with the pectin hypothesis. The results points at the release of Ca^{++} leading to pectin cross-linking and the increase or decrease of β -elimination depolymerization. However, the relatively high amounts of neutral sugars and strongly bound NEP in HTC seeds do not allow to rule out the possible existence of non- Ca^{++} based pectin cross-linking.

Keywords: Beans; Hard-to-cook; Storage; Soaking; Thermal treatment; Pectic polysaccharides.

Integrated Effect of Rhizobium Inoculation and Phosphorus Application on Tissue Content, Symbiotic and Phosphorus Use Efficiency in Soybean Production

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Abstract

Soybean (*Glycine max*) is an important legume crop that is cultivated all over the world as livestock feed, food for human consumption, soil fertility improvement and industrial products such as candles and paints. However, Nitrogen (N) and phosphorus (P) nutrient have been attributed to the decline in soybean yields. Furthermore, scanty information is documented on P-efficient soybean genotypes, which are a sustainable P management strategy for enhancing symbiotic efficiency (SEF) and phosphorus use efficiency (PUE). As a solution, field experiment was conducted at Chuka University farm to evaluate the integration effect of rhizobium inoculation (R) and P on tissue nutrient content, SEF and

PUE in soybean production in Meru South Sub County. Two cultivations (Trial I and II) were done in 2018. Treatments included; three rates of R (0, 100 and 200 g ha⁻¹), three rates of P (0, 20 and 30 kg ha⁻¹), either applied alone or integrated and soybean genotypes (SB19 and SB24). Both Trials were laid out in a randomized complete block design in split-split plot arrangement with each treatment replicated thrice. Genotypes were assigned main plot, R subplots and P in sub-subplots. Data collected was subjected to analysis of variance using the Scientific Analysis System SAS and significantly different means separated using Tukey test at (p 0.05). The results showed significant difference in N and P tissue content, SEF and PUE for SB19 and SB24 genotypes in both Trials at (p 0.05). The highest N tissue content of between 1.73% and 9.10% was observed when integration of R and P were applied at the rate of 200 g and 30 kg for SB19 and SB24 in both Trials. While R and P at the rate of 200 g and 30 kg per ha showed the highest P content of between 849.6 ppm and 955.0 ppm in both Trials. The highest SEF recorded was 207% and 261%, and 201% and 227% in Trials I and II, respectively. The PUE was highest when R and P was applied at the rate of 200 g and 30 kg per ha for SB19 and SB24 soybean in both Trials. Integration of R and P at the rate of 200 g and 30 kg ha⁻¹ and adoption of either SB19 or SB24 showed a potential in enhancing soybean cultivation.

Keywords: *Genotypes, phosphorus use efficiency, symbiotic, Tissue content.*

Challenges and potential opportunities for mitigation of food fraud in Kenya

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Abstract

Food fraud refers to deliberate and intentional substitution, addition, tampering or misrepresentation of food, food ingredients or food packaging, labelling, product information or false or misleading statements made about a product for economic gain that could impact consumer health. Most consumers in Kenya are vulnerable to risks of food fraud due to lack of knowledge of their existence and how to use simple techniques of detection. The most commonly adulterated foods include milk, sugar, honey, cereal grains and flour, cooking oil

tea leaves, salt, ice cream, coconut oil spices, meat and meat products, wine, jam, pulses, cloves, tomato sauce, ghee, coffee, and vegetables. Kenya's Anti-counterfeit Agency (ACA) estimates that at least 20% products sold in major Kenya towns are counterfeit thus a counterfeits are a major impediment to growth of the manufacturing sector which is key to attainment of targets in employment creation, and food security. The Standards and Regulatory committee of Kenya Association of Manufacturers (KAM) estimates counterfeit and substandard products cost East Africa over \$500 million in tax revenue annually. Other impacts of food fraud include loss of brand value which encompasses quality, efficiency, health and safety concerns in the food supply value chain. In this paper we discuss the challenges and potential opportunities for mitigation of fraud in Kenya as a strategy towards attainment of key components of the 'Big 4 agenda' on promotion of manufacturing and food and nutrition security in Kenya.

Keywords: *food fraud, adulteration, counterfeit, Big 4 agenda*

Differential Response of Nerica Yield to Irrigation regimes in Mwea irrigation scheme, Kenya

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Mwea is water-stressed due to the drying effect of global warming, thereby limiting rice production. An experiment was therefore carried out in two cropping seasons between 2016 and 2017 to determine the yielding of two Nerica cultivars under the effect four irrigation regimes. The design adopted was RCBD on split plot arrangement replicated thrice, where variety was the main plot and the irrigation regime was the sub-plot. Results depicted significant effect ($P \leq 0.05$) on 1000-grain weight and unproductive tillers in season 1 and 2 respectively. The 1000-grains were weightier at every three days' regime (55.92 g per hill), with Nerica 4 and less weightier at weekly regime (41.0 g per hill). Similar findings were reported by Ishmael *et al.* [1] who saw a correlation of 1000-grain weight in rice and soil-moisture conditions. Increased unproductive tillers was produced in Nerica 11 (2 tillers per

plant), therefore showing an inverse correlation with grain yield, signifying superiority of Nerica 4 (1.0 tiller per plant) over Nerica 11 [2]; [3].

It was further observed that the irrigation regimes did not significantly affect shoot biomass, root biomass, panicles, filled grains, productive tillers, net plot grain weight, and grain yield. However varietal differences revealed that Nerica 11 produced higher shoot biomass, root biomass, panicles, filled grains and productive tillers, whereas Nerica 4 recorded higher net plot grain weight and grain yield. Further, weekly irrigation regime positively influenced grain yield as was reported by Grigg *et al.*, [4] that, there was no reduction in yield under water-saving moisture stressed soil conditions. This is a confirmation of the research reports by IRRI [2]; Africa Rice Center [3]; Atera *et al.*, [5], that water-deficit conditions in this research yielded optimally beyond the expected. It was therefore inferable that, Nerica 4 optimized yield on weekly irrigation regime (8.42 tons/ha), and so recommended to farmers in Mwea irrigation scheme for adoption for optimum yields.

Keywords: *Mwea, irrigation regime, rice, Nerica, variety, yield*

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Relative Contribution of Farm Inputs and Activities to the Productivity of Coffee

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Abstract

A cooperative society is an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through jointly owned and democratically run enterprises. Cooperatives are formed by members when the market place fails to provide the needed goods and services of acceptable quality at affordable prices. Many of cooperatives in Africa have faced decline in performance since 1980s as a result of the structural Adjustment programmes championed by the World Bank and the International Monetary Fund. In Kenya the programmes saw the government withdraw its influence and controls of the cooperatives. In Kenya the coffee cooperatives suffered a double tragedy; besides the ill-timed liberalization, the International Quota System that ensured stable coffee prices collapsed leading to very low prices. This led to decline in coffee production from 138000 tonnes in 1987 to 38000 tonnes in 2009. The entrepreneurs and innovators need to come up with a way of helping bring the cooperatives sector to its past glory. To help recover from the decline the cooperative management need an environment that is conducive - management of cooperatives is one area that needs improvement. Studies carried out in the cooperatives show a lot of management incompetence and general lack of suitability. This article highlights how weighted voting could be used to improve the management commitment to the cooperatives. It has two objectives; to assess the importance of management in cooperative societies and to evaluate the applicability of weighted voting to improve the quality of management of coffee cooperative societies. The study was conducted in Muthithi Coffee Farmers' cooperative society in Murang'a County, Kenya. It was concluded that weighted voting would improve the management commitment in the coffee cooperatives.

