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**Jomo Kenyatta University of Agriculture and Technology**

# QUALITY ASSURANCE BULLETIN

## VOLUME 5, 2011

*The launch of Education for Sustainable Development (ESD) Policy: JKUAT has committed itself to entrenching the concept of sustainability in all its activities. The University, through its vision and mission endeavors to incorporate ESD pillars in its mandate of training, research, innovation and community service in order to become sustainable.*

Compiled by:

Directorate of Academic Quality Assurance (DAQA)

## VISION

*A University of Global Excellence in Training, Research, and Innovation for Development*

## MISSION

*To offer accessible Quality Training, Research, and Innovation in order to Produce Leaders in the Fields of Agriculture, Engineering, Technology, Enterprise Development ,Built Environment, Health and other Applied Sciences to Suit the Needs of a Dynamic World*

**Prof. Francis Gichaga, PhD**
*Chancellor, JKUAT*

# Contents

# A WORD FROM THE VICE CHANCELLOR

Jomo Kenyatta University of Agriculture and Technology has committed itself to achieve world class standards by ensuring that it offers quality education, training and favorable environment that promote conducting of quality research and innovation. This has been manifested by formation of Directorate of Academic Quality Assurance (DAQA) to monitor and implement academic quality and to improve standards of academic excellence and funding of researchers through RPE Division. On top of that, the ISO 9001:2008 certification by KEBS has greatly enhanced quality culture within the entire University. For instance, the certification process necessitated the need to document all the procedures that were prerequisite for an efficient and effective quality education system which leaves a mark in the international academic arena.

Currently, innovative teaching methods are being used in the Faculty of Agriculture for Master of Science in Research Methods programme and other departments. The method has made learning to be enriched by reference to cross-curricular links, current research, industrial applications and development of generic skills such as communication and teamwork. In fact, such innovative teaching methods are depicted globally when Mr. Evans Wadongo (alumnus of JKUAT) was the 2010 CNN Hero Nominee for his innovation of environmentally friendly solar-powered light-emitting diode lamp being distributed in rural areas. The University has also restructured E-Learning Department by providing infrastructure and human resource to fast track offering of accessible high quality interactive learning programmes and materials. The University has also constructed an Olympic size swimming pool that will improve students and staffs recreation and nurture swimming talent.

Finally, my sincere gratitude goes to the staff at the DAQA staff members for their efforts that has enabled the improvement and timely production of this fifth academic quality assurance bulletin. The bulletin indicates that there was an increase in publications from 2009/2010 academic year to 2010/2011 academic year i.e. from 113 to 218. This is consistent with the latest Webometrics that showed JKUAT has jumped 354 places to stand at position 7,303 out of 12,000 universities worldwide. I also like to appreciate the members of staff who provided their research activities and publications for the production of this bulletin. Ultimately, the objective of this bulletin is to improve the quality of teaching and learning by encouraging University staff to consistently conduct research and innovations and publish.

**Prof. Mabel Imbuga, Ph.D.**
***Vice Chancellor***

# MESSAGE FROM THE DEPUTY VICE CHANCELLOR ACADEMIC AFFAIRS

Jomo Kenyatta University of Agriculture and Technology strives to be a University of global excellence in training, research and innovation for development. This is only possible through emphasis on academic quality. Quality in higher education is perceived as consisting of a synthesis of conformity, adaptability and continuous improvement. It is a synthesis of a range of expectations of many stakeholders. Students may focus on facilities provided and perceived usefulness of education on future employment. Academic staff may pay attention to the teaching and learning process. Management may give importance to the University's achievements. Parents may consider the achievement of their children. Employers may consider the competence of the graduates. At JKUAT quality can therefore, be viewed from many approaches but spread headed at the Directorate of Academic Quality Assurance (DAQA).

The University's purpose of existence is to offer accessible quality training, research and innovation in order to produce leaders in Agriculture, Engineering, Technology, Enterprise Development, Built Environment, Health and other applied Science to suit the needs of a dynamic world. This is possible because quality is viewed as added value to students during education and training. It is the way of formulating learning outcomes to realizing the outcomes in the graduates. JKUAT enables students to enhance knowledge, competence and employability. Great attention is payed to what is expected. The Directorate of Academic Quality Assurance checks the effectiveness of all academic programmes. During monitoring DAQA takes reports from external examiners, staff and feedback from students, alumni, employers, professionals and accreditation bodies into considerations. Through DAQA the University ensures that standards and quality of educational provisions are maintained and enhanced. It is important to emphasize that quality assurance is a means to an end not an end in itself. It is a way of defining and securing good learning through continuous research and innovation that offer new and improved ways of supporting student to fit in the dynamic world.

For JKUAT to produce professional leaders, all stakeholders are encouraged to participate actively in the continuous improvement of academic quality. The participation should include information and knowledge sharing to enhance training, research and innovations. Finally, my gratitude goes to the University community for the contribution of their research and publication pieces of information and to the Directorate of Academic Quality Assurance for the production of this Bulletin.

**Prof. Romanus Odhiambo, Ph.D.**
Deputy Vice Chancellor Academic Affairs.

# MESSAGE FROM THE DIRECTOR

Directorate of Academic Quality Assurance (DAQA) was established in June, 2008 to spearhead academic quality assurance in the University. The Directorate is within the Vice chancellors office. Its decision making organ is the Academic Quality Assurance Board. It is headed by the Director who reports to the Vice Chancellor. Below him are two administrative staffs, five Data Entry Clerks and one Clerk. The administrative staffs Mr. Richard Wamalwa and Ms. Alice Simiyu were involved in management and subsequent publication of this bulletin. Director works closely with Deputy Vice Chancellor Academic affairs. The aims of the DAQA include; monitoring academic standards and the quality of provision of programmes of study throughout the University and approved centers; validating and/or reviewing programmes with a view to their viability, market niche and sustainability as well as their academic content, human and physical resource availability, relevance and curriculum design; ensuring consistency of JKUAT quality assurance procedures with national and regional requirements as laid down through Commission for Higher Education (CHE) and Inter-University Council for East Africa (IUCEA) guidelines.

This quality assurance bulletin is the fifth volume to be rolled from DAQA. It contains the research activities that are on-going, the finished research works and the publications in peer refereed journals/ conferences, some audits in CEP centres and some trends in the past four years. The Directorate ensures that quality teaching takes place; through providing instruments like class attendance lists and quality teaching forms. It conducts random checks of continuous assessment tests administration during the semester. It also deals with other quality assurance complaints from stakeholders.

In developing research competences among Departments, Institutes, Faculties, Schools, College and Campuses; the office compiles the quality assurance bulletin annually. The Directorate is fully involved with ISO 9001:2008 quality management system in sustaining the quality of the University products and services with a view to promoting the University's core business of teaching/ learning, training, research, innovation and community service.

The following are some of the obstacles encountered: Lack of quality assurance awareness; Resistance of staff because they feel threatened; There is not enough knowledge on quality assurance available in the University (students resistance to the activity); There is resistance because quality assurance is time consuming and costly; The purpose and the added value are not always clear; Lack of clear communication between the staff and the institutional management. To overcome the problems it is important to: Understand clearly what quality assurance means; Know the available instruments; Know about the requirements set for a quality assurance system; Design the system very clearly and to formulate the strategy to introduce it; Tune the system to external developments.

The quest for quality is not an easy one, especially since there is no absolute quality or objective quality. Nevertheless, we expect University education to assure its quality, to demonstrate its quality and to have its quality assessed by outsiders. For JKUAT quality is fit for the purpose taking on board the customers` expectations through sharing of information.

**Prof.David M.Mulati, Ph.D.**
***Director, Directorate of Academic Quality Assurance***

# SECTION A: COMPEDIUM OF ON-GOING RESEARCH ACTIVITIES

# 1. FACULTY OF SCIENCE

## 1.0 DEPARTMENT OF STATISTICS AND ACTUARIAL SCIENCES

| | |
|---|---|
| *Topic:* | Construction of Robust Confidence Intervals. |
| *Researcher(s):* | Christopher Ouma Onyango, **Romanus Odhiambo Otieno** and George Otieno Orwa. |
| *Status of Research:* | On-going. |
| *Topic:* | Optimizing Crop Production. |
| *Researcher(s):* | Joel Cheruiyot Chelule, **George Otieno Orwa** and Ronald Waweru Mwangi. |
| *Status of Research:* | On-going. |
| *Topic:* | Uniformly most powerful test for the Behren's-Fisher problem. |
| *Researcher(s):* | **Orwa George Otieno**, Otieno Romanus Odhiambo and Odongo Leo Odiwuor. |
| *Status of Research:* | On-going. |

## 1.1 DEPARTMENT OF PURE AND APPLIED MATHEMATICS

| | |
|---|---|
| *Topic:* | Analysis of convective heat transfer of fluid flow over an axi-symmetrical body with curved surfaces. |
| *Researcher(s):* | Duncan kioi, **Prof. Kinyanjui Mathew**, Prof. Kwanza Jackson. |
| *Status of Research:* | On-going. |
| *Topic:* | Error detection and correction in the ISBN code using modulo 13. |
| *Researcher(s):* | Peter Waweru, **Prof. Cecilia Mwathi**, Dr. Kivunge Bernard. |
| *Status of Research:* | On-going. |
| *Topic:* | MHD flow over a stretching surface in a rotating system with heat and mass transfer |
| *Researcher(s):* | Kang'ethe Giterere, Prof. M. Kinyanjui, Prof. S.M. Uppal |
| *Status of Research:* | On-going. |
| *Topic:* | The analysis of hydromagnetic thrust bearing |
| *Researcher(s):* | Phineas Roy Kiogora, **Prof. M. Kinyanjui**, Dr. D. Theuri |
| *Status of Research:* | On-going. |
| *Topic:* | Benoulli equation calculator with its application to leakages in tanks. |

*Researcher(s):* Douglas Wanyama, **Phineas R. Kiogora**, Nicholas Mutua.
*Status of Research:* On-going.

*Topic:* Taylor couttes flow in an annulus.
*Researcher(s):* Kennedy Banda, **Phineas R. Kiogora**, Nicholas Mutua.
*Status of Research:* On-going.

*Topic:* Numerical solution of hydromagnetic flow between two plates.
*Researcher(s):* Mathias Mkichwa, **Phineas R. Kiogora.**
*Status of Research:* On-going.

*Topic:* Investigation on magnetohydrodynamic fluid flow in slider bearing
*Researcher(s):* Wafula .M, **Prof. J. Kwanza**, Dr. J. Okelo.
*Status of Research:* On-going.

*Topic:* Relationship between prime factors of a number and its categorization as either friendly or solitary.
*Researcher(s):* Richard K. Gachimu, **Prof. Cecilia Mwathi**, Dr. I.N .Kamuti.
*Status of Research:* On-going.

*Topic:* Investigating the maximal determinant of an $n\ n$ x$n\ n$ matrix
*Researcher(s):* Okello Irene, **Prof. Cecilia Mwathi**, Dr. B. Kivunge.
*Status of Research:* On-going.

*Topic:* Buoyancy Driven free convention heat transfer in an enclosure
*Researcher(s):* Sigey. J. K, **Gatheri F.K**, Kinyanjui M.N
*Status of Research:* On-going.

*Topic:* Numerical study of buoyancy driven natural convention turbulent in an enclosure
*Researcher(s):* B**. Menge**, J.K. Sigey, F.Gatheri
*Status of Research:* On-going.

## 1.2 DEPARTMENT OF CHEMISTRY

*Topic:* Cellulosic Ethanol synthesis as a Biofuel from locally available Agricultural residues through acidic-basic hydrolytic solvent regimes.
*Researcher(s):* **Okong'o, E. R.,** Osano, A. M., Oyaro, N. K., Chacha, J. S. and Kiptoo, J.
*Status of Research:* On-going.

*Topic:* Production of Cellulosic ethanol from locally available agricultural residues after base hydrolysis using naturally occurring rock salts.
*Researcher(s):* A. Osano, E. Okongo, **J. K. Kiptoo**, N. Oyaro.
*Status of Research:* On-going.

*Topic:* Metal Biosorption studies of green algae and its potential use for biomonitoring of heavy metal pollution.
*Researcher(s):* G. Matei, **J. Kiptoo**, A. Onditi, N. Oyaro.
*Status of Research:* On-going.

| | |
|---|---|
| *Topic:* | Studies on the degradation kinetics and assessment of the levels of some organic-based pesticides in coffee pulping wastewater. |
| *Researcher(s):* | E. Ngumba, **J. Kiptoo**, A. Gachanja. |
| *Status of Research:* | On-going. |
| *Topic:* | Investigation of Wastewater management techniques in selected smallholder tea factories in Kenya |
| *Researcher(s):* | **Dr. Gitu L.** |
| *Status of Research:* | On-going. |
| *Topic:* | Characterization of freshwater algae and evaluation of its Bioethanol and Biodiesel potential |
| *Researcher(s):* | **Dr. Gitu L.** |
| *Status of Research:* | On-going. |
| *Topic:* | Ethanol production from the simultaneous Saccharification and fermentation of pineapple by-products |
| *Researcher(s):* | **Dr. Gitu L.** |
| *Status of Research:* | On-going. |
| *Topic:* | Determination of Aflatoxins in selected livestock feeds. |
| *Researcher(s):* | **Dr. Gitu L.** |
| *Status of Research:* | On-going. |
| *Topic:* | Determination of functional groups of selected plastics for assessment of their degradation. |
| *Researcher(s):* | **Dr. Gitu L.** |
| *Status of Research:* | On-going. |
| *Topic:* | Production and products evaluation of the seed oil and other plant parts of Yellow oleander (*Thevetia peruviana*) plant. |
| *Researcher(s):* | **Keriko, J. M.**; Waihenya, R.; Shitanda, D.; Odhiambo, P.; Karanja, P. N.; Muthuri, C.; |
| *Status of Research:* | On-going. |
| *Topic:* | Fish lipids in Marine and freshwater fishes and their effects on reducing chronic diseases resulting from high cholesterol level intake. |
| *Researcher(s):* | **Keriko, J. M.**; Chege, C. W.; Mwachiro, E.; Githua, M. N. and Mbugua, M. M. |
| *Status of Research:* | On-going. |

## 1.3 DEPARTMENT OF BIOCHEMISTRY

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|---|---|
| *Topic:* | Effects of CLA on PPAR gamma regulated gene expression in HEK cells. |
| *Researcher(s):* | **Fred Wamunyokoli.** |
| *Status of Research:* | On-going. |
| *Topic:* | The role of Zinc and Selenium micronutrients in the progression of HIV/AIDS among patients attending Comprehensive Care Centre in Mwingi District Hospital. |
| *Researcher(s):* | Joy Ochieng and **Fred Wamunyokoli.** |
| *Status of Research:* | On-going. |
| *Topic:* | Isolation and molecular characterization of human Para-influenza type 1 in infants below 36 months attending Mbagathi Hospital, Nairobi, Kenya. |
| *Researcher(s):* | Kimutai, Joshua Kiptinness and **Fred Wamunyokoli.** |
| *Status of Research:* | On-going. |
| *Topic:* | The *Baculovirus* expression vector system as a model for demonstrating the susceptibility of rift valley fever virus to RNA- induced silencing. |
| *Researcher(s):* | Rono, Evans and **Fred Wamunyokoli.** |
| *Status of Research:* | On-going. |
| *Topic:* | Biochemical antimicrobial characterization of antibiotics from *Streptomyces* isolates obtained from national parks in Kenya |
| *Researcher(s):* | Kipkirui, Ngetich Raymond and **Fred Wamunyokoli.** |
| *Status of Research:* | On-going. |
| *Topic:* | Musculoskeletal disorders among nurses at the Moi Teaching and Referral Hospital in Eldoret, Kenya. |
| *Researcher(s):* | Chepkwony, Edna and **Fred Wamunyokoli.** |
| *Status of Research:* | On-going. |

## 1.4 DEPARTMENT OF PHYSICS

| | |
|---|---|
| *Topic:* | Towards high diffraction efficiency Holograms for security applications. |
| *Researcher(s):* | Calvine Ominde, **Dr. Kihara Rurimo** and Dr. George Nyakoe. |
| *Status of Research:* | On-going. |
| *Topic:* | Impact of atmospheric tides of climate models. |
| *Researcher(s):* | Francis Gachari, **Prof. Mulati D. M.** and Dr. Joseph N.Mutuku. |
| *Status of Research:* | On-going. |
| *Topic:* | Determination of ionospheric total electron content value over Kenya during Solar Cycle 24. (Predicted peak, May 2013). |
| *Researcher(s):* | Antony Kiroe, **Dr. James Ngaruiya** and Dr. Waithaka Hunja. |
| *Status of Research:* | On-going. |

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| *Topic:* | Fabrication and characterization of a prototype trough solar collector for steam production. |
| *Researcher(s):* | Millien Kawira, **Dr. Robert Kinyua** and Dr. Joseph N. Kamau. |
| *Status of Research:* | On-going. |
| *Topic:* | Design and fabrication of a cost effective carbon-dioxide laser system. |
| *Researcher(s):* | Gikunda E. Mutuma, **Dr. Kihara Rurimo** and Joseph Mutuku. |
| *Status of Research:* | On-going. |
| *Topic:* | Assessment of quality control in medical diagnostic x-ray facilities in Western region of Kenya. |
| *Researcher(s):* | Matthew Kadima, **Dr. Robert Kinyua** and Dr. Richard Ongeri. |
| *Status of Research:* | On-going. |
| *Topic:* | Determination and assessment of electromagnetic radiation levels for mobile phones used in Kenya. |
| *Researcher(s):* | Wilson Ombati, **Dr. Joseph N. Mutuku** and Dr. Robert Kinyua. |
| *Status of Research:* | On-going. |
| *Topic:* | Determination of naturally occurring radioactive materials and radiation exposure levels at the soap stone quarries of Tabaka region in Kisii district. |
| *Researcher(s):* | Otambo Vincent Otwori, **Dr. Robert Kinyua** and Dr. Richard Ongeri. |
| *Status of Research:* | On-going. |
| *Topic:* | Analysis of wind speeds for Juja on the basis of the weibull model and data collection for wind pattern description. |
| *Researcher(s):* | Saoke Churchill, **Dr. Joseph Kamau** and Dr. Robert Kinyua. |
| *Status of Research:* | On-going. |
| *Topic:* | Solar energy potential assessment in Nakuru town of Kenya and its environ. |
| *Researcher(s):* | Lewis M. Omwando, **Dr. Jared Ndeda**, Dr. Robert Kinyua and Dr. Samuel Marigi. |
| *Status of Research:* | On-going. |
| *Topic:* | A confocal fabry-perot interferometer for analyzing laser frequency stability. |
| *Researcher(s):* | Justus Maithya, **Dr. Kihara Rurimo** and Dr. Joseph Mutuku. |
| *Status of Research:* | On-going. |
| *Topic:* | Design and fabrication of a tunable semi conductor laser for narrow line-width applications. |
| *Researcher(s):* | Wesley Bor Kipkemoi, **Dr. Kihara Rurimo** and Dr. George Nyaoke. |
| *Status of Research:* | On-going. |
| *Topic:* | Conceptual model of Menengai Geothermal prospect: An |