Keywords: *Weighted voting, cooperative, dictator, dummy, Banzhaf index*

Effect of Harvesting Stages and Nitrogen Fertilizer on Seed Quality and Yield of Jute Mallow in Kenya

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Abstract

Production of high quality seeds in African Leafy vegetables has not been practiced due to varying reasons including incorrect harvesting stages and poor agronomic practices like incorrect fertilizer rates. Jute mallow pods do not ripen simultaneously and appropriate time of seed harvest ensures maximum seed quality attributes of purity, germination and vigour. Farmers in Kenya plant seed from Jute mallow whose quality potential is not ascertained. The study sought to investigate effect of harvesting stages and nitrogen fertilizer on seed quality and yield of Jute mallow morphotypes. Four Jute mallow morphotypes (GEMS, GLMT, BEMS, BLMT) were planted at two sites of University of Eldoret and Kenya Agriculture and Livestock Research Organization, Kitale using Randomly Complete Block Design with three replicates and three nitrogen fertilizer levels (0, 60, and 120kg/ha). Five plants were randomly tagged per plot and seed harvested at three maturity stages of green, tan and black and seed quality test of purity, germination and vigour done and analyzed as per International Seed Testing Association, (2004) and means separation done by DMRT at p 0.05. Results showed harvesting stage maximizing on seed quality attributes of analytical purity was highest at tan stage (99.9%) on 120kg/ha N fertilizer by BLMT Morphotype and lowest at black stage (99.4%) on none fertilized GEMS and BEMS morphotypes. Germination was highest (92.9%) at tan stage from morphotypes GEMS and BEMS on 120kg/ha N fertilizer and lowest was at black stage (59.5%) by BEMS Morphotype on 0kg/ha N fertilizer. Highest seed vigour (93%) was at tan stage by GEMS and BEMS on 120kg/ha N fertilizer and lowest was black stage 59% by BEMS Morphotype on 0kg/ha N fertilizer. The lowest E.C. ($0.04 \mu\text{Scm}^{-1}\text{g}^{-1}$) was by Tan stage seed by GEMS and BEMS morphotypes on 120kg/ha N fertilizer and highest E.C being at black stage of $2.7 \mu\text{Scm}^{-1}\text{g}^{-1}$ by GLMT Morphotype on 0kg/ha fertilizer. It is concluded that best agronomic practices of Jute mallow seed be harvested at tan stage coupled with N fertilizer use for high quality seed and yield.

Key words: *Harvesting, Jute mallow, seed quality*

Soaking Coffee (Coffea Arabica L.) Cherries Negatively affects the Biochemical Composition and Cup Quality of Coffee Brew

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Abstract

During the peak harvest season, most coffee processing factories may lack sufficient capacity to process coffee cherries. Such processing delays lead to undesirable fermentation affecting the quality of the coffee. Soaking of coffee cherries may be adopted in an attempt to preserve the cherries but information on the effects of this practice on chemical composition and sensory quality of coffee is limited. This study aimed at determining the biochemical composition and cup quality of soaked coffee cherries, for a period of seven and ten days with daily change of soaking water and without change of soaking water with the control being freshly processed coffee cherries. The levels of caffeine, chlorogenic acids, sugars and trigonelline were determined by HPLC methods. The cup quality was determined by the use of 3 trained coffee cuppers. The results of this study showed that soaking of coffee cherries did not have significant variations in the level of trigonelline, chlorogenic acids, caffeine and sucrose. The levels of trigonelline ranged between 0.88-1.15 %, chlorogenic acid 6.71-8.13%, caffeine 1.04-1.13% and finally sucrose 5.67-6.60%. The results of sensory analysis revealed significant variations ($p < 0.05$) in terms of raw bean color, flavor and class of the coffee brew. In terms of quality, coffee samples obtained from freshly processed coffee cherries scored the highest at 4.78 (fair to good quality). Discrimination function analysis placed the freshly processed coffee cherries further distinctively from other treatments thus yielding the best quality.

Keywords: *Chemical composition, coffee cherries, cup quality, soaking.*

PERCEPTION AND ADOPTION LEVEL OF URBAN HORTICULTURE TECHNOLOGIES, NAIROBI COUNTY, KENYA

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Abstract

Urban and peri urban areas face numerous challenges such as food insecurity, inadequate basic services, air pollution, insufficient water supply, waste-disposal problems and high population. An investigation was done to evaluate the main socioeconomic factors significantly determine the farmers' decision for adoption of horticultural practices and how knowledge transfer influence urban horticulture. A sample of 580 respondents was used, 138 in Kasarani, 195 in Mathare and 247 in Kibera. Data was collected by use of Questionnaires and observations. Social and economic characteristics such as accesses to space, access to information, business management and governance data was collected. Frequencies and percentages were used to analyze the data using Statistical Package for Social Sciences (SPSS). The chi –square was used to differentiate different groups and conclusions. The most common vegetables among urban respondents in order of prevalence were kales, Spinach, Onions and Amaranth while pepper was the least common. About 70% of surveyed farmers mentioned the source of food as the main reason for adoption of urban horticultural technologies. With respect to space identified for farming, over 20% of the farmers mentioned along the road strips. More than 65% of the respondents were female. About six different modes of Technology transfer were identified and the most common was authority. The study also shows that there is positive relationship between age in peri-urban respondents and technology transfer while there was a negative relationship between education level and technology transfer at 95% level of confidence, statistical test.

Keywords: *urban and peri urban farmer, horticultural technologies, food insecurity*

Assessment of Rhizobia Strains Isolates of Soils around Lake Victoria Basin for their Effectiveness in Nodulation and Symbiotic Efficiency on Soybeans and Bambara Groundnuts

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Abstract

The symbiotic Biological nitrogen fixation (SBNF) is a sustainable and low-cost alternative to expensive and inaccessible inorganic fertilizers. However, SBNF is underutilized in soils of Lake Victoria basin due to insufficient information on local rhizobial strains diversity and their N-fixation efficiency. This study was carried out to assess the effectiveness of rhizobium strains isolates of Kisumu, Port Victoria, Kendu bay and Karungu soils within Lake Victoria basin in nodulation and symbiotic efficiency on soybeans and bambara groundnuts. Two bambara seeds of groundnut landraces; Kakamega Cream (KAKC) and Busia Brown (BUSB) used in this study were collected from farmers in Kakamega and Busia counties respectively. Screen house experiment was performed at Kenya Forestry Research (KEFRI) in plastic pots with four seeds of each cultivar which was later thinned to two plants. Randomized Complete Block Design (RCBD) was used. Experiments data were subjected to analysis of variance (ANOVA) using Genstat 16th Edition and significant means separated using Least Significant Difference at [LSD5%] and Dancun Multiple Range Test (DMRT). Result indicated highly significant ($p < 0.05$) effect of isolate inoculation on number of nodules per plant. Soybean Variety SB19 formed effective nodules with rhizobia in the genera Bradyrhizobium, Rhizobium and Agrobacterium. On the other hand, 'Safari' was quite selective and formed very few nodules with isolates identified as Bradyrhizobium. However, both varieties SB19 and 'Safari' had better growth under glasshouse inoculation with Bradyrhizobium spp., rhizobia isolates although one Rhizobium isolate (SoyKis1) resulted in good nodulation of both varieties. Seed treatment of the two legumes with some isolates resulted in improved nodulation and better plant growth; in some instances, outperforming the commercial strain *Bradyrhizobium japonicum* USDA110. In conclusion, Isolates BAMKis12, BAMKis8, BAMKis4, BAMKbay8 and SoyKar2 were found to be potential elite strains and are recommended for more host range tests as viable inoculants sources.

Keywords: *Rhizobium, Nodulation Effectiveness, Soybeans, Bambara Groundnuts*

Evaluation of Suitability Human Solid Waste from Green Toilet System as Fertilizers for Agricultural Use.

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Abstract

Unabating exponential rise in world human population, Kenya not spared, has posed a major challenge in waste generation and its subsequent accumulation. The problem is far reaching in poor and developing nations in South East Asia and Africa that have no proper systems for recycling and safe use of the high volume of human waste filling open landfills. This has led poor farmers to use raw sewage to irrigate their farms, exposing both the human and animal population to harmful pathogens in the raw waste water. The use of human fertilizer for agricultural production has been safely and successfully applied in organic farms in developed nations like England and Japan in a bid to reduce dependence on synthetic fertilizers that are harmful to the environment. Green Toilet System was developed and used to destine solid and liquid human wastes to different collection points with negligible or zero contact. This study took advantage of the high volume of human waste being generated and use it to prospect for fertilizer safe for agricultural production. The study therefore identified, isolated and characterized microorganism and parasites colonizing the human solid waste, followed by determining the presence of heavy metals in the human solid waste. This study used biochemical techniques for isolation, biochemical and molecular characterization of the microbial community in the waste. Formal ether sedimentation technique was used to identify parasites. Mineral nutrients in the compost and raw waste was analyzed using atomic absorption spectrophotometer (AAS) and atomization for the case of mercury for comparison with the inorganic fertilizers. The physiochemical characteristics were determined using glass electrode pH meter and conductivity meter for the pH and conductivity respectively. The compost temperature, colour, structure, and odour were determined at the decomposition site. Heavy metal and minerals data was analyzed using SPSS. Molecular characterization results

were analyzed using bioinformatics tool for multiple sequence alignment tool and CHROMAS pro to draw the phylogenetic tree. The findings of this work are expected to guide research in determining the safety of human waste compost as fertilizer for agricultural and the efficacy of using biotechnology to enhance the decomposition of human waste into fertilizer.