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| | update from New ATM, MT and TEM data. |
| *Researcher(s):* | Daniel Samperu Saitet, **Dr. Maurice Korowe**, Dr. Marita and Prof. Doser. |
| *Status of Research:* | On-going. |
| *Topic:* | Assessment of wind energy potential in the Mwingi/Kitui plateau. |
| *Researcher(s):* | Benjamin Mukulo, **Dr. James N. Ngaruiya** and Dr. Joseph N. Kamau. |
| *Status of Research:* | On-going. |
| *Topic:* | Radiation levels within Titanium mines in Kwale District, Kenya and impact of the mining to the surrounding. |
| *Researcher(s):* | Elijah Sampuli, **Dr. Joseph Mutuku** and Dr. Richard Ongeri. |
| *Status of Research:* | On-going. |
| *Topic:* | An automated water-cum pump and irrigation system. |
| *Researcher(s):* | Bombo Zuma, **Dr. Richard Ongeri** and Dr. Home. |
| *Status of Research:* | On-going. |
| *Topic:* | The potential of perforated ceramic tiles as solar energy absorbers for solar air heating applications. |
| *Researcher(s):* | Guya Wycliffe, **Dr. James Ngaruiya** and Dr. Thomas Thorua. |
| *Status of Research:* | On-going. |
| *Topic:* | Analysis of Wind Speeds for Juja on the basis of the Weibull model and data correlation for wind pattern description. |
| *Researcher(s):* | **R. Kinyua**, C. Saoke, J.N. Kamau. |
| *Status of Research:* | On-going. |
| *Topic:* | Fabrication and characterization of a prototype parabolic trough solar concentrator for steam production. |
| *Researcher(s):* | **R. Kinyua**, M. Kawira, J.N. Kamau. |
| *Status of Research:* | On-going. |
| *Topic:* | Assessment of Solar energy potential in Nakuru, Kenya. |
| *Researcher(s):* | **R. Kinyua**, L.M. Omwando, J. Ndeda. |
| *Status of Research:* | On-going. |
| *Topic:* | Assessment of quality control in medical diagnostic X-ray facilities in the Western region of Kenya. |
| *Researcher(s):* | **R. Kinyua**, M.P. Kadima, P. Mwose. |
| *Status of Research:* | On-going. |

## 1.5 DEPARTMENT OF ZOOLOGY

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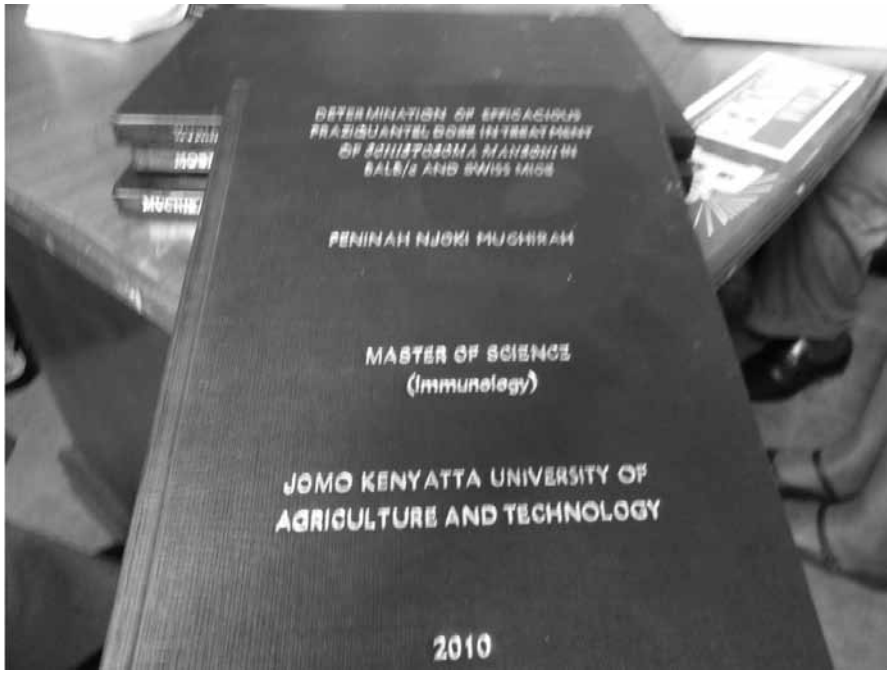
|---|---|
| *Topic:* | Tinega Alex Nyaribo and **Kutima Helen Lydia.** |
| *Researcher(s):* | Evaluation of fusing a cell penetrating peptide to *Theileria parva parva* antigens on the induction of $CD8^+$ cytotoxic T-lymphocyte responses (ILRI, Kenya) |
| *Status of Research:* | On-going. |
| *Topic:* | Kihara, J. H and **Kutima Helen Lydia.** |
| *Researcher(s):* | *Schistosoma haematobium* infection in pregnant women: the effect on anaemia, patho-physiological changes, nutritional status and birth weight outcomes. |
| *Status of Research:* | On-going. |
| *Topic:* | Nyamongo, D. S. and **Kutima Helen Lydia.** |
| *Researcher(s):* | Prevalence of HIV/AIDS among people living in the slums of Nairobi. |
| *Status of Research:* | On-going. |
| *Topic:* | Wasike W. Eric, **Kutima Helen Lydia,** Muya Shadrack and Wamachi A. |
| *Researcher(s):* | Diagnostic Procedures, Epidemiology and Genetic Diversity Of Cryptosporidiosis In Bungoma District, Kenya. |
| *Status of Research:* | On-going. |
| *Topic:* | Antobody response in baboons experimentally inoculated with HIV-I. |
| *Researcher(s):* | **Njenge H.K.** |
| *Status of Research:* | On-going. |




*The University has endeavored to promote capacity building among postgraduate students. For instance, the picture above indicates one of the four Master of Science theses of a student who benefited from JKUAT research funds awarded to Dr. Helen Kutima.*

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| *Topic:* | Determining the potential of kairomonal attractants with colored sticky traps in pest management of Thrips in French Beans and tomatoes |
| *Researcher(s):* | **Muvea Alexander.** |
| *Status of Research:* | On-going. |
| *Topic:* | The efficacy of oduor baited bottom board trap for trapping small hive beetle in honey bee colonies |
| *Researcher(s):* | **Mutyambai Daniel Munyao.** |
| *Status of Research:* | On-going. |
| *Topic:* | Haemoglobin as a measure of HIV disease progression in ARV naïve patients in Nairobi. |
| *Researcher(s):* | **Mutisya Mary.** |
| *Status of Research:* | On-going. |
| *Topic:* | Frequency of variant human cytokine genes in malarial infections with drug resistant parasites in different endemic zones in Kenya |
| *Researcher(s):* | **Undisa, S.M.** |
| *Status of Research:* | On-going. |

# 2. FACULTY OF AGRICULTURE

## 2.0 DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

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|---|---|
| *Topic:* | Commercial and industrial development of papaya (Carica papaya L.): Varietal improvement, production and processing technologies (2008 - 2011). |
| *Researcher(s):* | Freda K. Rimberia Wanzala, S. Wamocho, D. Shitanda, **Arnold N. Onyango.** |
| *Status of Research:* | On-going. |
| *Topic:* | The hard to cook defect in common beans: towards food security and sustainability in sub-Saharan Africa. |
| *Researcher(s):* | **Dr. Daniel N. Sila**, Prof. Marc Hendrickx. |
| *Status of Research:* | On-going. |
| *Topic:* | Improvement in mango production and value-addition: towards increased marketing, food sustainability and security. |
| *Researcher(s):* | **Dr. Daniel N. Sila,** Dr. Fredah Wanzala, Dr. Urbanus Mutwiwa, Dr. James Wambua. |
| *Status of Research:* | On-going. |
| *Topic:* | Nutritional quality, Toxicological Safety and Utilization of insects in Kenya. |
| *Researcher(s):* | John Kinyuru and **Glaston Kenji.** |
| *Status of Research:* | On-going. |
| *Topic:* | Chemical Hazards associated with Agriculture produce irrigated with raw sewage in lower Eastern Nairobi. |
| *Researcher(s):* | S. Mathenge and **G.M.Kenji.** |
| *Status of Research:* | On-going. |
| *Topic:* | Characterization of the diversity of coffee varieties in Kenya by genetic, biochemical and beverage quality profile. |
| *Researcher(s):* | Kathurima CW, **Kenji GM**, Njoroge S. M., Boulanger R. |
| *Status of Research:* | On-going. |
| *Topic:* | Evaluation of contamination levels of honey produced in different regions of Kenya. |
| *Researcher(s):* | Orina, I.N. and **Kenji G.M.** |
| *Status of Research:* | On-going. |
| *Topic:* | Regeneration of Bamboo to diversify the Food-base and Help stem the tide of Deforestation in Kenya. |
| *Researcher(s):* | Karebu M., Kanyi B.and **Kenji G.M.** |
| *Status of Research:* | On-going. |

# 2.1 DEPARTMENT OF HORTICULTURE

*One of the many researches being conducted in the Department of Horticulture*

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|---|---|
| *Topic:* | Production of disease-free papaya (*Carica papaya* L.) planting material of known sex for commercial fruit production in Kenya. |
| *Researcher(s):* | Wanzala, F. K., **Kihurani, A.W**., Mwaniki, M. and Waiganjo, M. M. |
| *Status of Research:* | On-going. |
| *Topic:* | Calibration of lime requirement tests for acid soils of kenya through maize yield and development of a quick liming test kit –intermediate and appropriate technological innovations for enhanced food security. |
| *Researcher(s):* | **E. N. Mugai**, A.B. Nyende and P.G. Kareru. |
| *Status of Research:* | On-going. |
| *Topic:* | Evaluation of the limitations and capacity of scientists in research methods during the planning and implementation of research projects: Case study of Karura Forestry ResearchCentre Kenya. |
| *Researcher(s):* | Nathan Muthoka, **Anthony Waititu**, Losenge and Vincent Oeba. |
| *Status of Research:* | On-going. |
| *Topic:* | Improved Scientific Research at KARI Kakamega Research Centre: A multidisciplinary Approach. |
| *Researcher(s):* | Hildah Wambani, **John Kihoro**, Kamau Ngamau and Maurice Mudeheri. |
| *Status of Research:* | On-going. |

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|---|---|
| *Topic:* | Researsearch Methods Support to groundnut breeding Programme at ICRISAT Malawi. |
| *Researcher(s):* | Harvey Charlie, **Edward Mamati** and Emmanuel S. Monyo. |
| *Status of Research:* | On-going. |
| *Topic:* | The role of research Methods Professional: Capacity building in planning and implementation of Dryland forestry research projects at KEFRI. |
| *Researcher(s):* | Frank Mwangi Chege, **A.B Nyende** and Vincent Oeba. |
| *Status of Research:* | On-going. |
| *Topic:* | Provision of Research Methods Support for Neglected Tropical Diseases Projects at Eastern and Southern African Centre for International Parasite Control (ESACIPAC), Kenya Medical Research Institute (KEMRI), Nairobi. |
| *Researcher(s):* | Paul Mrima Ng'ang'a, **John Kihoro** and Sammy M. Njenga. |
| *Status of Research:* | On-going. |
| *Topic:* | Data and Knowledge management at the international potato Centre (CIP): a case study of CIP sweet potato knowledge portal. |
| *Researcher(s):* | Karen Ayabei, **A.B Nyende** and Jens Riis-Jacobsen. |
| *Status of Research:* | On-going. |
| *Topic:* | Effecting research methods support in Research Stations: A scene of Asian Vegetable Research and Development Centre Regional Centre. |
| *Researcher(s):* | Charles Mubelwa, **Samuel Mwalili** and Christopher Ojiewo. |
| *Status of Research:* | On-going. |
| *Topic:* | Strengthening capacity of technical staff in research Methods for effective implementation of research projects at coastal eco-regional centre, G |
| *Researcher(s):* | Enock Kangogo, **Anthony Waititu**, Losenge and Vincent Oeba. |
| *Status of Research:* | On-going. |
| *Topic:* | Improving the quality of research for development at the Kenya Agricultural Research Institute, Thika-Kenya |
| *Researcher(s):* | Josephine Kiritu, **Caro Mugo** and Jessicah Mbaka. |
| *Status of Research:* | On-going. |
| *Topic:* | Supporting and improving research Methods in the Department of Medical Physiology at the Universityu o f Nairobi. |
| *Researcher(s):* | Cosmas Mugambi, **Samuel Mwalili** and Teresa Kinyari Mwendwa. |
| *Status of Research:* | On-going. |
| *Topic:* | Improving data manageement for potato (Solanum tuberosum L.) variety selection in Malawi. |
| *Researcher(s):* | Rumbidzai Matema Mutasa, **John Kihoro** and Paul Demo. |
| *Status of Research:* | On-going. |

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| *Topic:* | Research Methods Practices: A Case of the Soybeans Improvement Programme in Malawi. |
| *Researcher(s):* | Elliot Simtowe, **Edward Mamati** and Alene Arega. |
| *Status of Research:* | On-going. |
| *Topic:* | Enhancing research support in Research and Development. |
| *Researcher(s):* | Collins Abuga Marita, **Anthony Waititu** and Roger Day. |
| *Status of Research:* | On-going. |
| *Topic:* | Assessment of Research Methods Process: Improving and strengthening research approached used as the Kenya Forestry Research Institute. |
| *Researcher(s):* | Grace Wang'ombe**, A.B. Nyende** and Vincent Oeba. |
| *Status of Research:* | On-going. |
| *Topic:* | Improvig quality of Research through effective Data Management and Capacity Building. |
| *Researcher(s):* | Esther Mwangi, **Samuel Mwalili**, Hunja Murage and Parin Kurji. |
| *Status of Research:* | On-going. |
| *Topic:* | To evaluate the effect of research methodologies on project work plans budget and completion time: A case study of JKUAT research funded projects. |
| *Researcher(s):* | Richard Wamalwa, **Samuel Mwalili** and Martin Obanda. |
| *Status of Research:* | On-going. |
| *Topic:* | Enhancing effective use of research Methods at at the International Potato Centre (CIP): Case study "seet potato action for security and health. |
| *Researcher(s):* | Januaris Mbatha, **A.B Nyende** and Kirimi Sindi. |
| *Status of Research:* | On-going. |
| *Topic:* | Research Methods approaches in innovations in Livestock production systems Research Tean at ILRI, Ethiopia. |
| *Researcher(s):* | Mulugeta Yitayi, **Edward Mamati** and Ranjitha Puskur. |
| *Status of Research:* | On-going. |
| *Topic:* | Improving research Methods on Bean Breeding at Burundi Agronomic Sciences Institute (ISABU). |
| *Researcher(s):* | Nepomuscene Ntukanamazina, **Elijah Ateka**, Caro Mugo and Nkezabahizi Desire. |
| *Status of Research:* | On-going. |
| *Topic:* | Application of Research Methods knowledge and skills in formulartion and execution of innovation projects at Research Production and Extension. |
| *Researcher(s):* | Nancy Waitherero Chege, **John Kihoro** and Martin Obanda. |
| *Status of Research:* | On-going. |
| *Topic:* | Enhancing Crop Livestock systems and Women and Markets: A case of Mozambique in Southern Africa. |
| *Researcher(s):* | Blessing Masamha, **Kamau Ngamau** and Siboniso Moyo. |
| *Status of Research:* | On-going. |

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|---|---|
| *Topic:* | Statistical analysuis of ranking Data from a survey of different tree species in Uganda and Rwanda.*Researcher(s):* Ronald Muchelo Omeli, **Samuel Mwalili**, C. Muthuri Fergus Sinclaire and Dr. Anja Gassner. |
| *Status of Research:* | On-going. |
| *Topic:* | Contribution to Research Methodology through capacity building at World Agroforestry Centre (ICRAF) Rwanda |
| *Researcher(s):* | Gregoire Hagenimana, **Elijah Ateka**, Caro Mugoathanase Mukurarinda and Anja Gassner. |
| *Status of Research:* | On-going. |
| *Topic:* | Research support at International Potato Centre-Uganda using the cloneselector. |
| *Researcher(s):* | Shiphar Mulumba, **Anthony Waititu** and Mwanga Robert. |
| *Status of Research:* | On-going. |
| *Topic:* | Approaches of research methods in strengthening Quality for horticultural research at the Kenya Agricultural Research Institute. |
| *Researcher(s):* | Deborah Omayio Bikoro, **Caro Mugo** and M.M Waiganjo. |
| *Status of Research:* | On-going. |
| *Topic:* | Effecting research methods support in large surveys: a scene for the climate change, agriculture and food security baseline survey in Africa. |
| *Researcher(s):* | Silas Ochieng Otieno, **Kamau Ngamau** and Patti Kristjanson. |
| *Status of Research:* | On-going. |
| *Topic:* | Research Suppoer to NEPAD Fish Project in Malawi. |
| *Researcher(s):* | Salima Chimwemwe, **John Kihoro** and E.K. Kaunda. |
| *Status of Research:* | On-going. |
| *Topic:* | An Inquiry into Research Methods Practices at Center for Agricultural Research and Development-Malawi. |
| *Researcher(s):* | Maxwel Mkondiwa, **Edward Mamati** and Charles B.L. Jumbe. |
| *Status of Research:* | On-going. |
| *Topic:* | Providing research Support to the international Livestock research Institute (ILRI) markets theme department. |
| *Researcher(s):* | Barbara Mayoba Moono, **Elijah Ateka** and Isabelle Baltenweck. |
| *Status of Research:* | On-going. |
| *Topic:* | Characterization of commercial mobydick (*Asclepias spp.)* grown in Kenya. |
| *Researcher(s):* | **A.O. Watako** and Saggafu Malim Masito M. |
| *Status of Research:* | On-going. |

# 3. FACULTY OF ENGINEERING

## 3.0 DEPARTMENT OF BIOMECHANICAL AND ENVIRONMENTAL ENGINEERING (BEED)

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|---|---|
| *Topic:* | Design and development of a rice harvester for Kenya: Phase I-design of crop cutting and windrowing mechanism. |
| *Researcher(s):* | **Kanali, C.L.**, Makanga, J.T., Mailutha, J.T., Home, P.G., Mulamu, L.O. |
| *Status of Research:* | On-going. |
| *Topic:* | Application of genetic algorithms for optimization of on-farm machine design parameters for eco-efficient timber processing. |
| *Researcher(s):* | G.M. Muthike, D. Shitanda, **C.L. Kanali**, F.N. Musiu. |
| *Status of Research:* | On-going. |
| *Topic:* | Determining the Scientific Basis for Up-Scaling the System of Rice Intensification (SRI), for Increased Rice Production in Kenya. |
| *Researcher(s):* | **B.M. Mati**, R. Wanjogu, B. Odongo and P.G. Home. |
| *Status of Research:* | On-going. |
| *Topic:* | Evaluation of capillary wicks for use in irrigation for intensive horticultural crop production in Kenya. |
| *Researcher(s):* | J. Wesonga, P. Masinde, **P.G. Home**, F. Ombwara. |
| *Status of Research:* | On-going. |
| *Topic:* | Water saving irrigation technologies for ASAL areas. |
| *Researcher(s):* | C.K. Njoroge, **P.G. Home**, P. Masinde. |
| *Status of Research:* | On-going. |
| *Topic:* | Increasing rice productivity in Kenya. |
| *Researcher(s):* | **E. Kahangi**, H. Murage, P.G. Home |
| *Status of Research:* | On-going. |
| *Topic:* | Development of rice harvester. |
| *Researcher(s):* | **J.T. Makanga**, J.T. Mailutha, C.L. Kanali, P.G. Home, L.O. Mulamu. |
| *Status of Research:* | On-going. |
| *Topic:* | Improvement in Mango Production and Value-Addition: Towards Increased Marketing, Food Sustainability and Security. |
| *Researcher(s):* | D. N. Sila, **U. N. Mutwiwa**, F. Wanjala, K. Wambua. |
| *Status of Research:* | On-going. |

## 3.1 DEPARTMENT OF MECHATRONICS ENGINEERING

*Topic:* Design and Development of an Electro Discharge Machine.
*Researcher(s):* **Ikua B.W**., Nyakoe G. N., Keraita J. N.
*Status of Research:* On-going.