Keywords: *population explosion, human solid waste, diseases, Green Toilet System, microbial progression, molecular characterization, heavy metals, micro and macro nutrients.*

Determination of Effect of Media Type and Temperature on Pathogenicity Isolates of Sorghum Exserohilum Turcicum (Pass.) Leo. and Suggs in Tharaka Nithi County, Kenya

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Abstract:

Development of *E. turcicum* is influenced by factors such as light, temperature, dew period, plant age and inoculums concentration. Tharaka Nithi County has heterogenous climate including temperature ranges. The heterogenous temperature among other condition may influence growth development and virulence of TLB pathogen thus negate the region's potential for high sorghum production. The knowledge of the effect of heterogenous temperature such as that of Tharaka Nithi and media type on the development of TLB pathogen is scanty. The current study attempted to determine the effect of temperature and media type on growth of *E. turcicum* isolates from different regions of Tharaka Nithi County. Five isolates initially isolated on PDA was subjected to different temperatures and different media types at the laboratory at Chuka University. Study design was complete randomised design. Data on effect of temperature and media type was analysed using General linear model on SAS software version 9.4 and significantly different means separated by LSD at 5% probability level. Effect of temperature and media type showed statistically significant differences for the growth and development of *E. turcicum* ($Pr < 05$). Corn meal agar with

mean of 4.233 was the best growth media followed by Malt extract agar at 3.32. The best temperature was found to be 30 °C. Future studies involving TLB pathogen from Tharaka Nithi county should in cooperate wider environmental factors.

Keywords: *Incidence, Severity, TLB, Sorghum, Tharaka-Nithi, Kenya*

Incidence and Severity of Turcicum Leaf Blight Caused by Exserohilum turcicum (pass.) Leonard and Suggs) on Sorghum Populations in Different Regions of Tharaka Nithi County, Kenya

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Abstract

Sorghum [*Sorghum bicolor* (L.) Moench] is a drought tolerant food crop preferred by subsistence farmers in dry areas which experience low annual rainfall. However, Turcicum Leaf Blight (TLB) caused by *Exserohilum turcicum* has threatened sorghum production in the world. New sorghum varieties have been introduced into the Kenyan production systems, including the drier parts of Tharaka Nithi County to boost yield and thus meet the increased demands for food and as a raw material by brewing industries. Nonetheless, challenges due to infection by TLB have negatively impacted on sorghum production resulting from damaged photosynthetic leaves. This study was conducted to determine the incidence and severity of TLB on sorghum populations in different regions of Tharaka Nithi County. Sorghum farms in eleven villages for the study were selected by multistage random sampling. The study was conducted between the month of January and June 2018. Data analysis was done by SAS software version 9.4 and significantly different means separated using LSD test at 5% probability level. There was statistically significant difference in the severity and incidence of *E. Turcicum* leaf blight on sorghum population from different regions in Tharaka Nithi County ($P < 0.05$). Disease TLB occurred in all the villages surveyed though at different frequencies. The disease incidence was higher at Kithaga, and Nkairini recording 74.45% and 55.93% and

lowest at Gatuntu and Gituntu both recorded the disease incidences 12.22%. Thus, farmers should be educated on sorghum TLB management for increased sorghum production and higher income to farmers.

Keywords Incidence, Severity, TLB, Sorghum, Tharaka-Nithi, Kenya

Goat Manure-Based Vermicompost Effects on Soil Properties under Garlic Production in Meru South and Manyatta sub-counties, Kenya
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Abstract

Majority of farmers in the Eastern region of Kenya mainly apply chemical fertilizers to boost crop yields. Continuous use of chemical fertilizers causes several adverse effects such as P-fixation, volatilization of essential nutrients and leaching that affect safety of groundwater and agricultural environment. Hence, the effects of goat manure-based vermicompost on soil chemical properties under garlic were evaluated in PCEA Nkio secondary school, Meru South sub-county and KALRO Embu horticultural field, Manyatta sub-county; from 2018 to 2019. The experiment was laid out in a randomized complete block design and replicated thrice. The treatments were; goat manure-based vermicompost applied at five levels (0, 5, 10, 20 and 30 t ha⁻¹), NPK 17-17-17 at 200 Kg ha⁻¹ and goat manure (30 t ha⁻¹). Soil sampling and analysis were done on entire sites before planting and after harvesting of garlic on each experimental plot. The results showed that application of goat manure-based vermicompost had statistically significant difference ($p < 0.05$) on soil chemical properties. Application of 30 t ha⁻¹ goat manure-based vermicompost showed significantly ($p < 0.05$) higher soil pH (8.00), total N (0.606%), available P (21.933 ppm) and exchangeable K (0.863 Cmol Kg⁻¹) than control treatment that had pH (6.59), total N (0.043%), available P (4.670 ppm) and exchangeable K (0.456 Cmol Kg⁻¹) at Chuka. A similar trend was observed in Embu where vermicompost gave significantly higher soil pH (7.91), total N (0.563%), available P (21.053 ppm) and

exchangeable K ($0.710 \text{ Cmol Kg}^{-1}$) compared to control which had pH (6.54), total N (0.030%), available P (4.596 ppm) and exchangeable K ($0.343 \text{ Cmol Kg}^{-1}$). Hence, the results of this experiment revealed that addition of goat manure-based vermicompost enhanced soil chemical properties leading to improved garlic productivity.

Keywords: *Garlic, goat manure, vermicompost, soil chemical properties*

Characterization, Incidence and Severity of *Solanum lycopersicum* Bacterial leaf spot Caused by *Xanthomonad* species in Farms in Wanguru, Mwea, Kirinyaga County, Kenya

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Abstract

Demand for tomato has increased tremendously but its production has been bedeviled by phytopathogens such as bacteria leaf spot. Studies have reported cases of bacteria leaf spot associated with tomato losses in many tomato production regions globally. However, despite persistent of tomato diseases in different agroecological regions in Kenya, there is scanty information on incidences and severity of individual diseases. This study was done to determine the incidence and severity of bacteria leaf spot of tomato in Wanguru in Mwea, Kirinyaga county in Kenya between February and April 2019. A total of ten tomato farms were selected randomly for the surveyed of incidence and severity bacteria leaf spot. From these ten farms, a total of 3000 tomato leaves in 100 tomato plants were assessed. Severity was scored by rating on a scale of 0 – 5. Data collected was subjected to analysis of variance using SAS software version 9.3 and significant means separated using least significance difference (LSD). Results showed that bacterial leaf spot incidence and severity was significant ($p < 0.05$). Bacteria leaf blight was observed in all farms but at lower rates. However, the incidence was below 15% with farm 7 recording mean of 13%. The lowest incidence was observed in farm 3 and 5 recording 8.33%. Severity observed in all the farms was below 35% with farm 7 recording severity mean of 33.33% while farm 5 recorded

lowest severity mean of 16.00%. The colonies isolated from the infected leaves were generally yellow on the surface of nutrient agar. Results of differential staining showed gram negative rods while biochemical tests slightly varied. Based on totality of cultural, morphological and biochemical tests results, we concluded that *Xanthomonas campestris pv vesicatoria* is responsible for leaf spot tomato disease in Wanguru. However, we recommend the inclusion of molecular tool for proper identification. This study therefore reports the incidences and severity of bacteria leaf spot caused by Xanthomonads species complex though at lower rates. The study should be extended to other tomato production areas in Mwea.

Key words: Incidence, Severity, Tomato_Leaf_spot, Wanguru, Mwea

Effect of Maize-Cowpea Cropping patterns on Soil Moisture Conservation in Meru and Tharaka Nithi Counties

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Abstract

Given the frequent drought pressure caused by the unpredictable and limited precipitation concurrent with global climate change, highly efficient cultivation technologies have been increasingly recognized by various levels of scientific communities. Maize (*Zea mays* L.) based intercropping systems are widely practiced in Kenya, but only a few studies have focused on cowpea (*Vigna unguiculata* L.) as the companion intercrop. This two site study was conducted during the 2018 long rains of March-April at the Kenya Agricultural and Livestock Research Organization (KALRO) Igoji research station and Magutuni in Meru and Tharaka-Nithi Counties Respectively. The objective of the study was to assess the effect of incorporating cowpea into the maize production pattern on crop cover and soil moisture content (SMC). Randomized complete block design was used in the experiment with three replications in 3 x 4 m plots. The treatments comprised of pure maize stand (T1), maize

intercropped with inoculated cowpea (T2), maize intercropped with non-inoculated cowpea (T3) and pure non-inoculated cowpea (T4). A generalized linear model (GLM) was used to determine the effects of cropping patterns on ground cover, leaf area index and soil moisture content, using Genstat 19th edition. Means were separated using Fischer's protected least significant difference (LSD) test, with differences considered significant at $P = 0.05$. Significantly higher (82%) crop cover was exhibited at kernel development stage in T2 compared to 78, 64 and 53% in T3, T4 and T1 respectively. Similarly, the highest SMC was recorded at kernel development stage: 210.3, 209.3, 200.2 and 196.4 mm in T2, T3, T4 and T1 respectively. Relative to (T1 and T4), (T2) recorded the peak LAI of 3.75 at 70 DAP at Igoji and 3.16 at 63 DAP in Magutuni. The study showed that cowpea is a promising legume crop that could be integrated into maize cropping patterns to improve moisture conservation.