*Topic:* Developing an integrated maintenance optimization model to improve the local maintenance practice.
*Researcher(s):* **Muchiri K. A.**, Ikua B.W., Kibicho K.
*Status of Research:* On-going.

*Topic:* Modelling of Bulge Formation in Polymers during Laser Micromachining.
*Researcher(s):* **Ndeda R**., Keraita J. N., Kioni P. N.
*Status of Research:* On-going.

*Topic:* Development and Analysis of $CO_2$ Laser Engraving System.
*Researcher(s):* **Wairimu G**., Ikua B. W., Kioni P. N.
*Status of Research:* On-going.

*Topic:* Development of Brown Paper Converting Machine.
*Researcher(s):* **Muchiri K. A**., Nduati.
*Status of Research:* On-going.

*Topic:* Development of a vision guided autonomous mobile robot with wireless communication capability.
*Researcher(s):* **Nyakoe G. N**., Ikua B. W.
*Status of Research:* On-going.

*Topic:* Design of an Adaptive Controller for the Cylindrical Grinding Process.
*Researcher(s):* **Kabini S. K**., Ikua B. W., Nyakoe G. N.
*Status of Research:* On-going.

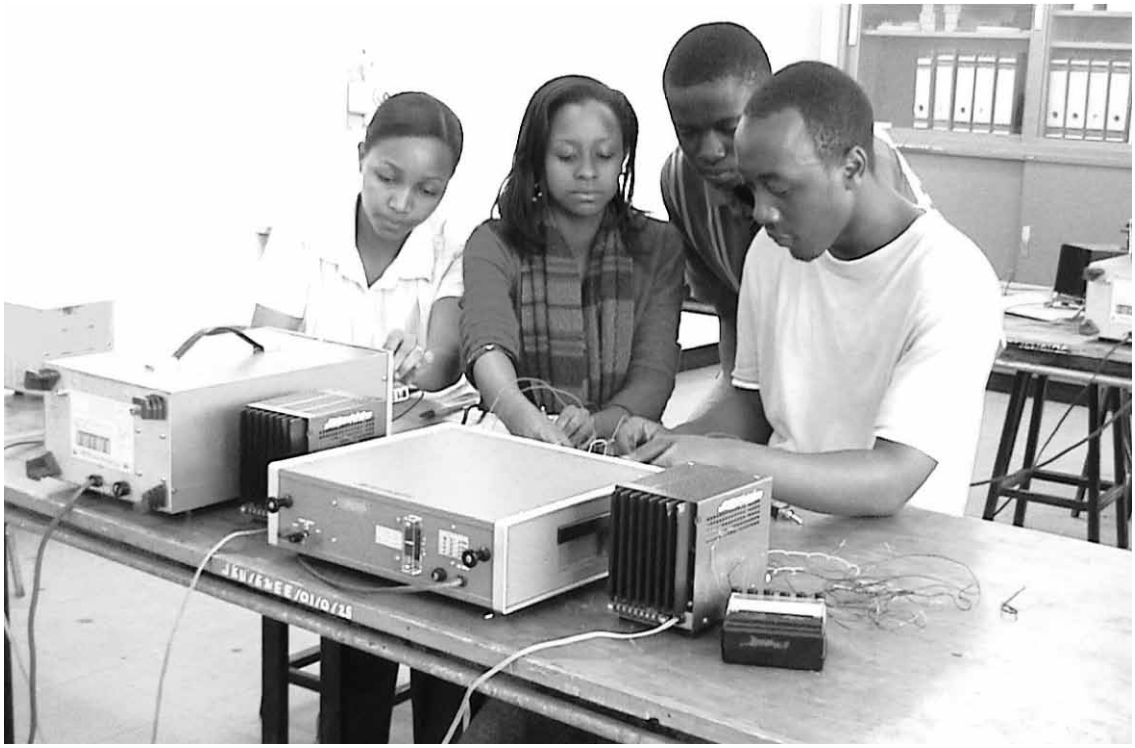
*Topic:* Optimization of Fuel Consumption in Hybrid Wind-Diesel-Storage system using a Neuro-Fuzzy Controller.
*Researcher(s):* **Owino L**. A., Nyakoe G. N., Kibicho K.
*Status of Research:* On-going.

*Topic:* Optimization of Ultrasonic Waves in a Powder transport system.
*Researcher(s):* **Wanjiru E. M**., Kihiu J. M., Nyakoe G. N., Mutuli S.
*Status of Research:* On-going.

*Topic:* Design of a $CO_2$ laser Beam Delivery system to optimize the influence of surface inclination on cut quality.
*Researcher(s):* **Gituku E. W**., Ikua B. W., Nyakoe G. N.
*Status of Research:* On-going.

*Topic:* Improving Solar Cell Efficiency using Lead Selenium nanocrystals
*Researcher(s):* **Toroitich L. R**., Ikua B. W., Nyakoe G. N.
*Status of Research:* On-going.

## 3.2 DEPARTMENT OF ELERTICAL AND ELECTRONIC ENGINEERING



*Students during practical session in the School of Electrical, Information and Electronic Engineering (SEIEE)*

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|---|---|
| *Topic:* | Underdetermined blind speech de-noising for enhanced teleconferencing using machine intelligence. |
| *Researcher(s):* | **Denis Ombati**, Dr. E. N. Ndung'u and Dr. L. M. Ngoo. |
| *Status of Research:* | On-going. |
| *Topic:* | Design and Analysis of Neural Fuzzy Based DC-DC Converter Controller Optimized with Swarm Intelligence. |
| *Researcher(s):* | **Kanai .M Michael**, John .N Nderu and Peterson .K. Hinga. |
| *Status of Research:* | On-going. |
| *Topic:* | Performance analysis of mobile ad hoc network routing protocols using Self Organising Map (SOM). |
| *Researcher(s):* | **Mureu Ephraim W.**, Stephen Musyoki and Peter Kihato |
| *Status of Research:* | On-going. |
| *Topic:* | Impact of Fuzzy and Neural Network Techniques in Dynamic Load Modelling for Voltage Stability Analysis. |
| *Researcher(s):* | **C. M. Muriithi**, L. M. Ngoo, G. N. Nyakoe. |
| *Status of Research:* | On-going. |
| *Topic:* | Impact of Spartial Diversity Techniques In Combating Interference and Multipath Fading in Wireless Communication Systems. |
| *Researcher(s):* | **Muiga Rugara**, D. O. Konditi, S. Musyoki. |
| *Status of Research:* | On-going. |

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| *Topic:* | Kenyan Power System Reactive Power Compensation and Transmission Line Power Transfer Capacity Improvement. |
| *Researcher(s):* | **R. Njoroge**, K. Kaberere, A. Akumu. |
| *Status of Research:* | On-going. |
| *Topic:* | Electronic Load Controller for Mini/Micro Hydro Power Generation. |
| *Researcher(s):* | **C. K. Kitur**, J. N. Nderu, K. Kaberere. |
| *Status of Research:* | On-going. |
| *Topic:* | Application of Neuro-Fuzzy Control Technique in a Three-phase Hybrid Power Filter for Harmonic Mitigation. |
| *Researcher(s):* | **Nelson K Bett**, P. K. Hinga, J. N. Nderu |
| *Status of Research:* | On-going. |
| *Topic:* | Sensitivity and Comparison of Load Modeling Using Digsilent Powerfactory. |
| *Researcher(s):* | **J.K. Muriuki**, C. M. Muriithi, D. K. Murage. |
| *Status of Research:* | On-going. |
| *Topic:* | Voltage Stability Analysis of the 66kV Nairobi Area Network. |
| *Researcher(s):* | **S. Oketch**, C. M. Muriithi, K. K. Kaberere. |
| *Status of Research:* | On-going. |
| *Topic:* | Adaptive Real-Time and Virtual Monocular Car Vision using Modular Artificial Neural Networks. |
| *Researcher(s):* | **Inno Odira**, P. K. Kihato, S. I. Kamau. |
| *Status of Research:* | On-going. |
| *Topic:* | Harmonics and Power Factor Controller in Unbalanced Three Phase System Using Fuzzy Logic Controller. |
| *Researcher(s):* | **Charles Ndung'u**, L. M. Ngoo, J. N. Nderu. |
| *Status of Research:* | On-going. |
| *Topic:* | Application of Neural Network for Short Term Load Forecasting. |
| *Researcher(s):* | **Ireri T. Gichovi**, N. O. Abungu, D. K. Murage. |
| *Status of Research:* | On-going. |
| *Topic:* | Enhancement Of Electrical Power Supply Using Grid Connected Photovoltaic Generation: A Case Study Of Nairobi Embakasi Suburb. |
| *Researcher(s):* | **G.G. Kidegho**, K.K. Kaberere, M.S. Mbogho. |
| *Status of Research:* | On-going. |
| *Topic:* | Design and Simulation of a Fuzzy Logic Traffic Controller for a Signalized Intersection. |
| *Researcher(s):* | **C.M. Mwangi**, S. Kang'ethe, G. N. Nyakoe. |
| *Status of Research:* | On-going. |

## 4. INSTITUTE OF BIOTECHNOLOGY RESEARCH (IBR)

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|---|---|
| *Topic:* | Molecular analysis of biofortified cassava with pro-vitamin A in confined field trials. |
| *Researcher(s):* | **A. B. Nyende**, P. K. Telengech and Joyce Malinga. |
| *Status of Research:* | On-going. |
| *Topic:* | Agrobacterium-mediated transformation of pigeon pea with CRYAcgene for pod borer resistance. |
| *Researcher(s):* | **A. B. Nyende**, P. A. Okemo, J. Machuka and S. de Villiers. |
| *Status of Research:* | On-going. |
| *Topic:* | Screening and genetic analysis of somaclonal variants and mutants of sorghum for drought and salinity tolerance. |
| *Researcher(s):* | Makobe, **A.B. Nyende** and E. Njue, J. Mwende. |
| *Status of Research:* | On-going. |
| *Topic:* | Development of an in vitro protocol for the elimination of viruses from banana. |
| *Researcher(s):* | **A.B. Nyende**, E. Ateka and G. Mungai. |
| *Status of Research:* | On-going. |
| *Topic:* | Elimination of cassava brown streak virus from infected cassava. |
| *Researcher(s):* | **A.B. Nyende**, and E. Ateka. |
| *Status of Research:* | On-going. |
| *Topic:* | Diversity of white rot fungi from selected horticultural farms and their potential in biodegradation of pesticides. |
| *Researcher(s):* | Magoma, Ochora, A.B**. Nyende** and O. Nyakundi. |
| *Status of Research:* | On-going. |
| *Topic:* | Screening, yield evaluation and genetic finger printing of Drought Tolerant Orange-Fleshed Sweet potato (*Ipomoea batatas Lam*) hybrid clones for East Africa. |
| *Researcher(s):* | **A.B. Nyende**, P. Masinde. K. Ngamau and S. Agili. |
| *Status of Research:* | On-going. |
| *Topic:* | Distribution, diversity and conservation of yam species in Kenya. |
| *Researcher(s):* | **A.B. Nyende**, E. Mamati and Z. Muthamia. |
| *Status of Research:* | On-going. |
| *Topic:* | Molecular characterisation, regeneration and agrobacterium mediated transformation of Jatropha Curcas. |
| *Researcher(s):* | **A.B. Nyende**, J. Onguso, J. Machuka and C. Mweu. |
| *Status of Research:* | On-going. |
| *Topic:* | Selection of quality and resistance to coffee Berry Disease in the coffee Arabica L. Composite cultivar, Ruiru 11. |
| *Researcher(s):* | **A.B. Nyende**, E. Mamati, and M. Gichimu. |
| *Status of Research:* | On-going. |

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|---|---|
| *Topic:* | Genetic characterization of Hiv-1 subtypes vertically transmitted from mother to child within Nairobi. |
| *Researcher(s):* | King'oo, J. M., Khamadi S. A., Muigai A. W., Waihenya R. and **Onguso, J. M.** |
| *Status of Research:* | On-going. |
| *Topic:* | Phynotypic and molecular characterization of pathogenic *Vibrio cholerae* isolated from cholera outbreaks in Western Kenya. |
| *Researcher(s):* | Maranga, R. M., **Onguso, J. M.** andYoshio, I. |
| *Status of Research:* | On-going. |
| *Topic:* | Micropropagation (Tissue culture) and Macropropagation of *Strychnos henningsii* for sustainable conservation. |
| *Researcher(s):* | Ngeno K. R., Njenga, P., Ngumi, V., Kahia, J. and **Onguso, J. M.** |
| *Status of Research:* | On-going. |
| *Topic:* | Collection and molecular characterization of of wild *Pleorotus* mushrooms in Kenya. |
| *Researcher(s):* | Ojwang D., **Onguso, J. M., M**atasyo, L.G. and Mutisya, J. |
| *Status of Research:* | On-going. |
| *Topic:* | Improvement of *Jatropha curcas* for oil production using genetic transformation techniques. |
| *Researcher(s):* | Mweu, C. M., Nyende, A. B., Machuka, J. and **Onguso, J. M.** |
| *Status of Research:* | On-going. |
| *Topic:* | Efficacy of commercial biological and chemical products on root health and nutrient uptake of tissue culture banana under different soil conditions in Kenya. |
| *Researcher(s):* | Kavoo A. M., Kahangi, E. M., Ateka. E.M. and **Onguso, J. M.** |
| *Status of Research:* | On-going. |
| *Topic:* | Genetic identification and extracellular enzymes of endophytic isolate from local banana (*Musa spp*) on solid media. |
| *Researcher(s):* | Maina, P. N., Kahangi, E. M., **Onguso, J. M.** and Losenge T. |
| *Status of Research:* | On-going. |
| *Topic:* | Characterization of soil nematodes from small scale tea growing areas in Kenyan. |
| *Researcher(s):* | Kosigei. K. T., Kinyua, J., Mamati, E, G. **Onguso, J. M.** and Kariuki, D. |
| *Status of Research:* | On-going. |
| *Topic:* | Mass micropropagation of A*loe vera* L. through leaf derived callus. |
| *Researcher(s):* | Mweu, C.M., **Onguso, J. M.**, Rugetho, J.N. and Nyende A. B. |
| *Status of Research:* | On-going. |

# 5. INSTITUTE OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY (ICSIT)

## 5.0 DEPARTMENT OF COMPUTING DEPARTMENT

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|---|---|
| *Topic:* | Risk Management in Financial Information System |
| *Researcher(s):* | **Dr. Waweru Mwangi**, Ms. Ann Kibe. |
| *Status of Research:* | On-going. |
| *Topic:* | Inteligent Automated Teller Machine. |
| *Researcher(s):* | **Dr. Waweru Mwangi**, Mr. David Kamau Biaru |
| *Status of Research:* | On-going. |
| *Topic:* | Fuzzy Model in Software Quality Metrics for Predicting Maintainability. |
| *Researcher(s):* | **Dr. Waweru Mwangi**, Ms. Joan Gichuru. |
| *Status of Research:* | On-going. |
| *Topic:* | Information Technology Security in Small and Medium Enterprises (SME's). |
| *Researcher(s):* | **Dr. Waweru Mwangi**, Dr. Stephen Kimani, Mr. Michael Kimwele. |
| *Status of Research:* | On-going. |
| *Topic:* | Automated Content Manager for research Management System |
| *Researcher(s):* | **Dr. Waweru Mwangi**, Mr. John Njue. |
| *Status of Research:* | On-going. |

# 6. INSTITUTE OF ENERGY AND ENIVIRONMENTAL TECHNOLOGY (IEET)

*Topic:* The role of community wildlife conservancies in the management of resource conflicts in Kenya using GIS and strategic environmental assessment (SEM).
*Researcher(s):* Gichuhi, M. W.; Mwaura, C.; **Keriko, J. M.** and Kitetu, J. J.
*Status of Research:* On-going.

*Topic:* An Assessment of pollution status of Lake Naivasha and Potential for Utilization of Geothermal fluids for Irrigation and solution mining
*Researcher(s):* Njogu, P. M.; **Keriko, J. M.** and Kitetu, J. J.
*Status of Research:* On-going.

*Topic:* Development of anti-malarial briquettes from pyrethrum and *Jatropha carcus* seed cake.
*Researcher(s):* Nyakairo, K.; **Keriko, J. M**. and Karanja, H. K.
*Status of Research:* On-going.

*Topic:* The impact of prosecution on the status of health and safety in work places in Kenya.
*Researcher(s):* Nyakego, J. B.; **Keriko, J. M.**; Pete, Peter.
*Status of Research:* On-going.

*Topic:* Effects of work injury compensation on an organization's profitability and its implication on the Kenyan economic growth.
*Researcher(s):* Ndegwa, O. T.; **Keriko, J. M.;** Mburu, C.
*Status of Research:* On-going.

*Topic:* Workplace fires: An assessment of fire safety measures in supermarkets within Nairobi.
*Researcher(s):* Karanja, I. W.; **Keriko, J. M.;** Mburu, C.
*Status of Research:* On-going.

*Topic:* Nairobi Household solid waste management practices: Need for re-designing.
*Researcher(s):* Mutuku, D. M.; **Keriko, J. M.** and Njogu, P. M.
*Status of Research:* On-going.

*Topic:* Impact of safety committee on organizational safety and health: A case of limited companies at the Nairobi Stock Exchange.
*Researcher(s):* Tuitoek, N. K.; Kitetu, J. J.; **Keriko, J. M.**
*Status of Research:* On-going.

*Topic:* Determination of some heavy metals and fish lipids classes in common freshwater fish species in selected Kenyan waters.
*Researcher(s):* Mbugua, M. M.; **Keriko, J. M.** and Kareru, P. G.
*Status of Research:* On-going.

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|---|---|
| *Topic:* | Accidents involving motocycle taxis: An emmerging road safety poblem in Kenya. |
| *Researcher(s):* | Bartich, P. C., **Keriko, J. M.** and Kiiyukia, C. |
| *Status of Research:* | On-going. |
| *Topic:* | Impact of integrating road safety in trucking industry: A case study of some multiple hauling companies. |
| *Researcher(s):* | Makau, I. K.; **Keriko, J. M.** and Kitetu, J. J. |
| *Status of Research:* | On-going. |
| *Topic:* | Investigation of the 'Savannah Hypothesis' and comfort in workplaces. |
| *Researcher(s):* | Muruka, A. O.; **Keriko, J. M.** and Shinji, M. |
| *Status of Research:* | On-going. |
| *Topic:* | Phytoremediation of heavy metals using Arrowroots (*Colocasia esculanta*) found in Meru region. |
| *Researcher(s):* | Kimathi, E. T.; **Keriko, J. M.**; Nyagah, C. G. and Njenga, J. W. |
| *Status of Research:* | On-going. |
| *Topic:* | Up-scaling of Soil-Water Management (SWM) Technologies and drought tolerant of maize varieties for increased productivity in Eastern and Central African countries (ASARECA-CGS Stream B Projects). |
| *Researcher(s):* | Mwangi, H. W. (Ken); **Keriko, J. M. (Ken);** Mgonja, F. M. (Tz); Matowo, P. (Tz); Admassu H. (Et); Wagari, D. (Et), Debele, T. (Et). |
| *Status of Research:* | On-going. |
| *Topic:* | Assessment of the effectiveness and Public acceptance of Wildlife Conservation and Management Systems in Kenya. |
| *Researcher(s):* | **Margaret Gichuhi.** |
| *Status of Research:* | On-going. |
| *Topic:* | Eco paint for Adobe based Constructions. |
| *Researcher(s):* | **Benson Karanja.** |
| *Status of Research:* | On-going. |
| *Topic:* | Development of a Wind Resource Assessment Model for areas with Dominant Thermal effects with specific reference to Kenya. |
| *Researcher(s):* | **Francis Xavier Ochieng.** |
| *Status of Research:* | On-going. |
| *Topic:* | Waste to Energy – Conversion of the Organic Component of Municipal solid waste to electricity. |
| *Researcher(s):* | **Eng. Sylvia Njeri Kahiu.** |
| *Status of Research:* | On-going. |
| *Topic:* | Benefit – Cost analysis of Solar Water Pumping Systems in Kenya. |
| *Researcher(s):* | **R. Kinyua** and Maina M.N. |
| *Status of Research:* | On-going. |

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|---|---|
| *Topic:* | An evaluation of the Ministry of Energy's Solar PV Programme for Public Institutions in ASAL regions of Kenya – Technical and Social-Economic aspects. |
| *Researcher(s):* | **R. Kinyua** and Kabiro P.M. |
| *Status of Research:* | On-going. |

# 7. INSTITUTE OF TROPICAL MEDICINE AND INFECTIUOS DISEASES (INTROMID)

## 7.0 DEPARTMENT OF MEDICAL LABARATORY SCIENCES

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| *Topic:* | The Baculovirus Expression Vector System and a Model for Demonstrating the Susceptibility of Rift Valley Fever Virus to RNA-induced Gene Silencing. |
| *Researcher(s):* | E. Rono, D. Masiga and **J. R. Ongus.** |
| *Status of Research:* | On-going. |
| *Topic:* | Development of Replenishable, Cost Effective and Stable ELISA Reagents for the detection of Chikungunya Virus Infection. |
| *Researcher(s):* | C. Wasonga, **J. R. Ongus**, L. Musila and R. Sang. |
| *Status of Research:* | On-going. |
| *Topic:* | Molecular Sub-typing of Wild-Type Rubella Viruses Circulating in Kenya. |
| *Researcher(s):* | F. Mbugua, G. G. Mbugua, **J. R. Ongus** and W. Bulimo. |
| *Status of Research:* | On-going. |
| *Topic:* | Characterization of Human Metapneumoviruses in Kenya |
| *Researcher(s):* | R. Nzunza, **J. R. Ongus,** J. B. L. Check M. K. Njenga and W. Bulimo. |
| *Status of Research:* | On-going. |
| *Topic:* | Genetic differentiation and Vector competence of *Aedes aegypti* mosquitoes from the coastal and inland regions of Kenya for Chikungunya virus, under varying extrinsic incubation temperature and relative humidity. |
| *Researcher(s):* | J. J. L. Lutomiah, **J. R. Ongus.** |
| *Status of Research:* | On-going. |
| *Topic:* | Paediatric Blood Transfusion Practices at Nyanza Provincial General Hospital, Kisumu, Kenya, 2007/2008. |
| *Researcher(s):* | J. O. Ndinya, **J. R. Ongus** and R. Juma. |
| *Status of Research:* | On-going. |
| *Topic:* | Risk Factors Associated With Loss-to-Follow-Up Adults Patients at the Mbagathi District Hospital Comprehensive Care Clinic, Nairobi. |
| *Researcher(s):* | S. N. Gathu, **J. R. Ongus** and P. Wanzala. |
| *Status of Research:* | On-going. |
| *Topic:* | Seroprevalence of Dengue Viruses in Patients With Fever Visiting Alupe District Hospital and KEMRI/CIPDCR Alupe Health Facility. |
| *Researcher(s):* | J. A. Awando, **J. R. Ongus** and M. Mwau. |
| *Status of Research:* | On-going. |

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| *Topic:* | Dried Blood Spots and Saliva as Alternative Specimens to Serum in the Detection of Rubella Virus-Specific IgM By ELISA. |
| *Researcher(s):* | R. Chelangat, **J. R. Ongus** and J. Kombich |
| *Status of Research:* | On-going. |
| *Topic:* | Co-infections between Selected Arboviruses and HIV, Hepatitis B Virus and/or Hepatitis C Virus among Febrile Patients at Selected Health Facilities in Trans Nzoia District, Kenya. |
| *Researcher(s):* | N. R. Demba, J. Ouma, **J. R. Ongus** and M. Mwau. |
| *Status of Research:* | On-going. |
| *Topic:* | Determinants of Uptake of the Human Papilloma Virus Vaccines by Health Care Workers in Nairobi, 2009. |
| *Researcher(s):* | L. A. Osamong, J. Mutai and **J. R. Ongus.** |
| *Status of Research:* | On-going. |
| *Topic:* | Identification of Rotavirus strains Affecting Young Rotavirus-vaccinated children < 5 years old with Gastroenteritis in Nairobi. |
| *Researcher(s):* | M.T. Agutu, **J. R. Ongus** and J. Kombich. |
| *Status of Research:* | On-going. |
| *Topic:* | Tuberculosis recurrence and risk factors associated with multidrug resistance in TB patients attending various clinics in Nairobi, Kenya. |
| *Researcher(s):* | **P. W. Ndung'u**, **Z. Ng'ang'a** and G. Revathi. |
| *Status of Research:* | On-going. |
| *Topic:* | Toxicological characterization of Kenyan snake venoms with a view to development of an antivenin. |
| *Researcher(s):* | **Joseph K. Gikunju,** Kareru P.G and Njonge F.K. |
| *Status of Research:* | On-going. |
| *Topic:* | Pharmacological and epidemiological investigation of snake envenomation in Kenya. |
| *Researcher(s):* | **Joseph K. Gikunju,** Kareru P.G .Ochola F, Muchemi G. |
| *Status of Research:* | On-going. |
| *Topic:* | Characterization of toxic proteins in Kenyan snake venoms. |
| *Researcher(s):* | **Gikunju, J K** Kareru P.G Njonge F.K.Otieno, Kimani, Muigai. |
| *Status of Research:* | On-going. |

# 8. NAIROBI CENTRE CAMPUS

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| *Topic:* | Anti-malarial and Chemical Studies in *Microglossa pyrifolia* and *Trimeria glandifolia.* |
| *Researcher(s):* | Omollo, J.; Rukunga, G. M. and **Keriko, J. M.** |
| *Status of Research:* | On-going. |
| *Topic:* | Phytochemical and anti-helminthic activity of *Entada leptostachya* and *Rapanea rhododendroides.* |
| *Researcher(s):* | Omigo M. O.; Kareru, P. G.; Rukunga, G. M.; Mbaria, J.; **Keriko, J. M.** |
| *Status of Research:* | On-going. |
| *Topic:* | Anti-malarial and Anti-leishmanial Studies of Some Selected Medicinal Plants of Kenya. |
| *Researcher(s):* | Elizabeth V. M. Kigondu; **Keriko, J. M.;** Rukunga, G. M. and Yenesew, Abiy. |
| *Status of Research:* | On-going. |
| *Topic:* | Efficacy and Chemistry of Potential Anti-malarial Compounds from Some Selected Kenyan Medicinal Plants. |
| *Researcher(s):* | Muthaura, C.; **Keriko, J. M.**; Rukunga, G. M. and Derese, S. |
| *Status of Research:* | On-going. |
| *Topic:* | Pharmaceutical Formulation Development Involving Excipients of Problem Drugs Manufactured in Kenya. |
| *Researcher(s):* | Ouko, S. P. A.; Keriko**, J. M.**; Rukunga, G. M. and Orwa, A. |
| *Status of Research:* | On-going. |
| *Topic:* | Anti-schistosomal properties of *Chenopodium ambrosoides* (Wormseed) against the parasite *S. mansoni* in mice. |
| *Researcher(s):* | Moilo, J. M.; Yole, D.; **Keriko, J. M.** and Mkoji, O. |
| *Status of Research:* | On-going. |
| *Topic:* | The characteristic absorption of pavaquone, bupavaquone and related drugs. |
| *Researcher(s):* | Ronoh W.; **Keriko, J. M.** and Rukunga, G. M. |
| *Status of Research:* | On-going. |
| *Topic:* | In search of Leads for *Mycobacterium tuberculosi.* |
| *Researcher(s):* | Muriuki, B.; **Keriko, J. M.** and Midiwo, J. O. |
| *Status of Research:* | On-going. |
| *Topic:* | Respiratory health of *Jua Kali* garage workers in Nairobi, Kenya. |
| *Researcher(s):* | Mungoma, M.; **Keriko, J. M.** and Mbakaya, C. L. |
| *Status of Research:* | On-going. |
| *Topic:* | Health Effects Associated with Occupational Exposure to Organic Solvents Among Construction Company Painters in Nairobi. |

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| *Researcher(s):* | Machache, M. E.; Mbakaya, C. L. and **Keriko, J. M.** |
| *Status of Research:* | On-going. |
| *Topic:* | Socio-Economic impact of diabetes mellitus among patients in Mikindani Health Centre, Mombasa, Kenya. |
| *Researcher(s):* | Mwaih, A. Judy, **Keriko, J. M.** and Mutai Joseph. |
| *Status of Research:* | On-going. |
| *Topic:* | Hearing Lose Impairment among industrial workers in Nairobi |
| *Researcher(s):* | Gachomo, J.; **Keriko, J. M.** and Mbakaya, C. L. |
| *Status of Research:* | On-going. |
| *Topic:* | Formulation of innovative processing technology for herbal medicine and fabrication of allied equipments. |
| *Researcher(s):* | Njoroge, C. K.; Shitanda, D. and **Keriko, J. M.** |
| *Status of Research:* | On-going. |

# SECTION B: COMPENDIUM OF COMPLETED RESEARCH ACTIVITIES

## 1. FACULTY OF SCIENCE

## 1.0 DEPARTMENT OF STATISTICS AND ACTUARIAL SCIENCES

*Title:* Optimal Admissibility for the Bayesian and Frequentist Estimation Approaches with to actuarial Sciences.

*Researcher(s):* Wakaba Mabel Riri, **Romanus Odhiambo Otieno** and George Otieno Orwa.

*Background:* The Bayesian Frequentist estimation can be modeled with respect to their various properties. In this study, general admissibility has been derived for the two approaches and with respect to the application in Actuarial Sciences. Thereafter using simulated data with the Poisson distribution as the underlying distribution, the viability of the derived admissibility has been demonstrated.

*Methods:* In our study, we have considered $X_i$, i =1, 2, 3...., and have used these $X_i$ to construct an estimate of the parameter $\theta_i$, which is the parameter governing underlying distribution. The idea in our work was to interrupt the experiment after $X_2$, and assuming that $X_1$ contains information used to construct $\theta_1$ and that $\theta_1$ is used to estimate $\theta$.

*Results:* Similarly X2 contains information used to construct $\hat{\theta}_2$, etc i.e we have a series of Xi's, and these whether truncated at any point pt, can help estimate $\theta$.

*Conclusions:* So, in our construction, we looked at the Bayesian estimation of $\theta_2$ using $\hat{\theta}_2$ and also the Frequentist construction of $\hat{\theta}_2$ to estimate the same $\theta_2$.

*Title:* Ordinal Regression versus Multiple Binary Logistic Regression Model for Predicting Student Loan Allocation.

*Researcher(s):* Dennis Kariuki Muriithi, **John Mwaniki Kihoro** and Anthony Gichuhi Waititu.

*Background:* This study involves modeling HELB loan application data from three public universities to investigate whether the loan was allocated based on needs of the respected applicants. The data was classified into two natural categories of those not allocated the loan (1) and those allocated the loan (1).

*Methods:* This study classifies further to consider the amount awarded by the HELB. This was possible since we observed that HELB loan was awarded in district categories. Ordinal logistic model determines the cumulative probability of being allocated a certain amount. A model was created that included all predictor variables that were useful in predicting the response variable. The goal of binary logistic regression was to correct predict the category of the outcome for individual cases using the most appropriate model.

*Results:* The three quarter of the data was used to develop model and remaining quarter for models validation. Eventually, we compared the interpretation of ordinal logistic regression model with binary logistic regression.

*Conclusions:* In particular, this study intended to determine the accurate model / criteria that will enable HELB make viable awarding decision. It is expected that proper determination of most accurate model/ criteria will go along way in minimizing the number of misclassification when awarding HELB loan.

*Title:* Cluster Analysis with weighted Binary Variables.

*Researcher(s):* Mary Kariuki Kamundi, **John Mwaniki Kihoro** and Samuel Musili Mwalili.

*Background:* Cluster analysis is a technique that is used in a variety of fields-biology, ecology taxonomy, sociology, etc. However, few of these methods focus on categorical data (especially binary data). The categorical techniques that do exist have significant shortcomings in terms of performance, and the cluster they detect. There has not been away to indicate that some binary variables are more important than others and thus the formation of clusters that do not portray this aspect. This leads to the misinterpretation of data the data.

*Methods:* This study focused on emphasizing the degree of importance of some binary variables and how unique clusters were formed when they were weighted. The Squared Euclidean distance was used for the unweighted binary data in order to be consistent with the distance measure used for the weighted binary variables- the Squared Euclidean distance measure.

*Results:* Also, for consistency of measures Ward's method was used for cluster analysis with unweighted binary variables as for cluster analysis with weighted binary variables. Weights for the data were obtained using the Principal Components Analysis method and also using sampling of relative frequencies from data – the frequencies were then inverted to get the weights.

*Conclusions:* We successfully proved that membership of clusters changed and those very unique clusters were formed when weighted binary variables were used.

*Title:* Impact of MASSES Project on performance of Mathematics (A case study Naivasha District).

*Researcher(s):* Muriithi Jane Njeri, **Anthony Gichuhi Waititu** and Samuel Musili Mwalili.

*Background:* The study focused on the SMASSE – in service programs in Kenya. The target population was mathematics teachers and students from schools in Naivasha district. Stratified random sampling was used to sample the schools since they represented a heterogeneous population.

*Methods:* Sub –samples were drawn by proportional allocation method. The sub –sample formed four strata. The strata were, national, provincial, district, and private schools. Two teachers and eight students were randomly selected from each of the thirteen schools. The total number of teachers was 26 while the students were 104 making a total of 130 respondents. Information was obtained through administering a questionnaire for the teachers

and another different one for the students. The design which was employed was comparative research technique.Performance in mathematics was monitored between the years 2000 to 2004 (before SMASSE and 2005 to 2009(after SMASSE). Statistical tool (viz.chi –square and T- test) were used in the data analysis. Chi-square test was used to test for independence of distributions of the observed data variables from the different strata before and after SMASSE. Contingency tables were constructed for each test item in the questionnaires which contained qualitative data-test was used to test for differences in means before and after SMASSE in the different strata. Data was analyzed using computer software SPSS version (16) and R program.

*Results:* The results showed that SMASSE had no impact on motivation and attitude of teachers towards teaching of mathematics.

*Conclusions:* SMASSE had impacted positively on performance of Mathematics in Naivasha district.

*Title:* Logistic Regression and Artificial Neural Network for modelling household food security in Kenya.

*Researcher(s):* Abdallah Yussuf Kombo and **Anthony Gichuhi Waititu.**

*Background:* World wide, around 852 million people are chronically hungry due to extreme poverty, while up to 2 billion people lack food security intermittently due to varying degrees of poverty. Humanitarian relief and development organizations increasingly need to measure food security to monitor and evaluate the impact of programs and make planning and targeting decisions. However, this is based on the national estimates, which naturally mask disparities in districts and other localized areas of high prevalence of food insecurity. This study is aimed at exploring the potential for developing direct measures of household food security using mathematical techniques and that are based on an in –depth understanding of the experience of food insecurity at the house hold level .

*Methods:* Specifically, Logistic regression and Artificial Neural Network were employed. It focused on testing whether the Artificial Neural Networks and the Logistic regression perform equally.

*Results:* The results indicated that Artificial Neural Networks outperformed Logistic regression.

*Conclusions:* Data was adapted from a survey carried out on households' food security indication in the nine districts of the lake region basin for lake Victoria Research Initiative project (2007) and was analyzed using the statistical package, R version 2.9.2.

*Title:* Bootstrap and Conventional Confidence Interval for Model Based Sample survey.

*Researcher(s):* John Oseko Motubwa and **Thomas Ombui Mageto.**

*Background:* The bootstrap approach to statistical inference in sample Survey is an area which has seen considerable development in the resent past. In model based approach to sample survey theory the main interest has been to overcome the problem of robustness under misspecifications. The bootstrap method under restrictive model specifications has recently been suggested by Chambers and Dorfman (2002) as a way of achieving this.

*Methods:* In this study, we construct both bootstrap and conventional

confidence interval for the population model based on simple random sampling with replacement. This is to provide a better measure of uncertainty associated with estimates of population total as compared to the corresponding rival confidence interval under restrictive models as one in Chambers and Dorfman (2002). To do this, we generate bootstrap simulation for the population of interest by the assumed general model. The producer is a modification of the one by Chambers and Dorfman (2002). However our method is less cumbersome to apply than that of Chambers and Dorfman.