Keywords: *maize-cowpea intercropping, soil moisture content, maize development stages, Canopy cover, Cropping Patterns.*

Optimization of Garlic (*Allium sativum* L.) through Application of Goat Manure-Based Vermicompost in Eastern Kenya

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Abstract

Garlic, a bulb vegetable used as food and for medicinal purposes, has gained prominence among farmers in Eastern Kenya. The number of consumers preferring organic agricultural products has increased. But, the farmers are still overutilising chemical fertilizers, which cause adverse effects on the environment and human health. The objective of this study was to evaluate the effects of goat manure-based vermicompost on growth and yield of garlic. The study was conducted at PCEA Nkio secondary school farm and KALRO Embu horticultural field in 2018 to 2019. The experiments were laid out in a Randomized Complete Block Design and replicated three times. The treatments consisted of goat manure-based vermicompost at five levels (0, 5, 10, 20 and 30 t ha⁻¹), inorganic fertilizer (NPK 17-17-17) at the rate of 200

Kg ha⁻¹ and goat manure (30 t ha⁻¹). Data were collected on plant height, number of leaves, stem diameter, leaf length, leaf width, bulb fresh weight, bulb diameter, bulb length, number of cloves per bulb, bulb dry weight and bulb yield. The data obtained were subjected to ANOVA and significantly different means were separated using least significance difference at $\alpha = 0.05$. The results showed that application of goat manure-based vermicompost had statistically significant difference ($p < 0.05$) on growth and yield of garlic. Application of 30 t ha⁻¹ goat manure-based vermicompost showed significantly ($p < 0.05$) higher plant height, number of leaves, stem diameter, leaf length and leaf width. Application of 30 t ha⁻¹ goat manure-based vermicompost showed significantly ($p < 0.05$) higher bulb fresh weight, bulb diameter, bulb length, number of cloves per bulb, bulb dry weight and bulb yield. The study recommended use of goat manure-based vermicompost at rate of 30 t ha⁻¹ in the organic production of garlic in the study area.

Keywords: *Garlic, goat manure-based vermicompost, growth, bulb yield*

Technological Quality Characterization of Bakery Products supplemented with Raw Chia Seeds (*Salvia hispanica* L.)

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Abstract

The viability of production of good quality and acceptable baked products with chia seeds substitution for wheat flour was evaluated. Chia seeds were added to standard bread, muffins and cookies recipes at 5 % and 10 % substitution levels for flour on a weight for weight basis for comparison with standard products. The bakery products were assessed for their baking loss, specific volume, moisture content, textural properties and porosity. The addition of chia seeds at 5 % and 10 % chia seeds showed similar quality to standard bread in terms of baking loss, cohesiveness, porosity and moisture after 24 hours of storage, with the three formulations remaining stable for the 48 hours shelf life. A lower moisture content and higher hardness and

gumminess were observed with chia seeds fortified breads, which was more evident with 10 % supplementation. The textural quality of the three bread and muffins formulations showed significant increase in hardness, gumminess and chewiness, while cohesiveness and resilience significantly decreased during storage. However, springiness remained stable for the standard and chia enriched breads and muffins. Baking loss and specific volumes in muffin and cookies were not significantly affected by chia supplementation. The porosity percentage of the three formulations for bread and muffins were not significantly different. However, hardness of cookies increased significantly for all the cookies formulations during storage. Change in fracturability during storage of the three cookie formulations were not significantly different with stabilization at the end of the storage. The study confirmed that bakery products formulation with chia seeds affect the technological qualities of the final products caused by natural processes during product staling which a complex process. Wheat flour supplementation with chia seeds for bread making can lead to acceptable quality products that can help to extend the baked products choices in the African market.

Key words: *Chia seeds, wheat flour, texture, bread, muffins, cookies*

Effect of Different Stabilizers and Emulsifiers on Functional, Rheological and Sensory Properties of Macadamia Nut Spread

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ABSTRACT

Macadamia nuts are known for their nutritional composition that makes the edible kernel beneficial to human health. In addition to nutritional value, it has high economic potential leads to the country foreign exchange through exportation, job creation for both the farmers, intermediary agents and the processors. However, the macadamia nuts production is seasonal with short storage in raw form due to microbial growth and chemical composition instability. This may be mainly contributed by amount of free water and unsaturated fatty acids in the kernel. The nuts therefore need to be dried immediately after harvesting to lower the water activity and prevent rancidity through vacuum packaging of clean kernel. Various products

may be made such as macadamia nut spread to ensure continuous supply to consumers. Processed nut spread is an alternative to spread made from animal products and is known for its good flavor and smooth spreadability. Attempts by various processing companies to produce macadamia nut spread has been failing due to chemically and physically instability during storage, thus, need for use of favourable and permitted emulsifiers and stabilizers. Change in rheological behavior of macadamia nut spread during storage, leads to oil solid phase separation that is not acceptable to consumers. Incorporation of chia seed mucilage and palm stearin will be evaluated to improve the functional, rheological and sensory properties. Different proportions of the selected stabilizers are used to formulate macadamia nut spread while considering process modification and optimization. The products are evaluated for chemical composition, sensory, functional and rheological properties.

Mould Characterization and Mycotoxin Quantification of Chia Seeds (*Salvia hispanica* L.) Grown in Kenya

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Abstract

Chia seeds are functional food that have been considered highly nutritious. They have high levels of polyunsaturated fatty acid content therefore counteract lifestyle disorder such as cardiovascular diseases. This study sought to determine the level of mould contamination in chia seeds; enumeration and characterization of the types of molds and quantification of mycotoxin level, for chia seeds grown and sold in Kenya. A complete randomized block design with triplicates was used in the study. Samples were collected at random from farmers and distributors in Nyeri, Nakuru, Busia and Trans Nzoia counties. Moulds species were isolated from PDA and MEA Medias and morphological characteristics was determined under X 40 magnification power. Mould counts were found to be between 1.33×10^3 cfu/ml to 2.67×10^3 cfu/ml. Mould characterization done by microscopic and macroscopic technique showed evidence of *Rhizopus* spp, *Trichoderma* spp and *Fusarium* spp. Amongst the three genera

found, *Rhizopus spp* was the predominantly occurring mould. The percentage moisture content of chia seeds samples ranged from 6.49 ± 1.26 and 9.16 ± 0.43 . Significant variations on moisture content ($p < 0.05$) were observed among chia samples from different farmers. Aflatoxin was not detected in all chia samples. It can therefore be concluded that the chia samples were not contaminated with aflatoxin although different species of mold were present. Farmers need to be trained on proper postharvest handling methods of chia seeds, as well as proper storage and an objective method of analyzing the moisture content of the chia seeds need to be developed.

Keywords: *chia seeds, mould characterization, mycotoxins*

WATER, ENERGY, GIS, AND REMOTE SENSING, ENVIRONMENT & CLIMATE CHANGE

Analysis of Spatial Factors Affecting Rental House Prices: A Case Study of Nyeri Town Constituency, Nyeri County.

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Keywords: real estate, rental houses, GIS, remote sensing.

Real estate is the backbone of all developments in Kenya as it forms the basis of basic human need, shelter. This sector has attracted many developers constructing commercial and residential houses. Various investors use variety of methods to mark rental prices of their houses. Various factors have been noted to influence rental house prices others having a higher effect than others. This research endeavors to analyze the spatial features that affect rental houses prices and deduce their relationship with rental house prices. This has been achieved by primary data collection from house owners and estate agents in the study area through use of questionnaire, land value data from government valuers, infrastructure, and population data from relevant sources alongside with secondary data which is collected, digitized and prepared then all saved onto a database before analysis. Through use of GIS and remote sensing technologies all the spatial factors identified to affect rental house prices are analyzed and their relationship deduced then through a regression and multicriteria analysis different weights are assigned to the various factors as they are noted to influence the prices differently. The results of the study indicates different indexes as seen from various spatial factors identified. Various maps are generated showing relationship of various spatial factors with rental house prices. With this indexes, investors or agencies can know the percentage influence of the factors and may peg their decisions on the results of this research which can also be used in development of rental house price predictive models which is very crucial for the undeveloped plots. This research is paramount in decision making procedures of investors as they eye on setting up developments within the constituency. The county government may benefit heavily as they may be able to work on certain areas that may increase the revenue in

the sector hence boosting Kenya's overall gross domestic product. This research has proved how GIS and remote sensing technologies can contribute in the real estate sector.

Modelling the Influence of Cropping Patterns on Avocado Pests and Pollinators Distribution

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Keywords: Sentinel-2, Random forest, Niche modelling, Remote Sensing, Crop health

Abstract

Pollinators play a pivotal role in agroecosystems and agricultural food production through their pollination services and promoting biodiversity. However, there has been a decline in pollinators due to several factors including the intensive use of agrochemicals in managing crops pests, whose infestation or lack thereof are influenced by cropping patterns (annual sequence and spatial arrangement of crops). On the other hand, crop pests threaten food security by reducing the produce of crops by about 10-16%. The main objective of this study therefore was to evaluate how cropping patterns influence avocado pests and pollinators' distribution, with avocado being an important horticultural crop in export value in Kenya that depends on pollinators.

In specific, classified Sentinel-2 multispectral space-borne image of February 2019 covering three sub counties in Murang'a county together with 'presence only' data of avocado insect pests and pollinators and intervening variables of elevation and bioclimatic variables were used in Maximum Entropy (MaxEnt), an ecological niche model, to provide a spatial understanding of how the cropping patterns influence avocado insect pests and pollinators distribution. The pests in focus were false codling moth (FCM) and fruit fly (FF) whereas the pollinators were honeybees and wasps. Using field data on land use land cover and crop types, the Sentinel-2 image was classified into twelve classes using random forest machine learning classifier. The results showed that cropping patterns could be classified with an overall accuracy of 78% and kappa of 0.76. Seven of the twelve classes extracted comprised of

different crop types i.e. avocado, tea, coffee, cabbage, maize and pineapple. The different croptypes were also categorized into various cropping patterns such as monocrop, mixed, perennial and annual to be used in the model.

Prior to modelling in MaxEnt, all variables were subjected to a collinearity test using the variable inflation factor (VIF) approach thus eliminating those with a $VIF > 10$. As a result, seven variables were retained for use in the modelling i.e. cropping patterns, aspect, slope, hillshade, isothermality, temperature seasonality, and rainfall seasonality. To note however is that three additional intervening variables i.e. rainfall wettest month, rainfall wettest quarter for pollinators and minimum temperature of coolest month for pests in this study regarded as important to the specific pests and pollinators according to reviewed literature were also used despite having a $VIF > 10$. Overall, the area under curve (AUC) of all pollinators and pests were above 0.75 indicating good model performance. It was noted that the cropping patterns contributed the highest (66%) in FF and second highest in FCM, wasps and honeybees distribution models at 41.4%, 39.2% and 11.6% respectively. This results will thus aid in providing advisory tools for making informed decisions by various stakeholders to promote integrated pest and pollinator management for avocado crop production.

Application of Geophysical Methods in Foundation Investigation for Construction Purposes at Olkaria (V) Fields, Kenya.

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ABSTRACT

Geophysical methods were used in structural foundation investigation at Olkaria (V) field in Kenyan rift valley prior to the construction works. The objective of this investigation was to analyze the foundation conditions without soil disturbance. Geophysical techniques are faster, cost effective and non-destructive compared to conventional way such as borehole investigation, which is expensive and provide information in discrete area, whereas geophysical investigations provide a wider picture of the subsurface. Electrical resistivity, gravity and seismic methods were used in the investigation. Data was collected using electrical resistivity imaging system, gravimeter, geographical positioning system (GPS), receiver and seismograph. The RES2DINV, SURFER and Geometrics SeisImager Software respectively

were used to process results obtained from these investigations. The methods used gave results that are significant in the preliminary stages of site assessment for foundation works. The techniques probe the depth to the bedrock and present weak soils zones. Analysis and interpretation of geophysical data aids in understanding the subsurface geology for foundation works.

Compact rock materials were observed from a depth of 14m below ground level extending down to greater depths. Further, the area was characterized by weak Silty material, which has low bearing and consolidation ability. Such materials are prone to frequent washout under conditions of percolating waters hence require utmost care during the placement of engineering structures. Utilization of piles is necessary and should be anchored to a depth greater than 14m below ground level such that they rest directly on the competent bed. In-situ compaction should go before utilization of reinforced concrete amid the development of shallow foundation to achieve the maximum compaction limits due to the anticipated load of the proposed infrastructure. Equally, excavation of the top soil is necessary and thereafter refilling with competent material such as gravel and laterite in order to have a strong basement.

In-season and Inter-season Maize Crop Monitoring with Radar Satellites- case study of Endebess, Kenya

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Keywords: TerraSAR-X, Sentinel-1, Maize BBCH, Phenology mapping

Continued monitoring of crops in the fields during the entire cropping season, and from one season to another, ensures good cropping seasons, and thus good yields. Remote sensing provides fast, cost effective and timely tools necessary for the effective monitoring of the crops. The acquisition of cloud free optical images in tropical regions however remains a big challenge since the cropping season is characterized by high amounts of rainfall and cloud cover. With the availability of radar images however, it is now possible to acquire cloud free images during the entire cropping season since radar is not influenced by the weather

condition. The objectives of the study were two fold. The first objective was to compare the performances of TerraSAR-X (TSX) X-band and Sentinel-1 (S-1) C-band radar images in monitoring the maize growth in Kitale, Kenya. S-1 and TSX image pairs having comparable acquisition times, acquisition modes, and acquisition incidence angles were selected. The second objective was to investigate the transferability of the maize phenological characteristics from one season to the other by comparing the S-1 backscatter values for 2015 and 2016 cropping seasons. 18 ADC Olgatongo Company maize fields were identified for this study, with the principal maize growth and development stages being defined by the universal extended BBCH scale. From the results, the TSX backscatter values were higher than the S-1 backscatter values for the greatest part of the cropping season. The difference between their backscatter values was larger at the beginning of the cropping season, decreasing progressively during the crop growth. This was attributed to reduced influence of soil reflectance after the leaf canopy formation. The maize phenological development stages could however be identified from both the TSX and S-1 images. The field planting orientation influenced the amount of backscatter values observed, with fields oriented in an East-West direction exhibiting higher backscatter values. For the comparison between the 2015 and 2016 cropping seasons, the backscatter values for the S-1 ascending mode performed best in terms of both S-1 2015 and S-1 2016 backscatter curves overlaying. Maize fields planted in similar dates for both the 2015 and 2016 season performed the best. Hence, a S-1 backscatter curve extracted for one cropping season can establish a baseline for the monitoring of the subsequent cropping seasons. In the event that a deviation from the expected backscatter values is noted, then the necessary action can be taken to mitigate the situation.

Pond Water Fertilization Effects on the Performance of *Oreochromis Niloticus* in Different Culture Systems in Meru County

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Abstract

Information on pond water fertilization is important as it gives among others, productivity of various types of culture systems. Different pond water fertilization rates and physicochemical

parameters were investigated in liner, earthen and concrete ponds in Meru County Kenya over a period of 3 months, August to November 2015. The aim of the study was to find out the effects of different rates of pond water fertilization on the production of *O. niloticus* in different culture systems. Twelve fish ponds of size 2m² were constructed in a randomized design, 4 of each and stocked with 8 niloticus monosex fingerlings each weighing 20gm sourced randomly from a hatchery in the county. Weight gain and total production was measured every 30 days for 90 days. ANOVA was used to analyze the data. Results revealed that, concrete culture system produced the highest mean weight gain of 11.21 ± 3.27 gms, earthen 7.67 ± 1.36 gms and liner 6.41 ± 4.88 gms with 4 gms DAP, showing a significance difference in mean weight gain (F = 20.07, df = 2, P = 0.002). The study concludes that, different pond water fertilization rates strongly influences the growth performance of *O. niloticus* in different culture systems.

Key words: Fertilization, culture system, weight gain, monosex, *O. niloticus*

Development of an Integrated Web-based GIS for Revenue Collection, Case Study: Laikipia County, Kenya

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ABSTRACT

Most of the counties in Kenya perform very poorly in revenue collection, most of them failing to meet their projected revenue thereby causing huge local revenue collection gaps. In Laikipia County, property records are maintained in analogue format. Different types of data in stored in different departments. This research study aims to demonstrate how integrated web based GIS can be used in effective revenue collection and monitoring. One of the major limitations to efficient county revenue administration is lack of cadastre and updated land information management system.

Needs analysis was carried out and the majority of the respondents supported the adoption of the system by the county government. Technology decisions are made based on a proper understanding of user requirements, workflow needs and established system performance

expectations. Therefore there is a need to come up with a system that will help Laikipia county government to achieve its revenue targets collection through cashless payments.

The system developed, provides an effective platform, for efficient revenue management. Various revenue streams were mapped and their spatial attributes captured. Users can be able to register and make payments from the system. The system has enabled Data accessibility and interoperability between various departments in Laikipia County.