*Results:* In terms of coverage performance, the 95% confidence interval, the bootstrap method is better compared to corresponding one under conventional method. However, in terms of length, the confidence generated by the bootstrap method is much larger as compared to their counterparts.

*Conclusions:* We note that the best performing confidence interval is one whose coverage rate is close to the true population total T and its length small. However, our research results provide great insight in constructing a sound confidence interval for the population total.

*Title:* Mixed Regression Analysis (Case study of Seedlings Profiles).

*Researcher(s):* Mwangi Muthoni Faith, **Samuel Musili Mwalili** and Anthony Gichuhi Waititu.

*Background:* Despite the knowledge that trees do help in rainfall and keeping the atmosphere clean there has a continued damage of environment through indiscriminate cutting down of trees in various parts of Kenya. Consequently deforestation is a great source of environmental degradation.

*Methods:* Afforestation, the process of planting trees, sapling or seeds on non – forest land, is the solution to this problem and hence the need to analyse the revolution of seedlings in Kenya. Using seedling data from Kenya Forestry Research Institute (KEFRI) for various districts in Central Kenya we investigated the distribution and evolution of seedlings in Kenya.

*Results:* We showed the distribution of seedlings by districts and distribution of seedlings by species via a mixed regression model.

*Conclusions* In this research we found that distribution of seedlings vary across the districts and also across the species.

*Title:* Buoyancy driven free convection turbulent heat transfer in an enclosure.

*Researcher(s):* **J. Sigey**, F. Gatheri and M. Kinyanjui.

*Background:* Equations governing natural convection have been solved using a fast and stable finite difference approximation, which has been developed and validated. The low–Reynolds number $k-\varepsilon$ model has been used in this case because of its high accuracy in turbulence flows. Turbulent flow in an enclosed cavity or box is a model for many flows of practical interest: cooling of electronic equipment, heating of a room; flow in a double glazing unit or ventilation is encountered in a number of situations of practical importance in our every day encounters.

*Methods:* A Three-dimensional enclosure in form of a rectangular enclosure containing a convectional heater built into one wall and having a

window in the same wall have been studied. The heater is located below the window and the other remaining walls are insulated. The size and position of the window and heater are fixed. The localized heating and cooling induces two boundary layers that collide in the region between the window and heater.

*Results:* The timed averaged equations for Continuity, Momentum and Energy, which are coupled to the Turbulence equations, were solved using a finite difference approximation (F.D.A) technique. The vorticity-vector potential formulation has been employed. A further use of difference false transient factors in different flow regions coupled with non-linear partial differential equations has been employed to fasten convergence of the numerical solution.

*Conclusions:* The results were that the enclosure is stratified into three regions: a cold upper region, a hot region in the area between the heater and the window and a warm lower region.

## 1.1 DEPARTMENT OF BIOCHEMISTRY

*Title:* Identification and Tisstue Localization of Olfactory Proteins in the Antenna and Head of *Glossina* Species

*Researcher(s):* **S. R. G. Nyanjom** and P. O. Lomo

*Background:* African trypanosomiasis is one of the neglected tropical diseases affecting humans and domestic animals. *Glossina* are the vectors of the disease, transmitting the trypanosome causative agents. The vectors locate their hosts through olfactory and visual cues. Olfaction is mediated by tsetse antennae based odorant-binding proteins (OBPs), which facilitate molecular coding of odorants as a first step in odor discrimination. The OBPs are a multigene family of soluble proteins that bind hydrophobic odorants entering the olfactory sensillium fluid from the environment and transport them to odorant receptors (Ors) located within olfactory receptor neurons (ORNs). This study focussed on identification of OBPs from *G. pallidipes* antennae and heads of *G. p. gambiensis* and *G. tachinoides*. These OBPs were used to screen male and female *G. pallidipes* tissues, including antennae, head, thorax, abdomen and legs.

*Methods:* Complementary (cDNA) libraries were prepared and sequenced from antennae of *Glossina pallidipes* and heads of *Glossina palpalis gambiensis* and *Glossina tachinoides*. The sequenced libraries were clustered based on sequence similarities and annotated using cDNA Annotation™ Software and PHYML. The clustered *Glossina* ESTs were compared to nonredundant (NR) protein database, conserved domains database (CDD) and to *Drosophila melanogaster*, *Anopheles gambiae, Aedes aegypti* and *Culex quinquefasciatus* proteomes.

*Results:* Expressed Sequence Tags (ESTs) were generated from the antennae (1127 for *G. pallidipes*) and head (906 for *G. p. gambiensis* and 830 for *G. tachinoides*) libraries. The analyses identified six (6) putative OBP genes (*GpaOBP1* and *GpaOBP2* from *G. pallidipes* antennae; *GpalOBP1* and *GpalOBP2* from

*G. p. gambiensis* head; *GtachOBP1* and *GtachOBP2* from *G. tachinoides* head). Multiple sequence alignments revealed a diverse OBP gene family while phylogenetic analysis indicated a closely related multigene family that could have evolved separately along different evolutionary time. Non-quantitative RT-PCR screening of male and female *G. pallidipes* tissues (antennae, head, thorax, abdomen and legs) revealed one (1) antennal specific OBP (*GpaOBP2*) in both male and female *G. pallidipes, GpalOBP1* localised in both antennae and head while *GtachOBP2* was distributed in all the *G. pallidipes* tissues.

*Conclusions:* The OBPs identified in tsetse antennae and head libraries may be involved in either olfaction or non-olfaction functions. This may be important in elucidating comprehensively the molecular basis of olfaction and in comparative study between major trypanosomiasis vectors.

## 1.2 DEPARTMENT OF CHEMISTRY

*Some products from Chemistry Product Centre exhibited during JKUAT Open Day.*

*Title:* Anti-plasmodial and Anti-trypanosomal natual poducts of Limonoids-Type of structure from some selected species of Meliaceae plants.

*Researcher(s):* Githua, M. N.; **Keriko, J. M.;** Hassanali, A.; Murill, G.; Ndungu, M. W. and Nyagah, C.

*Background:* Leaves and stem of *Turaea abyssinica* Hochst., *Trichilia dregeana* Harv. and Sond. and *Trichilia emetica* Vahl.; Leaves and roots of *Toona ciliata* M. Roem. and *Azadirachta indica* A.

Juss.; Stem and roots of *Turraea mombassana* Hiern ex C.DC.; Leaves, root bark and stem bark of *Melia azedarach* L. are known to have medicinal effects and were therefore sceened against *Plasmodium falciparum* and *Trypanosoma bucei rhdesiene in vitro*.

*Methods:* These plant parts were extracted with methanol for about 48 hr. twice and screened against the micoorganisms mentioned through the respective bioassay protocols. The active extracts were partitioned between water and chloroform and each fraction screened in vitro for antiprotozoal activities. Bioassay guideed chromatogaphic sepaations were done and structure elucidation performed.

*Results:* Methanol extacts of *Turraea abyssinica* leaves showed the highest antiplasmodial activity at $IC_{50}$ = 21.9 µg/ml)followed by *Azadirachta indica* roots and leaves with $IC_{50}$ = 25.6 and 31.2 µg/ml, respectively. The chloroform extracts of *A. indica* leaves and roots showed the highest anti-plasmodial activity with $IC_{50}$ = 11.1 and 17.8 µg/ml respectively. Methanol extracts of *Toona ciliata* roots exhibited the highest antitrypanasomal activity with MIC = 6.95 µg/ml followed by *A. indica* leaves and roots with MIC = 51.2 and 145.8 µg/ml respectively. Antitrypanosomal activities of their chloroform extract were highe with *T. ciliata* having an MIC = 3.2 µg/ml while *A. indica* leaves and roots had MIC = 4.4 and 8.5 µg/ml respectively. Nomal and reverse phase column chromatography follwed by prep. HPLC yielded 9 compounds which were screened for antitrypanosomal activity individually and in blends.

*Conclusions:* Results indicates that the 9 isolated compounds exhibited antitrypanosomal activities with MIC values ranging fom 1.7 - 31.25 µg/ml. Futher investigation is recommended and these and their constituent compounds be subjected to *in vivo* tests for their efficacy and safety by carrying out cytotoxicity tests for use by humans as potential antipotozoal drugs or as template for synthetic drug manufacture.

*Title:* Biological and Phytochemical studies of medicinal plants, *Antidesma venosum* (Euphorbiaceae) and *Kotschya africana* (Fabaceae) used in traditional medicine in Kenya.

*Researcher(s):* Gitu, L. M.; **Keriko, J. M.** and Chhabra, S. C.

*Background:* Kotschya africana and Antidesma venosum plants are used in traditional medicine ti treat bacterial, fungal and viral infections. The two plants have however not been systematically investiagated before. These work aimed at investigating the active pinciples in them. The leaves, stems and the roots were collected and subjected to extraction procedures.

*Methods:* Leaves, stems and root bark of the two plants were solvent extracted using solvents of increasing polarity namely; hexane, dichloromethane, ethyl acetate and methanol inthat order to afford various extracts.The crude extracts were subjected to several anti-fungal and anti-bacterial tests. Though seveal fractionation by column chomatographic steps and pep. TLC pocedures, pure compounds were isolated which wee also subjected to bioassay tests.

*Results:* Using the disc diffusion method, it was demonstrated that extracts of the leaves, stem and roots of these plants have moderate anti-bacterial activities against *Escherichia coli* and *Staphylococeus aureus* and low antifungal activity against the fungus, *Candida albicans*. The root extracts were the most active followed by the stem and the leaf extract.

Extracts from these 2 plants exhibited mild cytotoxicity to brine shrimp (*Artemia salina*) larvae with $LD_{50}$ values ranging from 89.21 to 3876.7 for K. Africana and 32.61 to 2515.4 for A. venosum. Five compounds were isolated and structurally elucidated.

*Conclusions:* Crude extacts and pure compound *K. africana* and *A. venosum* showed some radical scavenging characteristics at a loading of 50 µg. β-Sistosterol and lupeol had moderate activities while one impure compound showed the highest. More studies are recommended.

*Title:* Studies on novel pesticide fomulations based on botanical extracts.

*Researcher(s):* Wanyika, H. J.; Gachanja, A. N.; Kenji, G. M. and **Keriko, J. M.**

*Background:* Natural pyrethrins are highly active and safe insecticides but not photostable. In order to study their stability characteristics, various plant extracts were used including; galic extracts, neem oil, yellow oleander oil, cotton oil and tea extracts, were used.

*Methods:* The photostabilization effect wasconfirmed by studying UV profiles and by HPLC determination of the pyethrin contents of the mixtures before and after exposure to UV light at 254 nm and 366 nm.

*Results:* The vaious botanical oils under investigation were found to stabilize pyrethrins in a dose related relationship against UV radiations. At a concentration of 3%, cotton oil and yellow oleander oil in the pyrethrum extract based mixtures had the best photo stabilizing effects to the pyrethum compared to the 1% and 2% concentration. Tea extracts was also found to stabilize pyrethrum against UV light to varying degrees. Blending pyrethrum extract with garlic extract improved the biological efficacy of the pyrethrins.

*Conclusions:* Thus, solutions of pyrethrum extract (1%) blended with the botanical oils under investigation were found to be more efficacious against maize weevil, *Sitophilus zeamais* compared to neempyretto.

*Title:* Phytochemical and anti-parasitic activity studies of some selected Kenyan Medicinal plants.

*Researcher(s):* Kigondu, Elizabeth V. M.; **Keriko, J. M.**; Rukunga, G. M. and Ndiege, I. O.

*Background:* Malaria and leishmaniasis belong to the most widespread and poorly controlled parasitic diseases in the world. Since there is no vaccine in the immediate horizon coupled with an inrease in cases of drug resistance and failure, herbal medicine is highly used in the treatment of these diseases. Anti-protozoal drugs are inadequate due to their toxicity, lack of efficacy and inability to eliminate all life cycle stages of the parasite from the host. Therefore, new anti-protozoal agents with novel targets are urgently needed. 8 medicinal plants found locally were studied in this investigation.

*Methods:* The plants extracts were screened for *in nvitro* anti-plasmodial activity against two laboratory adapted *Plasmodium falciparum* stains (D6, chloroquin sensitive, and W2, chloroquin resistant). Related assay methods were applied; *in vitro* anti-plasmodial assay, *in vitro* anti-leishmanial assay, anti-promastigote assay, anti-amastigote assay, nitric oxide production determination method, cytotoxicity assay, molecular structural determination methods etc. were employed.

*Results:* Methanol extract of the leaves of *Suregada zanzibariensis* had the highest anti-plasmodial activity against D6 and W2 ($IC_{50}$ 4.66 and 1.82 µg/ml respectively while dichloomethane extract had appreciable anti-plasmodial activity ($IC_{50}$ 9.40 and 9.90 µg/ml respectively.

Three pure compounds were isolated and subjected to similar assay protocol.

*Conclusions:* *Suregada zanzibariensis* and *Aloe nyeriensis* var *kedongensis* (Christian) exhibited good anti-malarial and anti-leishmanial activities and hence should be considered as a template in the development of anti-protozoal drugs.

*Title:* Exposure to mercury and other mine related hazards amongst, Goldmine workers in Migori Gold belt, Kenya.

*Researcher(s):* Waruguru, M.; Mbakaya, C. L.; **Keriko J. M.** and Kombe, Y.

*Background:* Use of mercury (Hg) in gold mining is a recognized occupational hazard worldwide, yet little has been done to document its magnitude in Kenya. In order to determine the magnitude of exposure to mercury and other mine related hazards, a cross sectional study was undertaken.

*Methods:* Structured questions were used to determine prvalennce of signs of symptoms of mercury poisoning as well as injuries related to Gold mining. Spot urine wasobtained in 30% of randomly selected subjects for the determination of urinary mercury and creatinine levels. Data was coded and entered into a database using SPSS version 111.5. Categorical data was analyzed using *chi-squares* and continous data using mann Whitney U-test.

*Results:* Gold mine workers (23%) exceeded the WHO recommended upper urinary limit of 50 ug/ml Hg/g of creatinine. Dealers had higher median Hg levels than the miners and manifested with significantly more mercury-related neurological, respiratory and dermal disorders than the miners. Subjects who worked for more than 8 hrs per day had median Hg level of 30.18 ug/g creatinine that was higher than the 13.8 ug/g creatinine for those who worked for less hrs ($p = 0.012$). Cuts and blisters were reported in 58% of the workers as miners reported higher burdens of bronchial irritation, probably due to exposure to dust in the mines.

*Conclusions:* There is an urgent need to intervene on the dangers associated with gold mining in Kenya and beyond in order to protect the workers from further exposure and subsequent suffering that comes with it.

*Title:* Phytochemical and Biological studies of the compounds from the root bark of *Vernonia auriculifera* Hiern (Asteraceae).

*Researcher(s):* **Keriko, J. M.;** Githua, R. N.; Nyagah, C. G.

*Background:* Natural products once served man as a source of all drugs and higher plants provided most of the therapeutic agents. Today, natural products (and their derivatives and analogs) still represent over 50% of all drugs in clinical use, with higher plants - derived natural products representing 25 % of the total. Some of the drugs in clinical use are quinine from the cinchona bark, morphine and codeine from latex of opimium, poppy, digitalis leaves and atropine from the genus Solanaceae. The WHO estimates that 80% of the people in developing countries rely on traditional medicine for their primaryy health care and about 3.5 to 4 billion people in the World rely on plants as a source of their needed drugs.

*Methods:* The root bark of *Vernonia auriculifera* was sequentially extracted with n-hexane, dichloromethane and methanol respectively. The bioactivities

of these extracts were determined against brine shrimps using the existing protocols. Fractionation of the crude extracts through column chromatographic techniques led to the isolation of 5 compounds which were also subjected to similar micro-organism tests.

*Results:* DCM crude extract was found to show high larvicidal activities. All the extracts showed high anti-bacterial activity against *E. coli*, and *S. aureus*. The pure compound also indicated substantial activity against the same micro-organisms. Anti-fungal asssay using *Candida albacans* showed significant activity (inhibition diameter > 10 mm) with *n*-hexane and DCM extracts. Compound 1 and 11 had good inhibition on the fungal test.

*Conclusions:* The extract and the pure compounds isolated from this plant can be a suitbale constituent cheap natural alternative anti-biotics and more studies were recommended. The compounds could also be used as template in the manufacture of synthetic drugs.

*Title:* Phytochemical and Biological studies of the compounds of the aerial parts of *Senecio lyratus* (Asteraceae)

*Researcher(s):* **Keriko, J. M.;** Nderitu, P. N.; Nyagah, C. G.

*Background:* Man has from time immemorial relied on plants as a source of food and shelter for his survival. He has also discovered that plants could be used for treating his various ailments including those of their animals. Moreover, plants extracts could also be used as medicinal, pesticides, fungicides and insecticides which cannot be underestimated. It is estimated that 20,000 plants are used for medicinal purpose.

*Methods:* Solvent extract from the aerial part of *Senecio lyratus* (Asteraceae) were phytochemically and biologically studied. The extracts were obtained by fisrt drying and grinding the earial parts of the plant and sorking them in *n*-hexane folloewd by DCM and finaly with methanol at room temperature. After filteration, the filtrate was vacuum dried in a rota vap. equipment. From the crude extract, sample for biasssay were prepared. The active crude extracts were them subjected to further fractionation on silica gel columns. Three pure cmpound were isolated, purified and identified. Further biactivity tests were carried out on the pure copoumds.

*Results:* The $LD_{50}$ of the crude extracts were determined and found to be; 506.11, 553.21 and 689.44 ppm respectively for *n*-hexane, dichloromethane and methanol respectively. Fractionations of the *n*-hexane led to various fraction which were found to be active against *Staphylococcus aureus* and *Bacillus subtilis* at 100 ppm. Pure compound were found to be active against *Candida albacans* fungi. The three pure compounds were; β- amyrin, β-sitosterol and stigmasterol.

*Conclusions:* Further research work was recommended in order to try to unravel the nature of the active compound(s) from this medicinal plant and their mode of action.

*Title:* Ethnomedicine practices, analyses, and standardization of herbal althelmintics used by the Embu and Mbeere peoples of Kenya.

*Researcher(s):* Kareru, P. G.; **Keriko, J. M.**; Gachanja, A. N. and Kenji, G. M.

*Background:* Ethnobotany is the study of the relationship between plants and people, the focus being on the plant use for medicines, food, building tools, social life etc. including cultivation and conservation. Ethnobotanical information is therefore, indegenous knowledge about plants uses and is obtained from

experienced herbalists and knowledgeable old people down generations. Often, indigenous knowledge is jealously guarded and kept secret among family members within communities. Ethnobotany requires a variety of issues: the identification and preservation of plant specimens, cultural role of plants (anthropology) in society, leading to ethnomedical uses. Scientists are then able to screen plants for pharmacological activity, discover lead compounds, from which new drugs can be developed.