The system has enabled proper management of revenue by the county government since all the revenue streams are properly accounted for and enable sealing of loopholes where revenue is lost or under collected. The system enables users to make payments, and bring all the revenue streams into a spatial web based GIS database.

The system has provided an electronic client and property spatial database, this will enhance revenue processing, credit management and receipt processing on real time basis. All information regarding various revenue streams will be freely available to different users with a controlled level of access.

Once implemented the system will enable increased and streamlined revue collection with executive dashboards, county seals and certification permits with web verifiable QR codes. Also there will be mobile POS payment services with many payment options.

Key words: *Geographic Information System, Quick Response, County, Database, Revenue*

Assessing the crop health and growth using multi-temporal vegetation indices derived from sentinel-2 imagery: A case study of wheat production in Narok County

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Abstract

Assessment of crop condition at the early stages of growth is essential for monitoring the crop health and yield prediction. The performance and productivity of agricultural crops are however determined by various factors such as soil moisture, fertilizer application, disease, and other farm management practices throughout the crop growing season, which varies across from one farm to the other. So timely repeat information about the crop condition throughout the Phenological stages of crop growth and development is very important in monitoring the conditions of crop.

In this research, a 5-day multi-temporal sentinel-2 data was used to derive various indices that helped in determining the crop conditions throughout the crop Phenological cycle. The normalized difference vegetation index (NDVI), an indicator of the level of photosynthetic activity, was used to determine whether the crop is healthy or not. The plant stress is caused by many issues ranging from shortage of water, attack on crops by pest, presence of weeds and poor crop management practices.

Other indices were used to narrow down to a probable cause of crop stress. Shortage of water was analyzed using the Optimized Soil Adjusted Vegetation Index (OSAVI) which estimates the amount of moisture in the soil. In order to separate between the attack of crops by weeds and pests, the geometric patterns of vegetation were analyzed using canny edge algorithm where low NDVI values and high soil moisture content in a straight rows indicate attack by pests while the randomly allocated low NDVI values and high soil moisture content indicate that there is weeds in the field.

Results indicated that remote sensing data from sentinel-2 provides a very important information for large-scale monitoring and assessment of crop health. The weekly data helps in monitoring the progress of the crops as well as the weeds particularly in the first phase of the Phenological cycle. This then guides in taking measures to counter the threat before it is too late.

Keywords: crop condition, ndvi, crop health, crop phenology, remote sensing.

Application of Satellite Radar Interferometry (Sbas) in analysis of Land Deformation.

A Case of Kerio Valley

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Abstract

Land deformation is the process of the land changing its original shape which can be induced by naturally occurring phenomena such as volcanic eruptions, landslides, soil erosion, mudslides and earthquakes or by human activities such as extensive groundwater extraction, urbanization and mining. The research has been carried out in Kerio Valley, a region with steep slopes and an increasing rate of soil erosion caused by increased logging due to increased demand of firewood and charcoal. The application of satellite RADAR interferometry techniques overcomes the challenges of the traditional point based techniques such as levelling by providing more dense information on the deformation rate for large area in an effective and cost efficient way. The objective of this study is to apply DInSAR- SBAS technique to monitor the land deformation rate of the area using a set of 18 Sentinel 1 images from 2017 to 2019. The SBAS technique involves focusing and aligning the SAR data, generating interferograms from images with short baseline and unwrapping the phase using SNAPHU algorithms to obtain the land deformation in the Line of Sight. The deformation rate in the area ranged from 20 mm to – 45 mm per year with regions on the valley floor experiencing an uplift due to deposition while regions on the slopes and on mining sites experiencing subsidence. Using the RUSLE model, the total computed annual soil loss in the

region varies from 98 Mg ha⁻¹ per year to 419 Mg ha⁻¹ per year indicating the high rate of soil erosion in the area. Overlaying the two shows an increase in the rate of deformation with increased rate of soil erosion. This therefore calls for need for continuous monitoring of the area as part of risk assessment so that measures can be taken in time.

Keywords: SBAS, RUSLE, Soil erosion, interferometry, deformation monitoring

***Strengthening Human Capacity in Support of Enhanced Geothermal
Development in the East African Region – a case for Dedan Kimathi
University of Technology***

MARIITA Nicholas Obuya

Geothermal Energy Training and Research Institute, GeTRI

Abstract

In recent years, greater focus is being put to the development of geothermal energy resources in the Eastern Africa region. Geothermal projects are capital intensive. Like other projects of similar nature, their feasibility in terms of technology, financial and market viability need to be verified prior to their execution. Large investments have been made in training local personnel in geothermal exploration, development and production activities. Unfortunately, the number of geothermal experts trained so far is inadequate to oversee the planned expansion in development of the geothermal resources. This is due to lack of training institutions in the region, necessitating Africans travelling abroad to acquire training in geothermal energy technology. Dedan Kimathi University of Technology has taken the challenge of establishing a Geothermal Training and Research Institute (GeTRI), which is training a new generation of geoscientists, engineers and business leaders in all aspects of geothermal energy use. GeTRI will contribute, through the education of graduate students, in partnerships with industry and other training universities and in applying an interdisciplinary curriculum encompassing geo-science and engineering. The Institute is becoming both the national and regional centre of excellence in geothermal training and research. We describe the university's contribution in expansion of the energy mix in the region, the successes and challenges in training of experts and research in this renewable energy resource.

Climate Change Vulnerability Assessment using a GIS Modelling Approach in the Upper Ewaso Nyiro Basin

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Investments in climate change adaptation for communities and water resources are increasingly benefiting from vulnerability mapping worldwide. The Upper Ewaso Nyiro basin is a rich, diverse and dynamic ecosystem which is impacted by climate change that in turn is negatively impacting livestock, humans and the entire rangeland system. This research sought to assess the existing vulnerability of the local community to climate change. To achieve this objective, various datasets were identified for analyses including climate data, environmental data and socio-economic data. The community vulnerability assessment model was determined through the process of gathering geo-referenced socio-economic, biophysical data, and climate data. Climate analysis was processed to extract averages and trends. Land use land cover change detection analysis was analyzed using Landsat images, while the vegetation condition index was calculated from Normalized Difference Vegetation Index. Normalized indicator layers were averaged using the equal weighted averaging approach to derive component and vulnerability scores. Through the process of spatial integration of relevant datasets, community vulnerability hotspots maps were developed. Results show that high vulnerability was observed in areas exhibiting similar trend in high exposure and lack of adaptive capacity as well as high sensitivity. The highest vulnerability was observed in Korr/Ngurunit ward in Marsabit County where approximately 45.45% of the population were noted to be highly vulnerable to climate change impacts, while 54.55% of the population were noted to be moderately vulnerable. This study recommends that the county government and national government needs to build targeted resilience efforts within the highly vulnerable communities since this would improve community livelihoods.

Keywords: *climate change, vulnerability, spatial analyses; semi-arid.*

Assessing alien invasive plants species spatial distribution under changing climatic conditions

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Alien invasive plant species (AIPS) negatively affect the functions of forests, water, and agricultural ecosystems. AIPS may proliferate as a result of climate change or may act as drivers of climate change. Climate change enhances the invasion process by changing habitats range and hence increasing establishments range of the invasive species. This study assessed potential ecological habitats of five plant species including *Lantana camara L.*, *Opuntia stricta*, *Solanum campylacanthum Hochst. ex A. Rich.*, *Senna didymobotrya (Fresen.) H.S. Irwin & Barneby*, *Biancaea decapetala (Mauritius or Mysore thorn)* in areas within and surrounding nyeri forests conservation areas. Species occurrence location data were collected using GPS receivers through roadside surveys. Maximum Entropy (MaxEnt) Algorithm was used to model species distribution with occurrence data and explanatory environmental variables for current and year 2050 climate predictions. Future predictions of species habitats based on bcc_csm1_1_m Global climate model and future emission scenarios (Representative Concentration Pathways (RCP) 2.6 and 8.5) for the year 2050 based on IPCC Fifth Assessment Report (AR5) indicated higher suitability index in the current semi-arid parts of study area for all species assessed. Both lantana and senna species will have significant spread to northern semi-arid area and towards mt. kenya to the east and aberdares forest reserves to the west for both climate scenarios as compared to the other species. Although solanum and Mauritius thorn will spread to new habitats, their range shift will be limited to the central and northern parts of study area. Opuntia species suitability will decrease and hence decrease in range within current habitat for both scenarios. This study therefore is important to conservationists and policy makers on invasive species risk assessments in ecosystems threatened by climate change and human disturbances. Additionally, Invasive species which are likely to become invasive due to climate change can be identified through similar assessments and early warning systems developed to reduce biodiversity loss.

Keywords: Alien Invasive Plant Species, Biodiversity loss, Species Distribution Modelling, Climate Change

Experimental Model Investigating Potential of Geothermal Energy in Recycling Polyethylene Terephthalate

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ABSTRACT

Geothermal energy is one of the clean, sustainable and renewable resources, which provide heat energy that is derived from radioactive decay elements within the earth's crust. The non-electric utilization (direct use) of geothermal heat has been reported in various domains that have a need for sustainable supply of heat energy. Adoption and direct use of geothermal energy in Kenya is one way which can enable waste control to enhance environmental protection and optimize the use of this resource. In this research, heat energy from the geothermal well was simulated using an experimental model in which polyethylene terephthalate (PET) pieces were melted and moulded into usable products under suitable pressure conditions. The objective of this study was using experimental model to investigate the potential of using geothermal heat energy in recycling PET plastics. The ground plastic waste material was exposed to heat and the resulting molten medium was subjected to selected polymer processing techniques to obtain desired products. The suitability of geothermal conditions in recycling PET was investigated through numerical analysis. In the design, the study performed experiments on three controlled factors temperature, velocity and pressure. The data collected was analyzed by use of MATLAB. This study established, through experimental model, that geothermal energy conditions in Olkaria are viable in recycling PET plastics. These findings, will enhance control of environmental pollution and create job opportunities in the recycling process. The study recommends that Kenyan government should explore the utilization of geothermal energy in the recycling of PET plastics.

Keywords: experimental model, geothermal energy, recycling and polyethylene terephthalate

***Assessing the Impacts of Land Use Land Cover Changes on the Water Levels
Using Remote Sensing in Tana River Basin***

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Linking the river flow regime and the land use land covers changes (LULCC) is crucial in ensuring sustainable use of resources. This study discusses hydrological impacts of the LULCC on the water levels derived in Tana River basin. The changes in water levels were extracted from satellite altimetry observations at a virtual station. LULCC were obtained through the analysis of MCD12Q1 Moderate Resolution Imaging Spectroradiometer (MODIS) product from the year 2009 to 2018. The MCD12Q1 product was reclassified into six classes: forestland, grassland, cropland, wetland, artificial areas and others. The short-term changes in land use were quantified using the normalized difference vegetation index (NDVI) derived from MOD13A3 MODIS product. Preliminary analysis of the trends indicated a 39.47% increase in the cropland and a 46.88% increase in the annual water level changes. A 10-year plot of the monthly water levels revealed an increase in the water level from January to May, followed by an increase at a decreasing rate from May to November, and finally a decrease in December.

Keywords: *Land Use/ Land Cover, Remote Sensing, Satellite Altimetry, Water Levels.*

***Characterization of Wheat Production Using Earth-Based Observations: A
case study of Meru County, Kenya***

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ABSTRACT

Wheat demand in the world is on rise because of rural urban migration and overreliance on other types of food crops like maize. Earth based observations include use of remote sensing,

climatic patterns and the phenomenon being studied. The production of wheat is affected by climatic changes and have better yields in areas with low temperatures and high altitude. The main objective of the research was to evaluate factors affecting wheat production using Earth - based observations. This was achieved through characterization of climatic patterns, correlating the effect of change of Land use to wheat production and correlating wheat growth seasons to wheat production. The analyses include study of drought, change in Land use Land Cover and understanding the wheat growth seasons from 1985 to 2018. Extreme cases of drought was investigated and the most affected years for meteorological drought are 2000,2001,2002 ,2016 whereby it shows monthly SPEI Value of -1.72,-2.3,-2.14 and -2.21 respectively whereas Agricultural drought years are 1991,1992, and 1996 with NDVI monthly anomaly of -81.26,-97.88 and -145.08 respectively .SPEI -6 and SPEI-12 is considered best for Event based and Perennial drought assessment because of the duration and from the analyses they give clear understanding of drought. Strong correlation is in change of Forestland (R=0.75) and Bare land (R=0.66), moderate correlation in Agricultural Land (R=0.42), a weak correlation in vegetation (R=0.32) and a very weak correlation between length of seasons (R=0.16) to wheat production. The year 2000,2008 and 2009 had low whereas 2017 and 2018 had high wheat production (7600,5200,4975,46450 and 27800 tonnes respectively). Both Agricultural and Meteorological drought affects wheat production. SPEI is a good method in the study of meteorological and NDVI anomaly for Agricultural drought. The future analysis should focus on prediction analysis of both drought and Land use Land Cover Changes.

Keywords; *Agricultural drought, Meteorological drought, Growth Seasons and Climate change.*

Modelling Yala Swamp Dry Season Inundation Variation in Response to River Yala Basin Changing Environment

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The sustenance and ecological functioning of wetlands depends on hydrodynamic processes influenced by variation in inundation over time and space. Anthropogenic activities and climate change have been reported to continuously cause a variation in the inundation pattern of wetlands, interfering with their ecosystems and hydrological regime. The effects has called for reclamation and protection of wetlands. Advancement in remote sensing has made it possible to study wetlands spatiotemporal characteristics aiding in management of degraded wetlands. This study employed the technology to model dry season inundation pattern of Yala Swamp, in relation to the changing environment of River Yala Basin. The swamp's existence is currently being threatened because of unpredictability and the dynamicity of its inundation pattern. Population data from KNBS and Landsat imagery for the years 1986, 2006, 2015 and 2019 were used to estimate population density, inundation pattern, LULC changes and changes in LST. By utilizing historical inputs from TCWI, maximum likelihood classification, land surface temperatures, and population density, the future inundation pattern of Yala Swamp in 2029 was predicted using CA-Markov Chain Analysis Model. Yala Swamp inundation characteristics were classified into dryland, riparian, swamp and water, while LULC was classified into eight classes including swamp, water, bareland, grassland, cropland, plantation, urban and forest. The results established that the swamp has lost approximately 38% of its area in the span of 33 years. It is projected to lose 12% more in the next 10 years. It was also observed that a strong negative correlation exists between inundation and LST with an R^2 value of 0.9.

Keywords: *Yala Swamp, Inundation Pattern, Cellular Automata, Markov Chain Analysis, Change Detection*

Potential of Remote Sensing Data in Monitoring Water Quality at Ndakaini Reservoir Dam, Kenya

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Globally, pollution from anthropogenic inputs and natural processes threaten many fresh water bodies. In Kenya particularly, drought and occasional floods adversely impacted on quality

and quantity of open surface waters. It is therefore important to continuously monitor water quality to ensure good health for human beings and proper functioning of natural ecosystems. Currently, the use of in situ observation methods for assessing water quality in most reservoirs is not available and if then it is inadequate as the measurements are periodically and selectively done. To explore alternative methods, remote sensing based techniques were considered due to their synoptic view and repetitive coverage. The aim of this study was to assess key independent water quality parameters using moderate resolution satellite imageries within Ndakaini dam, a major source of domestic water for the county of Nairobi, Kenya.

Specifically, this study assessed variability in Chlorophyll concentrations (Chl_a), water temperature (SST) and Suspended Sediment Concentrations (SSC) at the reservoir before and after April-May 2018 floods. These parameters determine to a larger extent drinking water quality for open large reservoirs along the tropics. Landsat 8 OLI/TIRS imageries from USGS Earth explorer were analysed with different geospatial soft wares and integrated models for monitoring water quality. Resulting water quality variables were then compared to the Environmental Protection Agency (EPA) surface water standards of 2001 and other locally published drinking water quality benchmarks.

Assessed water quality parameters at the reservoir showed a spatial and temporal variation before and after the floods for the duration considered. Trophic state analysis showed that Ndakaini drinking Water dam is a low level pollution Mesotrophic lake.

Keywords: Ndakaini, Reservoir, Remote sensing, Water Quality, Monitor

Assessing Socio-Economic Drought Spatial Inequalities in Arid and Semi-Arid Basin Ecosystem

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Socio-economic drought is a situation whereby demand for a certain socio-economic commodity exceeds its supply. In context to pastoralists community's, water and pasture are the most essential commodities for their livelihood. Acute water shortage and degraded

rangelands have negative impacts to the pastoralist's communities. Scarcity and uneven spatial distribution of water and pasture within Upper Ewaso Ngiro River Basin (UENRB) is a nightmare to locals for a long period. This is manifested by frequent famine, rivalries among the neighbouring communities as well as human-wildlife conflicts. This is attributed by low rainfall, high water demand surpassing available water resource, degraded rangelands and uneasy access to available water sources. Assessing socio-economic drought is difficult and complex process in a heterogeneous basin ecosystem. Little attention has been paid to assess socio-economic drought as most researchers assess other environmental droughts such as meteorological, agricultural and hydrological droughts.