*Methods:* Ethnobotanical information and traditional medicines were investigated and documented in Embu and Mbeere districts, Eastern Province of Kenya. Oral interviews were obtained from over 100 herbalists, both men and women agedbetween 40 and 80 years. All the herbalists interviewed were Christians and had little formal education. Non-Christian herbalists were purpoted to combine herbal medicine with witchcraft and were therefore not interviewed.

*Results:* Of the 4*0*commonly used herbal plants, 25 were used as multipurpose medicinal plants (mpmp), while 15 were used to treat one disease type. There was correlation between the outpatient morbidity data at the local district hospital, and the common incident diseases treated by the herbalist. Generaly, a decoction or infusion of the herb was recommended for the treatment of internal or external condition of the patients. Malaria and typhoid were treatable with a total of 15 and 12 plants respectively and were among the first two commonest diseases found in the study area. *Terminalia brownii* was found to be the most used medicinal plants either alone or in combination with other herbs. The second and third most utilized medicinal plants were *Ovariodendron anisatum* and *Rapanea rhododendrides* respectively. Aqueous extracts from these plants were found to show activity against *scherichia coli* and other micro-organisms. A number of these medicinal plants were screened for *in vitro* anthelmintic activity. Aq extracts of some plants exhibited high activities.

*Conclusions:* Some plants were chosen and recommended as the helminthes herbal drugs alternatives. One specific plant, *Entada leptostachya* was identify as having the highest activity and exhibited the fingerprint' of the phytochemical marker compounds.

*Title:* Development and eveluation of an "Anti-aging" cosmetic product derived from plants and ruminants animals oil extracts: Phase 1. Evaluation of physical-chemical characteristics of the plants and ruminants animals oils/fats extracts and their effects on cosmetic products

*Researcher(s):* **Keriko, J. M.;** Kareru, P. G. and Musatzi, A.

*Background:* The manifestations of ageing that are of primary concern to the cosmetic chemist are wrinkles. Shrinking of the superficial muscles, which have their points of insertion in the dermis, causes these lines, which become more pronounced with age especially on the face. The facial expression muscles are the first areas to change with age. As they loose superficial mass, thinning of epidermis and a loss of collagen and elastin are apparent. These all contribute to the visible process called ageing. Ageing is thus an effect caused by the high death rate of the epidermal cells than they can be replaced by fresh cells coming up from below. This causes thinning and wrinkling formation. The new

cells become increasingly disorganized. Vitamins are essential nutrients for human organism. They are not obtainable via metabolic functions but must be introduced in the body through a balanced diet. Vitamins are characterized by their ability to be soluble and are divided into two groups, fat-soluble and water-soluble. Fat-soluble include; A, D, E and K while water –soluble vitamins are; B1, B2, B6, B12 and C.3. These Vitamins are very essential in determining the nature and state of the skin during aging process.

*Methods:* Phase I was the evaluation and characterization phase. It involved the determination of the physical-chemical parameters of the plants oil extracts i.e. of the grain amaranth species (*A. cruentus* and *A. hypochondriacus*), cucumber fruits, and goat and camel milk fat extracts. The physical parameters determined included; pH value, density, butterfat content and percentage oil content. The chemical parameters determined were sub-divided into identification and quality tests. Identification tests included; Hexabromide tests, Hydroxyl tests, Iodine value, Saponification value determination, Refractive index and Fatty acid composition. Quality tests included; Acid value, foreign matter, Moisture and Peroxide value. Other major chemical parameters include isolation and quantification of retinol and tocopherol in both plants oil and animal fats extracts and β-carotene in the grain amaranth leaves extracts.

*Results:* The physical – parameters that were determined had a direct bearing to the quality of the oils and fats extracts, which in turn can affect the quality of the formulated cosmetic product. The vales of pH, specific gravity, butterfat and % oil content all were found to be within the recommended range. However, some variable factors can affect these ranges of values and hence have an either positive or negative impact to the formulations. The physical parameters can also be distorted contamination e.g. unhygienic conditions; adulteration can affect the pH value, specific density etc. The chemical parameters that were determined also played a major role in the quality of the oils and fats extracts hence, affecting the quality of the product too. However, these parameters mainly focused on the chemical composition of the extracts e.g. saturation and unsaturation levels of the fatty acids, which are a major determinant of the chemical character of an oil/fat extract. These characters are not necessarily affected by contaminations like adulteration. Their values also fell within the recommended region.

*Conclusions:* Chemical parameters like retinol and tocopherol, which play a major role in the "anti-aging" effect to the skin, are easily denatured and hence their quality and quantities were greatly altered before their effects were achieved on the skin. Factors such as temperatures/heat that occurred as a result of poor storage and analytical methods of formulations also played a major role in determining the quality of products. Better and convenient methods of preventing or reducing these impacts are recommended to enhance and maintain the quality needed to formulate these products. Phase 2 of this project will require the incorporation of the plant oil extracts and animal fat extracts into the formulated body cream/lotion base and subject the product to individuals to test its impacts on the users' skin.

*Title:* Biological studies of the crude and fractions of the root bark of *Senecio lyratus* (Asteraceae).

*Researcher(s):* **Keriko, J. M.**; Marete, E. N. and Ndung'u, M. W.

*Background:* A key challenge to anti-biotic industry is that constant innovation is necessary not only because of the resistance but also of the side effects associated with the use of the anti-biotics, including bacterial resistance to the existing drugs. Most bacteria also produce materials that destroy the drug.
One area of research that remains far unexploited is the search for antibiotics from plant origin. This research work geared towards search for such materials from *Senecio lyratus*.

*Methods:* The root bark of *Senecio lyratus* were collected from Sotick in Bonet district. The samples were dried at room temperature, and ground into fine powder. 1.3 Kg of the powdered roots were sequentially extracted using; *n*-hexane (1.5 L), dichloromethane (1.5 L) and methanol (1.5 L) which were added sequentially and allowed to sock for three days each. The respective extracts were filtered and the filtrate dried *in vacuo* usind a rotary evaporator. Further column fractionation led to the isolation of pure compounds. Bioassay tests included; brine shrimp lethality test, anti-bacterial bioassay test, and structural elucidation was done through NMR, IR and other physical tests like, Mpt.

*Results:* The crude extracts exhibited significant anti-bacterial and anti-fungal activities. *n*-Hexane and DCM extracts exhibited relatively higher inhibition against *S. aureus* at 12.0 mm and 9,7 mm respectively at 1000 ppm. MeOH extracts exhibited relatively high inhibition diameter of 11.3 mm at 1000 ppm. 2 compounds were isolated where one was identified as β-sitosterol. No tests were carried out for the pure compound.

*Conclusions:* The results obtained indicated that compounds from *S. lyratus* may have a potential for use as anti-microbial agents and therefore, more work is recommended.

*Title:* Anti-plasmodial and larvicidal flavonoids from the seedpods of *Tephrosia elata* and *Tephrosia aequilata.*

*Researcher(s):* Muiva, Loise M.; Yenesew, A.; **Keriko, J. M.**; Derese, S. and Mutai, C.

*Background:* The genus Tephrosia is rich in flavonoids and isoflavonoid including rotenoids. In the search for compounds with anti-plasmodial and larvicidal activities from medicinal plants, the seedpods of *Tephrosia elata* and *Tephrosia aequilata* were investigated.

*Methods:* The dried and ground seedpods of the two plants were extracted separately with dichloromethane/methanol (1:1) by cold percolation for 24 hr at room temp. Chromatographic separation led to the isolation and identification of seven compounds. The crude extracts and the pure compounds were subjected to the, in vitro anti-plasmodial assay and larvicidal assay protocols.

*Results:* The crude extract showed significant anti-plasmodial activities with IC50 value of 8.4 and 8.6 ug/ml for T. elata and 1.5 and 22.4 ug/ml for T aequilata against chloroquin sensitive (D6) and chloroquin-resistant (W2) stains of Plasmodium falciparum respectively. The crude extract of seedpods of T. elata also showed larvicidal activity against the mosquito larvae of Aedes aegypti with LC50 of 68.9 ug/ml at 24 hr and 40.2 ug/ml at 48 hr. One novel compound from T. elata, elatdihydrochalcone showed anti-plasmodial activities with IC50 = 2.8 ug/ml and 5.5 ug/ml against (D6) and W2) respectively.

*Conclusions:* There is high possibility of the use of compounds from this study,

β-hydroxydihydrochalcones and flavanones as lead structures in the future development of anti-malarial drugs.

*Title:* Assessment of challenges encountered by small scale cut-flower sector in Central Kenya in complying with environmental standards.

*Researcher(s):* Kinyanjui, Jennifer, W.; **Keriko, J. M.** and Kituyi, E.

*Background:* Small scale cut-flower farmers in Kenya face various challenges including those involving compliance to environmental requirments. This study was carried out to assess these specific challenges by farmers in some regions of Centrel Kenya in particular those in Nyeri, Muranga and Kiambu districts.

*Methods:* Using a total of 360 small scale cut-flower farmers four main methods were applied in data collection; Field visits and interviews using closed ended questionares, observation and a ckecklist as a means of data collection instrument, consultations with experts and desk studies was also applied.

*Results:* The findings revealed that farming, post harvest handling, transportation, inspection and distribution of flowers to market are the activities along the supply chain involving small holder cut-flower farmers. The major actors/players along the value chain are inputs suppliers, exporters, Horticultural Crops Development Authority, Kenya Plant Health Inspectorate, Fresh Produce Exporters Association of Kenya, Kenya Flower Council, Ministry of Agriculture and donors. Key constraint faced by out growers in producing and complying with environmental requirements administered by international markets include: Lack of pesticides storage facilities, lack of training in safe use of pesticides and fertilizers, first aid, water and waste management in flower production, lack of proper record keeping, lack of financial assistance, poor water management skills and lack of proper harvest handling infrastructures.

*Conclusions:* Proper organized interventions are needed to save the sector. These include; the formation of stable producer groups with organizational structures to be classified as single farms, facilitation of group certification under the 2 of the GlobalGAP, strengthening of capacities to meet environmental standards by government, private sector and donors. An enabling policy framework that assures environmental requirements and provision of incentives to comply with private voluntary standards were recomended.

*Title:* An integrated economic, social and environmental impacts assessment model for geothermal power development in Kenya.

*Researcher(s):* Nyakundi, P. A.; Inoti, I. K., Thiong'o, G. T. and **Keriko, J. M.**

*Background:* Geothermal power has been used for electric and non-electric purpose for many centuries. In Kenya, geothermal power is one of the two main sources of energy available for a large scale electric power generation the other source being hydropowewr. The geothermal power generation in Africa is a new technology. In Africa however, Kenya is the only country utilizing this technology in power generation. There are some negative impact of its generation including noise, water pollution and other environmental effects that are associated with its generation.

*Methods:* Economic, environmental and social impacts were identified and quantified by use of; remote sensing, setelite images, Arcview 3.2a, topographic maps, table stereoscope, rainfall and noise measurements, energy generation and sales, Focused Group Discussion (FGD),

questionares, Statistical Package for Social Scientist (SPSS) and Ms Excel, quantification of the amount of water used for well drilling and population trends for 1979, 1989 and 1999 to analyze development trends in a temporal basis and develop a model to analyze economic, social and environmental impacts resulting from the geothermal power development.

*Results:* In this study, economic, environmental and social impacts have been identified and quantified by the use of; remote sensing, settlite images, Arcview 3.2a, topographic maps, table stereoscope, rainfall and noise measurements, energy generation sales, Focused Group Discussions (FGD), questionares, Statistical Package for Social Scientists (SPSS) and Ms Excel, amount of water used for well drilling and population trends for 1979, 1989, 1999 to analyze development trends in a temporal basis. These data helped to arrive at the conclusions and recommendations given in this study.

*Conclusions:* Current and future geothermal power exploitation in Olkaria field should take into consideration immediate and long term exploitation impacts for resource use sustainability. An integrated economic, social and environmental model has been proposed to guide sustainable development of this exploitation.

*Title:* Investigating institutional, policy and project financing barriers impeding clean development mechanism (CDM) implementation in Kenya.

*Researcher(s):* Mutevu, M. M.; **Keriko, J. M.**; Kituyi, E. and Kitetu, J. J.

*Background:* The Clean Development mechanism (CDM) is a new tool for promoting sustainable development in developing countries. It was established by the Kyoto protocol under the United Nation Framework Convention on Climate Change (UNFCCC). It promises developed countries certified emission reductions (CERs) if they comply with their quantified emission targets and developing countries sustainable development benefits if they participate and invest in clean renewable technologies.

*Methods:* Primary data required here were collected by using semi-structured questionares and personal interviews with respondents. Questionares were send by post, e-mail and hand delivered. Secondary data were collected through comprehensive review and analysis of up to date theoretical and empirical literature on CDM. Literature review was obtained from scientific journals, hand books, reports and reliable scientific web sites. The sample population was 30 respondents.

*Results:* 70% of respondents complied with our requirement and good feedback was received from them. 80% of respondents drawn from the private sector observed that institutional, policy and project financing barriers were impending CDM uptake. 60% of respondents in the public sector pointed out that, lack of willingness by private sector to embrace CDM is a key impendiment. Policy and legislative gaps in the energy policy, forestry policy and related Acts have played a key role in slowing the uptake of CDM. A poor profile of Kenya as a host country has made project financing a challene for CDM investor and project developer due to high CDM-specific risks and regulatory risks.

*Conclusions:* Kenya has a high potential to accelerate develoment of CDM projects. However, there in need to move away from the status quo if we are to benefit more from Clean Development Mechanism (CDM).

*Title:* Factors that influence environmental regulation compliance by micro- and small enterprises in the manufacturing sector in Nairobi.

*Researcher(s):* Mputhia, J.; Mukulu, E. and **Keriko, J. M.**

*Background:* Micro and Small Enterprises (MSEs) are recognized as agents of industrial change, innovation, and important vehicle for emloyment creation and economic growth. Since the 1972, International Labour Organization (ILO) report, the informal sector's contribution to overall economic development has assumed dominance in many debates in Kenya. The gorvernment has recognized the sector as a primary means of strengthening Kenya's economy since it has a far higher capacity to create employment and to alleviate poverty through equitable distribution of income than a situation where multinational and established companies take the centre stage.

*Methods:* The research work sought to establish the factors that influence environmental regulations compliance by Micro and Small Enterprises in the manufacturing sector in Nairobi, Kenya. The research adopted a mixed method approach which was both qualitative and quantitative. The qualitatvie aspect of the research was designed to find out the respondent's perception about benefits of environmental regulations compliance while the quantitative aspect was designed to find out the number and quantities or amounts of some of the variables used in the study. The target population was any highly polluting MSE in the manufacturing sector registered by the Ministry of Industrialization

*Results:* The study established that awareness of environmental regulations (ER), cost of compliance, experts' capability, perception of benefits of compliance and business premises ownership influenced compliance with environmental regulations. The results revealed a high correlation between the level of education, technical and mangement skills and familiarity with environmental regulations peocedures. The majority of MSEs found cost of compliance to be prohibitive but nevertheless undertook EAs regulaly using external consultants. Procedures found most difficult to implement by the majority of MSEs included liquid effluent management and solid waste management.

*Conclusions:* The national Environmental Management Authority (NEMA) and other stakeholders should increase outreach to all the MSEs in the sector to make them aware of the benefits of the environmental regulation compliance, support MSEs to reduce cost of compliance by increasing their internal capacity to undertake EAs and by ensuring that MSEs become aware of the negotiated compliance on the basis of risks to the environment poised by their activities. Implementing measures to convince MSEs to participate in environmental conservation activities and issue of awards for the MSE which complied with ER in order to encourage them and showcase them to other who may not have been so keen are other measures that should be considered.

## 1.3 DEPARTMENT OF PHYSICS

*Title:* Determination of naturally occurring radiation and exposure levels at the Tabaka soapstone mines of Kisii district, Kenya.

*Researcher(s):* **R. Kinyua**, V.O. Atambo, R. Ongeri.

*Background:* Gamma radiation from radionuclides is the main external natural source of radiation to the human body. High exposure levels are associated with high risk of cancer.

*Methods:* Rock and soil samples are analyzed using hyper pure germanium gamma ray spectrometry.

*Results:* Absorbed dose rates were found to average 177.6 $nGyh^{-1}$. Assuming an occupancy factor of 0.4 the annual effective dose rate average was 0.44 $mSvy^{-1}$ and is less than the 1 $mSvy^{-1}$ upper limit recommended by the ICRP. The external and internal hazard indices average 1.

*Conclusions:* Excess lifetime cancer risk to the workers is negligible (0.07%). Soapstone products do not pose any significant risk to users.

## 1.4 DEPARTMENT OF ZOOLOGY

*Title:* Immunization studies in rabbits using gut membrane-bound proteins Derived from *Rhipicephalus appendiculatus, R. evertsi evertsi* and *Amblyomma variegatum* female ticks

*Researcher(s):* **Helen Lydia Kutima**, Adepapo Amoo, Mabel Imbuga and Philip Museve Kutima.

*Background:* Ticks and tick-borne diseases are of world-wide importance. Ticks are responsible for severe losses caused by either the effect of the tick through mortality or debility due to the diseases transmitted, blood loss, damage to the hides and udders, tick worry, the injection of toxins and low weight gain. The current and most common method used to control ticks is the acaricide application. Acaricides are usually applied topically, by dipping the animals, running them through spray races, hand spraying or hand dressing. These practices are carried out as often as two times a week. There are many drawbacks associated with the use of acaricides in an attempt to control ticks. The rigorous application of acaricides has led to the development of acaricide resistant ticks. Development of new acaricides with different formulation is expensive. This poses a threat to livestock health and production in many areas of the world hence the need for an alternative method of control. The objectives of this study were to immunize rabbits with Gut Membrane-Bound Proteins (GMBP) derived from partially engorged *Rhipicephalus appendiculatus*, *R. evertsi evertsi* and *Amblyomma variegatum* female ticks and to assess whether the elicited immunity was protective against both homologous and heterologous tick instars and to isolate and identify the protective antigens.

*Methods:* Mid guts were dissected from fully engorged female ticks and Sodium Dodecyl Sulphate-Polyacrylamide Gel Electrophoresis (SDS-PAGE), carried out to determine the protein profile of the homogenized and sonicated midguts. Groups of rabbits

were immunized with the midguts and later challenged with homologous and heterologous tick species. Ouchterlony, Western Blot and ELISA were carried out to assess the specificity and cross reacting antigens.