This study focused on assessing spatio-temporal inequalities of socio-economic drought in an Arid and Semi-Arid basin ecosystem of the Upper Ewaso Ngiro River Basin in Kenya. Socio-economic drought was assessed based on Domestic Water Deficit Index (DWDI), Dry Bare Soil Index (DBSI) and cumulative travel time to water reach point derived using Tobler's hiking model. Equal weights logical combination amongst normalized DWDI, DBSI and travel cost was performed to generate socio-economic drought index for January 1995, February 2000, January 2005, 2009, 2015 and 2018. DWDI values for 1995, 2000, 2005, 2009, 2015 and 2018 were 0.98, 0.99, 0.98, 0.79, 0.98 and 0.93 respectively which revealed severe socio-economic droughts since they surpassed the equilibrium value of 0.5 which signified the normal condition. The DBSI average values for 1995, 2000, 2005, 2009, 2015 and 2018 were -0.71, 0.19, 0.39, 0.29, 0.08 and 0.07 respectively revealing that January 2005 experienced high depletion of vegetation manifesting high socio-economic drought while January 1995 registered lowest DBSI value revealing less degradation thus low socio-economic drought when compared with others years.

The generated cumulative travel time to water reach points revealed that the minimum travel time was 0 minute while the maximum travel time was 18days, 21hrs and 56 minutes. Derived socio-economic drought index (SEDI) for 1995, 2000, 2005, 2009, 2015 and 2018 had average values of 0.54, 0.56, 0.59, 0.51, 0.57 and 0.52 respectively. This implied that January 2005 registered high socio-economic drought while January 2009 revealed least SEDI value when compared to others. Using SEDI values it is evident that the socio-economic drought for all

the months under investigation surpassed the normal condition. The findings in this study provide baseline information and facts for formulating appropriate local socio-economic drought mitigation and water resources planning and management. Further research is recommended to establish how overstocking, agricultural yields, uncontrolled water abstraction in the upstream as well as existing government policies could improve the findings of this study.

Keywords: *environmental drought; socio-economic drought index; domestic water deficit index; bare soil index; cumulative travel cost; equal weighting.*

TRENDS IN TECHNICAL EDUCATION AND TRAINING

Maximizing on Teaching practicum exercise in technical training institutions

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Abstract

Teaching practicum requires thorough preparations for one to be successful. Over and above the area of specialty, a teacher trainee requires knowledge of educational psychology, curriculum studies and educational foundations courses. This knowledge will help a teacher trainee to adapt a personal teaching philosophy. The personal philosophy will aid the student teacher to be a reflective and reflexive teacher. This is a teacher who learns through hypothesis testing, context analysis, theorizing, inquiring, experimenting and justifying. If student teachers are well equipped with the stated abilities then they will be able to get maximum benefit of teaching practicum exercise. Such competency has to be built through searching and identification of oneself as a student teacher, based on one's personal philosophy of teaching and learning. For the cooperating teacher and assessors to help the students better their teaching competencies, they ought to have an elaborate assessment guideline. This is a guideline that can measure attitude, skills and knowledge. Teaching practicum (TP) assessment instruments provide insight into the nature of the knowledge that the university expects university-appointed tutors and school-based supervising teachers to have in order to make fair judgments about a student's teaching competence. This paper explores mechanisms that could be employed to maximize student experience during the teaching practicum exercises in technical training institution.

INFORMATION AND COMMUNICATION TECHNOLOGY

Cyberspace Situational Awareness: Measure and Manage it

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Abstract

The sustainable development goals (SDGs) were designed to serve as a useful guide for focused and coherent action on sustainable development at the global, regional, national and local levels, and also help to mainstream sustainable development into the United Nations system by 2030. Information, a leading factor of production cutting across all sectors lacks the due consideration as a significant enabler of progressive development. SDGs have set up a local, regional and global collaboration arena which inevitably involves among others intensive information sharing, collaboration, distribution and preservation in the cyberspace, powered by assorted information communication technologies (ICT). The cyberspace, however, has been targeted by cybercriminals with the view to compromising the confidentiality, integrity and availability of strategic information systems. With Kenya as a case study, using purposive sampling and qualitative analysis using Cybersecurity Capability Maturity Model (C2M2), this study explores the level of cyberspace situational awareness with a view to leveraging on its maturity level. It is established that cyberspace situation awareness is an obligatory requisite towards cyberspace security management approaches which is predominantly technical solutions oriented. The study further reveals that a thorough and comprehensive cyberspace incidents' intelligence, surveillance reconnaissance are vital, but missing components to achieving a mature, measured and managed cyberspace which may guarantee the achievement of the SDGs. In view of these findings, we demonstrate and create insights into how other non-technical thematic areas are pertinent towards the cyberspace situational awareness. It is recommended that adopting suitable framework encompassing technical, social and political facets would enable a maturity, sustainability and furtherance of cyberspace situational awareness, being core ingredient of information governance, thus the achievement of the SDGs.

Key Words: *Information, Cyberspace, Situation, Awareness, Governance, Surveillance, Intelligence, Maturity*

A NEW APPROACH TO TEXT SUMMARIZATION USING SUPERVISED AND UNSUPERVISED DEEP LEARNING ALGORITHMS

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ABSTRACT

The increased access to the Internet and affordability of smart devices, coupled with a growth in online content has resulted in users being subject to an avalanche of information. Users' information needs have also become more complex. In response researchers have investigated algorithms to improve information representation and information retrieval. Among the most significant of these algorithms are in summarization of content. The proposed Query Oriented Deep Extraction (QODE) algorithm IS exploits the concept of deep learning for text content summarization. The algorithm exploits both supervised learning and unsupervised deep learning. The new model uses Support Vector Machines (SVM) to classify content, before subjecting it to Restricted Boltzman Machines (RBM). In this research, extractive approach to summarization was used. First, we determine the relevant features to include in a feature matrix. Second, we determine the optimal sample size used in SVM training. Finally, we apply the trained SVM to the RBM. Subjecting the features matrix to the SVM yielded up to 23% of the original text, without loss of meaning. Further application to the RBM yielded a summary of 15% of the original text. Thus, combining SVM and RBM while deploying a features matrix based on ranking and similarity results in a mean summarization of 15%. We conclude that the performance of QODE multi-document summarization can be enhanced by classification approaches. The data used was an extract of Document Understanding Conference (DUC) 2007.

Keyword: *Deep Learning, Content Summarization, Query oriented algorithms, Restricted Boltzmann Machine, Support Vector Machines*

Towards Human Technology for Kipsigis Language Part of Speech Tagging

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Abstract:

This paper describes the development of a data-driven part-of-speech tagger for the resource-scarce Nilotic language of Kipsigis. Fourteen thousand corpora were manually annotated for classification task and a ninth of it was used to train a memory-based tagger while the rest for testing purpose. The results were very encouraging with Overall: Precision of 88.38%, recall of 88.25%, F- score of 88.63% and an average accuracy of 94.49%. This result demonstrates that language technology can be developed using a limited amount of corpus for spoken and under resourced languages.

Keywords: *Part of speech tagging, Data Driven, Tagger, corpus and Annotation*

SECURITY MANAGEMENT AND INNOVATIONS

The K-9s Dogs in Security Operations: An Assessment of the Their Performance in Detecting and Locating Explosive Materials

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Abstract

Explosive sniffer dogs also known by acronym 'K-9s' are specifically trained to detect and locate explosive substances in a working scenario. This capability has been enhanced acquainting the K-9s by experiences of screening for explosive substances in a working scenario. The concept of screening for was conceptualized as a series of events incorporating four independent variables: the K-9s knowledge; skills for detecting and locating explosive substances; their experiences coupled with time as dependent variable. These variables were studied by observation method in a quasi- experimental settings.

Several studies have depicted that the phenomena of using K-9s lacks adequate empirical studies. This study assessed the performance of the K-9s in a working scenario. This study assumed that the K-9s are enabled to perform in their working scenario by the variables studied. The K-9s knowledge; their skills in detecting for explosive substances; their skills in locating for explosive substances and their experience as independent variables for this study. Time taken in a working scenario was conceptualized as the dependent variables. Five attributes for the K-9s knowledge and five attributes for the K-9s skills in detecting and locating for explosive substances were observed. The K-9s experience was observed as the number of years each K-9 has had in a working scenario. These variable attributes were measured in an interval scale. The data were analysed by descriptive statistics and the relationship for the variables was determined use by of Pearson's correlation. A significant negative correlation was established between the K-9s knowledge and time taken in a working scenario. A significant negative correlation was established between the K-9s skills in detecting for explosive substances and time taken. An insignificant correlation was established between the K-9s experience and skills in a working scenario.

Keywords : *K-9s; explosives; detection and locating.*