*Results:* SDS-PAGE of the GMBP antigens demonstrated protein bands with molecular weights ranging from 16 to 140 KDa. Thirty-seven, 45 and 39 protein bands were fractionated from *R. appendiculatus*, *R. evertsi evertsi* and *A. variegatum* GMBP antigens, respectively, all possessing molecular weights ranging from 14 to 140 KDa. Twenty-two of the isolated proteins were shared among the three tick species. Immunized rabbits acquired resistance to challenge infestation by allinstars of the three tick species. Resistance was manifested by prolonged feeding, reduction in engorgement weights, egg mass weights, moulting and percentage hatchability and increased mortality. Immunization of rabbits with GMBP antigens generated protection and cross-protection against challenge infestation with homologous and heterologous instars, respectively. Cross-protection was more pronounced in the homologous than heterologous systems. Enzyme-Linked Immunosorbent Assay (ELISA) technique detected circulating antibodies in the anti-sera to GMBP from homologous and heterologous systems one week after the primary dose. Ouchterlony double immunodiffusion reactions with anti-tick GMBP sera formed 2 to 3 precipitin lines with homologous GMBP antigens and one to two precipitin line(s) with each heterologous GMBP antigens. A line of complete identity was observed when anti-sera to GMBP antigens reacted with GMBP from homologous and heterologous tick species, suggesting common antigenic epitopes. Western blot analysis on GMBP of *R. appendiculatus*, *R. evertsi evertsi* and *A. variegatum* with sera from immunized rabbits detected protein bands specific to the homologous GMBP antigens, and revealed considerable cross-reactions in the heterologous systems.

*Conclusions:* These results suggested further the presence of common antigens. The presence of cross-reacting antigens conferred cross-protection. Further work is required to purify and characterize the cross-reacting antigens that were responsible for the cross-protection.

*Title:* Assessment Of Gastro-Intestinal Parasites Of Captive Olive Baboons, *Papio cynocephalus anubis,* At The Institute Of Primate Research, Nairobi Kenya.

*Researcher(s):* Michael Oduor, **Helen Lydia Kutima**, Dorcas S. Yole, Rosebella O. Maranga.

*Background:* A wide array of parasites may infect non-human primates (NHPs) that are often valuable in studies of either human disease processes or vaccine and drug development. At the Institute of Primate Research, baboons are used for biomedical research. They are models for diseases like Schistosomiasis, Malaria and even Reproductive biology.

*Methods:* Assessment of gastrointestinal parasites of colony experimental baboon of different age and sex was done using non-invasive technique to determine the identity; prevalence and intensity of these parasites since parasitic infections may affect animal health and ultimately the studies for which the animals are used. A total of 80 faecal samples were collected from 20 baboons: Four faecal samples were collected per week from each animal. Examination of these faecal samples through Direct smears method to detect trophozoites of amoebae and flagellates,

Formal ether sedimentation technique for the identification of parasite eggs, cysts, and larval stages. Harada-Mori culture technique for identification of larvae from L1-L3 stage and MacMaster egg counting technique for intensity of parasite eggs per gram of feacal material.

*Results:* Four protozoan parasites (*Balantidium coli, Entamoeba coli, Entamoeba histolytica* and Giardia *spp*) and 3 nematodes (*Trichuris spp, Oesophagostomum* spp and *Strongyloides spp*) were identified from the faecal samples collected. *Entamoeba coli* were the most prevalent protozoan among the sex and age groups of baboons with all the sexes and age groups having a prevalence rate of 100%. In nematodes, *Trichuris spp* and *Oesophagostomum spp* had a prevalence of 100% in all the age group and sexes. Only one male adult and one female adult had one cyst count of *Giardia.*

*Conclusions:* There was significant variation on the parasite intensity among age and sex group with $p < 0.05$ for protozoan parasite. *Trichuris spp* had the highest intensity; no significant difference was observed between sex and age groups ($p > 0.05$). *Oesophagostomum spp*, the male adults had the highest intensity with low intensity recorded in male juveniles while the female adult and juvenile had equal intensity; there were significance difference of parasite between age and sex ( $p < 0.05$). *Strongyloides spp* was not recorded in female adult though the female juvenile had a high intensity.

*Title:* Antischistosomal Properties of Extracts from Medical Plants from Kakamega, on the parasite, *Schistosoma mansoni* in BALB/c Mice.

*Researcher(s):* Muchika Susy, **Kutima Helen Lydia** and Yole Dorcas.

*Background:* Schistosomiasis is a major public health problem in tropical and subtropical regions of the world where an estimated 200 million people are infected and close to a billion people are at risk of contracting the disease. Because it is a chronic insidious disease, it becomes a threat to development as the disease disables men and women during their most productive years. Although Praziquantel is a drug of choice for treatment of schistosomiasis, there have been reports of resistance hence a need for an alternative drug. Oxamniquine is the only alternative to praziquantel for *S. mansoni* infection but has limited supply because it is expensive. Cheaper treatment of schistosomiasis should be made available to poor communities in endemic areas and plants seem to be a cheaper source for drug development. The aim of this study was to investigate antischistosomal properties of extracts from Medicinal plants used in Kakamega in treatment of BALB/c mice infected with *Schistosoma mansoni.*

*Methods:* Parasitological, cercaricidal and pathological assays were carried out to measure the antischistosomal activity of aqueous and methanol extracts. The mice were infected with *S. mansoni* and then treated with two doses of either 150mg/kg body weight *Solanum* or *papaya* (n=60) or 450mg/kg body weight praziquantel (n=15). Concentrations of plant extracts (5ug/ml, 15ug/ml and 30ug/ml) were used with cercariae *in vitro* cercaricidal assay.

*Results:* *Solanum* and *papaya* extracts illustrated a desirable killing effect on the larvae worm of up to 100%. In worm recovery of different treatments, infected control had the highest number of worms (57 ± 1.3) as PZQ

had the lowest (25 ± 1.8). The four treatments: *papaya* methanol, *papaya* aqueous, *Solanum* methanol, *Solanum* aqueous had worm number counts between the two extremes; (35 ± 2.2), (38 ± 1.9), (33 ± 3.4), (32 ± 1.8) respectively. However, the *papaya* groups had a higher worm counts compared to the *Solanum* groups. Granulomas observed followed a similar trend as worm recovery in praziquantel and infected non-treated mice. However in a comparison between *papaya* and *Solanum, Solanum* treatments showed to have minimal pathological effect of the two.

*Conclusions:* There was a significant statistical difference between the number of worms recovered from praziquantel-treated mice and those from plant extracts ($p<0.05$). However there was no significant difference ($p>0.05$) between the number of worms recovered from infected non-treated mice and those from plant extracts. This suggests that praziquantel is more effective than plant extracts in the management of *S. mansoni infections*. Further work needs to be carried out to purify, characterize the active components form the medicinal plants and also carry out the synergistic effects of the two plants.

*Title:* Risk Factors for Pneumonia in Children Under Five Years of Age, Hospitalized in A Rural District Hospital of Western Kenya.

*Researcher(s):* Manya Ayub Shisia, **Helen Lydia Kutima,** Daniel Feikin and Christopher Tetteh.

*Background:* It is estimated that approximately 2 million children under five years of age die each year due to pneumonia in developing countries. In Kenya, pneumonia, along with malaria and diarrhoea, is a leading cause of death among children. A case-control study was carried out in Siaya district, with the aim of identifying risk factors associated with childhood pneumonia.

*Methods:* Children hospitalised with pneumonia were compared to those without pneumonia, with particular reference to demographic, socio-economic, environmental, immunization, and nutritional factors. The study was conducted in the paediatric ward of Siaya district hospital during the months of September, October and November 2005. Children hospitalised with pneumonia were age-matched and compared to those without pneumonia in the same ward. The diagnosis of pneumonia was made on clinical features according to the World Health Organization's Integrated Management of Childhood Illness (I.M.C.I). A standardized questionnaire was administered to selected study participants. Data were entered and analysed using *Epi Info* version 3.2.2. A matched analysis and multivariate analysis using conditional logistic regression were done. A total of 188 children participated, 47 of them being cases.

*Results:* In a matched univariate analysis, malnutrition was the most important risk factor for pneumonia. There was a dose-response effect, with the risk of developing pneumonia increasing as the degree of malnutrition increased. Severe stunting, as represented by a low height-for-age (z-score <-3), was strongly associated with pneumonia with a matched odds ratio of 6.00 (95% Confidence Intervals 2.07-17.31, p-value 0.0004). Use of firewood for cooking was found to be a significant environmental risk factor for pneumonia (mO. R, 2.90, 95% C.I= 1.055-8.015, P-value 0.041). Several markers for lower socio-economic status also proved significant risk factors for pneumonia.

*Conclusions:* Children from homes without a television set were more than three times likely to develop pneumonia (mO. R= 3.30, 95%C.I =1.12-9.71, and P-value 0.03) than those with television sets. The risk for those living in houses without cemented floors was three times compared to those whose floors were cemented (mO. R 3.33, 95%C.I= 1.48-7.33, p-value 0.0048). Those who received medication prior to admission were at an increased risk of developing pneumonia (mO. R 2.08, 95%C.I 1.02-4.24, p-value= 0.04). In multivariate analysis using conditional logistic regression, severe stunting (height-for-age z-score <-3) remained a risk factor for pneumonia (Adjusted odds ratio 7.35, 95% CI=2.44-22.15, p-value=0.0004). Those children who resided in houses with earthen floors were at risk of developing pneumonia (adjusted odds ratio of 3.96(95% C.I 1.65-9.49, p-value= 0.002), while those who received treatment from other centres prior to admission to Siaya were still at risk (A.O.R 2.83, 95% C.I 1.12-6.59, p-value= 0.015).
This study highlights the importance of malnutrition and low socio-economic status in the occurrence of childhood pneumonia. While poverty eradication programmes can take long to implement, there is an urgent need for local action to address the reduction of malnutrition.

*Title:* *Trypsin activity in* glossina morsitans morsitans, phlebotomus duboscqui, *Aedes aegypti* and *Stomoxys calcitrans* infected *with Trypanosoma brucei brucei.*

*Researcher(s):* **Helen Lydia Kutima**, Mabel O. Imbuga, Ellie O. Osir and Japhet K. Magambo.

*Background:* Trypsin activity was consistently low in teneral unfed *G. m. morsitans* (0.0022 ± 0.0003), *P. duboscqi* (0.0024 ± 0.00064), *A. aegypti* (0.0003 ± 0.00024) and *S. calcitrans* (0.0025 ± 0.0002). Trypsin activity increased following a bloodmeal and reached a peak between 48-72 h in *G. m. morsitans*, and 24-36 h post-feeding in *P. duboscqi*, *A. aegypti* and *S. calcitrans*, respectively. After the peak, the trypsin levels dropped progressively and by 120 h post-feeding the trypsin levels had returned to the same level as in the unfed flies. These results indicate that a bloodmeal is essential in the stimulation of trypsin synthesis.

*Methods:* Midgut homogenates from unfed *G. m. morsitans*, *P. duboscqi*, *A. aegypti* and *S. calcitrans* and at 0 h post-feeding had little or no effect on the parasites, but following a bloodmeal midgut homogenates lysed bloodstream and procyclic *T. b. brucei.*

*Results:* The activity of midgut trypsin of *Glossina m. morsitans* was significantly (ANOVA: P<0.0001) inhibited by bloodstream forms of *T. b. brucei* ingested in a bloodmeal between 0 and 24-h postfeeding. The activities of midgut trypsin of *P. duboscqi*, *A. aegypti* and *S. calcitrans* fed on an infected bloodmeal were lower than the controls but not significantly. In all the insect species, the peak of trypsin was delayed for 6-12 hours. The activity of trypsin in midgut homogenates isolated from *G. m. morsitans*, *P. duboscqi*, *A. aegypti* and *S. calcitrans* midgut trypsin activity was significantly (ANOVA: P < 0.0001) inhibited strongly by D-mannose. The other sugars tested either weakly inhibited the activity of midgut trypsin or had no inhibitory effect.

*Conclusions:* The objectives of this study were to detrmine the trypsin activity *in*

*vivo* before and after a bloodmeal and test *in vitro* the effect of live and lysates of *Trypanosoma brucei brucei* and selected sugars on trypsin activity.

*Title:* Mapping *Trichomonas vaginalis* among women living in Kisumu, Kenya.

*Researcher(s):* Harriette Sande, Elizabeth Bukusi and **Helen Lydia.** .

*Background:* *Trichomonas vaginalis* is one of the most common occurring sexually transmitted infections in the world. It accounts for 170 million new cases of treatable STIs occurring every year world wide. This infection has been associated with increased rates of HIV transmission and can be used as a surrogate marker for recent risky sexual behaviour. The aims of this study were to evaluate the distribution of *Trichomonas vaginalis* among women living in Kisumu in relation to sexual hotspots.

*Methods:* The prevalence rate of *Trichomonas vaginalis* among women in Kisumu aged between 15-45 years was 15.5%. Women between the ages of 15-45 years were found to have the highest infection rate. Mapping of the infection showed that Township and West Kolwa locations had the highest numbers of infected participants and sexual hotspots.

*Results:* Multivariate logistic regression analysis showed there was no association between distance to hotspots and *Trichomonas* infection.

*Conclusions:* Marital status and age group was associated with infection. Intervention that is formulated should cater for the need of specific population especially those that indicate to have higher rates of infection.

*Title:* Immunological effects of *Solanum incanum* in swiss mice infected with *Schistosoma mansoni*: Role of Exposure and Treatment

*Researcher(s):* Mokua John Mose, **Helen L. Kutima**, Rebecca Waihenya and Dorcas Yole.

*Background:* Variations in exposure and treatment with medicinal plants may contribute to heterogeneity in immunity and granuloma induced pathology in human Schistosomiasis.

*Methods:* To examine this hypothesis, swiss mice were infected with a single dose of *Schistosoma mansoni* cercariae. They were then treated with crude extracts of a selected medicinal plant [*Solanum incanum*] or praziquantel at specific time points. Sampling for blood to obtain serum for IgG ELISA was done. Liver tissues were obtained and cytokine responses by peripheral blood mononuclear cells were measured at week 6. During primary infection, antigen specific 0-3hr and SWAP induced cytokine production correlated with granulomatous inflammation. Cytokine levels peaked during the acute infection, declined with chronic infection and became undetectable after treatment.

*Results:* After treatment, there was a marked rise in SWAP specific Interleukin-5 and also arise in 0-3hr and SWAP specific immunoglobulin-G regardless of the time point.

*Conclusions:* IL-5 production was significantly greater in the infected control and the treatment groups ($p<0.05$). 0-3hr and SWAP induced gamma interferon production however did not increase after treatment

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| *Title:* | The prevalence of malaria, associated anaemia and the use of Insecticide Treated Bed nets among expectant women during high transmission season in Bungoma, Kenya |
| *Researcher(s):* | Wasike, E.W., **Kutima, H.L**., Vulule J. Magambo, J.K. Kiambo J. |
| *Background:* | To demonstrate the effectiveness of insecticide Treated Nets (ITNS) in community set ups and under program situations, 387 expectant women in an endemic area were recruited. The objective was to assess the use of ITNS and determine prevalence of malaria and anaemia in expectant women attending Ante natal clinic (ANC) during high transmission season. |
| *Methods:* | Of the 387 women recruited, 190 (49.1%) owned nets, either conventional or long lasting ones. Prevalence of malaria parasitemia was 28.9% of which 19.8% (77/387) had malaria (parasitemia ≥800mps/ml blood). |
| *Results:* | Thirty two point eight percent (32.80%), 21.64% and 9.09% of primigravidae, secundigravidae and multigravidae, respectively had moderately severe anaemia (5.0g/dl<7g/dl). |
| *Conclusions:* | Parity and net use were significantly associated with malaria status. Marital status and level of education were important predictors of net ownership and use. |

# 2. FACULTY OF AGRICULTURE

## 2.0 DEPARTMENT OF HORTICULTURE

*The Faculty of Agriculture has embraced innovative teaching methods especially in Horticulture Department under the Master of Science in Research Methods programme. The picture shows a seminar session (on Introduction to R) being given by Mr. Richard Wamalwa, a second year student who was pursuing Master of Science in Resesearch Methods.*

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| *Title:* | Investigation of Social Economic Activities and their Implication for Wetland Conservation at Household Level in Nyando Wetlands. |
| *Researcher(s):* | **J.K. Maithya**, W. Kariuki, J.B.N Mukundi. |
| *Background:* | Wetlands are vital parts of a watershed. The Nyando wetlands are multidimensional resources that provide the community with a range of inter-related environmental functions and socio-economic benefits, which support a variety of livelihood strategies. Because of the range of wetland use strategies at the local levels, there are often conflicting demands placed upon wetlands. The loss and degradation of wetlands not only affects the existence and health of an individual wetland and causes local suffering, but also affects the ecosystem as a whole and can contribute to regional and even global environmental problems. The need to use these wetlands wisely is greatest as biodiversity is higher in these regions and basic human needs are most acute. Unfortunately, the exploitation of these wetlands around the Lake Victoria region of Kadibo has been extensive leading to their decline in quality and functioning. The threat from overuse and over exploitation, lack of application of new management technologies and weak institutional policies have resulted in reduction of the biodiversity within these wetlands. |

*Methods:* The study was carried out in Kadibo division of the Nyando wetlands of the Lake Victoria basin. This included use of questionnaires, interviews, visiting relevant stakeholders, use of remotely sensed data and field observations.

*Results:* The research indicated degradation by unsustainable levels of resource extraction. The wetland resources were currently undergoing rapid transformation through diverse consumptive practices (crop production, fishing, grazing, craft materials, brick making, clay, water and wood fuel harvesting) by the communities for their daily survival. Large areas of the wetlands had been altered to other forms of land use. The area under swamps and wetland cover increased by 4.58 $Km^2$ (20.8 %) in 1985-1995 and then decreased at a rate of 0.65 $Km^2$ per year to 6.54 $Km^2$ (24.6 %) in 1995-2008 period. In addition, the area under dense agricultural land use increased by 37.71 $Km^2$ (53.9 %) in 1995-2008.

*Conclusions:* Alternative sustainable development options have been studied to be of significant help in improving the livelihood of adjacent communities; some of which include eco-tourism and recreation, business, educational sites and agro forestry. The wetlands can be utilized sustainably through value addition techniques. Value addition contributes significantly to sustainability of papyrus materials. Local involvement and participation should be present in all stages of their management.

*Title:* Evaluation of Landscape Options for Building Resilience to Climate Change: A Case of Mount Kenya ecosystem.

*Researcher(s):* **Ochieng Aggrey Adimo**, John Bosco Njoroge, Leonard Wamocho.

*Background:* Landscape metrics: Patch richness (PR) and class area proportion (CAP), (2) Patch number (PN) and Patch density (PD); and (3) Patch size as MPS (mean patch size); *(Wache et al., 1996; Andre, 2002; Cook, 2002; Andre &Ahern, 2002; Ruslan, 2003);* Carnegie Ames Stanford Approach (CASA) model for Net Primary productivity; A numerical model of monthly fluxes of water, carbon and nitrogen in terrestrial ecosystems. NPP = Sr* EVI *emax*T*W; and Thornewaite Monthly water balance model.

*Methods:* Data Acquisition and processing: Surveys; Landsat Thematic Mapper (TM) satellite imagery -two Landsat scenes, p168r60 and p168r61 (25/02/1987 & 14/02/2002); Aster (2007) extracted land cover maps; SRTM data; Software; ERDAS 9.1; ARCGIS 9.3; IDRISI Kilimanjaro; FRAGSTAT 3.3; Image; processing – 743 band combination; Geometric corrections; Supervised classification; LANDSAT 7ETM; agriculture (dense), agriculture (Sparse), barren land, bush land (sparse), bush land (dense), forest, plantations, town, water, and woodland. (Meyer, 1998); ASTER; Small Scale Tea Farming, Closed and open Shrubland, closed and open grassland, Bamboo, tree plantations ,Subsistence agriculture, Indigenous vegetation, Riverine, Moorland,snow, towns, wheat farming.

*Results:* Evidence from this modeling study indicates that Satellite observed canopy greenness EVI is useful as a variable to help account for CO2 sink in Mt. Kenya and Indigenous species are more resilient.

*Conclusions:* Agricultural land have great potential for sequestration; CASA model captures landscape scale variability; Thornewaite water balance model show consistent water deficit maps; and CASA model can be used for annual Co2 fixation estimation in Mount Kenya.

*Title:* Potential for yield increase in mobydick (*Asclepias spp*.) flowers cv. *Gympocarpus physocarpa*.

*Researcher(s):* **Watako, A. O.** and Saggafu Salim M.

*Background:* Mobydick is a day – neutral plant in which flowering is year – round. However, global demand for cut flowers is generally high during certain occasions such as New Year, X - mass, Mother's day, Valentine day etc. Thus, it will be to the farmers' advantage if they can produce enough cut flowers to be available on these specific dates. Pinching, a mechanical flower forcing technique has been used in other floral crops to manipulate flowering dates.

*Methods:* A trial initiated on 5th April 2010 is on – going at the department of horticulture, Jomo Kenyatta University of Agriculture and Technology to investigate the effects of different pinching methods on growth and flowering of mobydick. Pinching treatments comprised: a control (no pinching), single pinch (apical portion of plant removed at 30 cm high from transplanting), single and a third pinch ( first pinch done as above with a third of emerging shoots pinched at 22.5cm height), double pinch ( first pinch as above and second pinching of all laterals at 14.5cm height).

*Results:* Preliminary data shows that unpinched plants recorded the maximum plant height at every growth stage over the rest of the treatments. The stem length for single pinch plants treatment was 99.2cm at 55days, the date of flower bud initiation. While single and a third pinched plants were 36.5cm, 55days later. All pinching treatments were associated with more initiated lateral buds which were shorter than the control.

*Conclusions:* Generally, pinching treatments seem to largely influence stem length and number of lateral shoots per plant; determinants of harvestable yield. Meanwhile, the evolution of vegetative and reproductive parameters is being followed.

# 3. FACULTY OF ENGINEERING

## 3.0 DEPARTMENT OF BIOMECHANICAL AND ENVIROMENTAL ENGINEERING

*Title:* Wetlands as regulators of water flow and matter transport – Development towards sustainable tropical landscapes (Mara Basin project).

*Researcher(s):* **B. M. Mati**, F. Mtalo, G.E. Mtalo.

*Background:* The Mara River is the lifeline of the trans-boundary Mara basin across Kenya and Tanzania. The basin is considered one of the more serene sub-catchments of the Lake Victoria Basin and ultimately the Nile Basin, and traverses the famous Maasai Mara and Serengeti National Parks. The basin also contains forests, large-scale farms, smallholder farms, pastoral grazing lands, as well as hunter gatherers and fishers. There is growing concern, however, regarding land degradation in the basin, particularly deforestation in the headwaters, that is affecting the natural resource base and the river flows. Accurate scientific data are required to advise policy, and to plan appropriate mitigation measures. The objectives of this study included determining: (i) the changes in land use–land cover over the last 30 years in the Mara basin; (ii) whether or not there has been a significant change in the flow volumes and hydrological regimes of the River Mara; and (iii) whether or not any changes in the flow regimes were attributable to changes in rainfall characteristics or were the result of human activities in the basin.

*Methods:* This study utilizes remote sensing and geographical information system (GIS) tools, and hydrological and ground-truth studies to determine the magnitude of the land- use/cover changes in the Mara River Basin, and the effects of these changes on the river flows over 30 years. Modelling changes in the flow regimes between 1973 and 2000 was accomplished with the Geospatial Streamflow Model, GeoSFM, a physically based, semi distributed geospatial hydrological model. The model uses remote-sensed Land use change, hydrology, and the Mara basin data, numerical weather forecast data, ground observation and geographical datasets that describe the soils and land surface to calculate different parameters.

*Results:* The study results indicate that land-use/cover changes have occurred. In 1973, for example, rangelands (savannah, grasslands and shrublands) covered 10 989 $km^2$ (79%) of the total basin area. The rangelands had been reduced to 7245 $km^2$ (52%) by 2000, however, while the forest areas were reduced by 32% over the same period. These changes have been attributed to the encroachment of agriculture, which has more than doubled (203%) its land area over the same period. The hydrology of the Mara River also has changed, with sharp increases in flood peak flows by 7%, and an earlier occurrence of these peaks by 4 days between 1973 and 2000. There is evidence of increased soil erosion in the upper catchments, with silt build-up in the

downstream floodplains. This has caused the Mara wetland to expand by 387%, adversely affecting riparian agriculture. There is need for urgent action to stem the land degradation of the Mara River Basin, including planning and implementing appropriate mitigation measures.

*Conclusions:* The flow regimes in the Mara River and its tributaries also have undergone significant changes between 1970 and 2000, resulting in increasing and earlier occurrences of high flows. The results of this study were confirmed on the ground, and the local people have stated that the low flows have been reduced, while the high flood peaks have increased. Land degradation upstream has generally adversely affected the water resources of the Mara River Basin, with increasing downstream sedimentation resulting in expanded wetlands. The water cycle also has become short-circuited, leading to higher run-off flows reaching more than 89 $m^3 s^{-1}$. As more land is opened for crop production, pastoralists are finding it increasingly difficult to support their families, and also are highly vulnerable to drought. Furthermore, the locally driven degradation has increased the vulnerability of thousands of wildlife, posing a risk to the sustainability of their natural habitats. This situation calls for new approaches for addressing land use and the planning, utilization, and management of the Mara River Basin resources at local, national and subregional levels. Further studies are required to determine if the shift in rainfall peaks predicted in this study are associated with climate change.

*Title:* Evaluating the Use of Constructed Wetland in the Treatment of Tannery Wastewater.

*Researcher(s):* F. N. Kilonzo, U. N. Mutwiwa, C. W. Muriuki,, M. Waweru, S. Mutua, N. Mutua.

*Background:* The tannery industry has been identified as a major source of environmental concerns producing both solid and liquid waste. Chrome-tanning constitute 90 % of the global leather production with chromium salts being used in the tanning process. With conventional methods being expensive and uneconomical for developing countries, the use of alternative cheap methods has been explored. This research was mainly concerned with assessing the viability of use of constructed wetlands to treat industrial wastewater, establish the efficiency of pollutant removal in tannery waste streams by combined use of adsorption and phyto-remediation, and evaluate the impact of pollutant abatement on the environment.

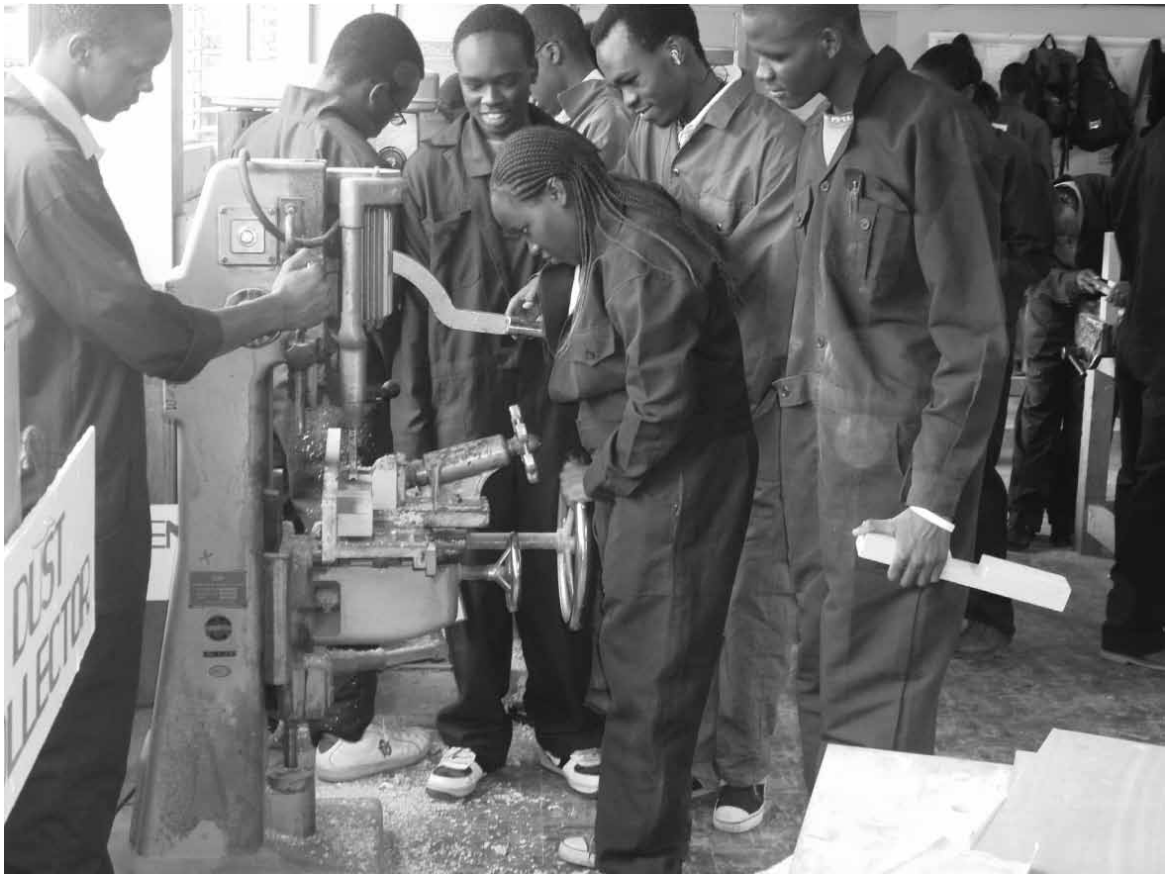
*Methods:* A pre-feasibility study was done to identify a suitable tannery were selection was based on, Environmental Compliance, discharge into the environment, presence of an effluent treatment plant and distance of the tannery. Leather Industries of Kenya, located in Thika town on the Nairobi-Garissa road, was selected as the most suitable tannery for undertaking the project study. Design parameters were established using the Reed's method for design of subsurface flow constructed wetland using a first-order plug flow model equation. A treatment facility consisting of a pumping unit, pre-treatment unit, wetland treatment cells and a drainage system was set up taking 10% of the total discharge

from the tannery. A 18 treatment cells pilot wetland with two aspect ratios 2:1 and 4.5:1 was filled with 3 aggregate sizes of Pumice lightweight material and planted with either Vetiveria (Chrysopogon zizanioides), Bulrush (Typha latifolia), or left vacant as control. Samples were collected every Monday for two months in September and October 2010, from all the cells containing Vetiveria, Bulrush and control, and also from the influent and the composite effluent. All samples were analysed for total chromium using the 357.9 nm wavelength with Atomic Absorption Spectrophotometer (AAS) model 929. The pumice media was also characterised before use in the experiment.

*Results:* The study result showed that on average 100m3 of tannery waste is produced daily with hourly as well as daily variability. Analysis of the pumice material used as media showed that the pumice was rich in silicate 55.39 % and aluminium oxides 12.48%; and this was consistent with literature values for pumice composition. Compared to the national standards set for discharge of effluent in to the environment under the water quality regulations, (GOK, 2006), the treatment system was able to remove chromium levels below the set standards of 2mg/l. Qualitative observations of a dark organic colour and low odour as compared to the initial odour of the inflow were made associated with the influence of the vegetation and oxidation of the waste water in the tanks respectively. There was no noticeable different in the amount of chromium removed by either type of plant. Vetiver showed a higher adsorption of chromium with the mean average being above 91.69% (6.67SD) as compared to typha reeds with 91.47% (6.05 SD). However over time the Vetiveria plants were unable to withstand the high toxicity of the wastewater and dried up.The chromium adsorption in both the wide (aspect ratio 2:1) and the narrow tanks (4.5:1) showed similar trends with no major differences. Adsorption in the wider tanks showed a higher chromium adsorption with an average of 90.07% (7.03 SD) as compared to the narrow tanks with 88.29% (6.64 SD). In comparison to the controls, all the cells containing pumice, Vetiver or typha reeds, either wide or narrow displayed higher chromium intakes

*Conclusions:* The main findings of this study were that; the treatment process by pumice with combination with vetiver or typha reeds was effective in attenuating Chromium pollution with high absorption ranging between 80 to 100% and significantly reduced the chromium levels in the waste water to levels below the NEMA standards (2mg/l) as well as reduced odour. The use of constructed wetlands may provide a cheap effective alternative and futher studies are required to determine their full potential in tannery waste water treament.

## 3.2 DEPARTMENT OF MECHATRONICS ENGINEERING



*Students during practical session in the School of Mechanical, Materials and Manucturing Engineering (SoMMME)*

*Title:* Study of effects of laser ablation conditions on cut quality and microstructures using $CO_2$.

*Researcher(s):* **Wairimu Grace**, Dr. Ikua B.W. and Prof. Kioni P.N.

*Background:* Lasers are employed in a wide range of applications such as in material removal, heat treatment, cleaning of surfaces and paint removal. This is due to the many benefits associated with the laser technology in terms of geometrical and dimensional accuracy which has proven to be difficult and expensive with conventional machining processes especially with hard-to-machine materials. However, there are numerous parameters that need to be considered in order to reap the full benefits in terms of optimization by being able to predict the cut quality from the machining conditions. It is also necessary to determine the effect of $CO_2$ laser on microstructures of mild steel on exposure so as not to damage underlying material in case of laser paint removal. This research was geared towards the development of a $CO_2$ laser system and its usage to determine the effect of exposure time and number of passes on depth, HAZ, hole diameters, kerf widths and aspect ratios in various materials. Microstructural changes on mild steel after exposure were also investigated.

*Methods:* A $CO_2$ laser was generated, delivered and focused on the workpieces to be machined. Each machining condition

considered was varied at a time while holding the other entire parameters constant and its effect on cut quality investigated. Machining conditions considered were exposure time, position of the beam focal point, material type, use or absence of an assist gas and cut quality defined by depths, hole diameters, heat-affected-zone (HAZ), aspect ratios, kerf widths, geometrical and dimensional accuracy and taper. PJ 311 Profile Projector and a travelling microscope was used to take the measurements. Some surfaces of polished and etched mild steel were painted and both the unpainted and painted specimens exposed to the beam for a definite time. A microstructural microscope with a magnification of 544 was used in observation of the microstructures before and after exposure.

*Results:* An increase in machining time and/or exposure time increased depth attained, kerf widths, taper, hole diameters and HAZ upto a saturated value. Use of compressed air as the assist gas improved geometrical accuracy and increased relevant dimensions. Exposure time of at least 30 seconds led to microstructural changes in mild steel for the painted surfaces only. No visible marks were observed on the shiny surfaces even for the longest exposure time.

*Conclusions:* Polished surfaces of mild steel have high reflection to the $CO_2$ laser energy. Painting improves the surface absorptivity of the underlying material. Laser beam has some effects on the microstructure of the underlying materials. There is a minimum exposure time below which laser beam cannot remove the paint. The many advantages of laser paint removal could be compromised by the adverse side effects such as substrate damage.

*Title:* Optimization of Machining Process for Free-form surfaces using an intelligent adaptive controller

*Researcher(s):* **Njiri J. G**., Ikua B. W., Nyakoe G. N.

*Background:* Control of the machining process is presently receiving significant attention due to potential economic benefit associated with automated machining, which includes increased productivity and reduced production cost. To effectively control machining process, it is important to have the knowledge of cutting forces emanating from the process. The cutting forces are the main factors governing machining accuracy, machine tool vibration, power requirements and tool life. A major drawback in Computer Numerical Control (CNC) of machine tools is that machining parameters such as spindle speed, feedrate and depth of cut are programmed off-line. With such an approach, the part programmer usually sets these parameters conservatively in order to avoid excessive tool wear, tool breakage or poor machining quality. This leads to under utilization of the machine tool, and consequently low productivity. Therefore, there is need to develop a model to predict the cutting forces and design a control system that can adjust these parameters in real time in order to optimize machining process.

*Methods:* In this research, a theoretical model was developed for the prediction of cutting forces in ball-end milling of spherical surfaces. Several

experimental tests were carried out to validate the model. The influence of various cutting conditions on cutting forces was also investigated. An adaptive fuzzy logic controller (FLC) algorithm was developed for CNC machine tool to optimize the machining process. The control algorithm was such that when spindle loads are too low, the system increases the federate to a value above the pre-programmed one, and when these loads were too high, the feedrate was lowered. When the system detects extreme forces, it automatically stops the machine to protect the cutting tool and machine tool from damage.

*Results:* The results of this study show a good agreement between theoretical and experimental values of cutting forces. Also the table feedrate was varied in real-time depending on the generated force during the machining process.

*Conclusions:* It was demonstrated that the FLC developed can provide stable machining and improve the performance of the CNC milling process by varying feedrate in real-time.

# 4. INSTITUTE OF TROPICAL MEDICINE AND INFECTIOUS DISEASES

## 4.0 DEPARTMENT OF MEDICAL LABORATORY SCIENCES

*Title:* Incidence and Molecular Subtyping of Human Metapneumovirus Isolates from Selected Populations of Kenya, 2006 – 2009.

*Researcher(s):* V. O. Omballa, J. Oundo, **J. R. Ongus** and K. M. Njenga

*Background:* Human Metapneumovirus (hMPV) is a newly discovered member of the family *Paramyxoviridae* responsible for Acute Lower Respiratory Tract Infections (ALRTI) in young children, elderly patients, and immuno-compromised hosts. It has an estimated prevalence of 5-15% in studied populations. Epidemiological data and genetic diversity on the virus is well documented worldwide, but not in developing countries especially Africa. Determining the circulating subtypes of hMPV in the selected study populations of Kenya and analyzing their epidemiological data relating to hMPV cases will provide knowledge on common symptoms, the most affected age groups and circulating subtypes for use in vaccine development.

*Methods:* From 1st October 2006 to 30th September 2009, Nasopharyngeal and oropharyngeal swabs were collected in the study populations and analyzed for respiratory viruses to screen for hMPV. Selected hMPV positive samples were cultured in Rhesus monkey epithelial kidney cells (LLC-MK2) cells prior to DNA sequencing, multiple sequence alignment and phylogenetic analysis to determine genetic diversity.

*Results:* The most affected segment of the population under study were children below 5 years old with incidence rates up to 7.59 per 1000 person years in males below 12 months in Kibera. Incidence rates per 1000 person-years in Kibera urban informal settlement were higher than those in Lwak rural community with the risk of acquiring the virus (RR = 1.79) in children below 5 years was statistically significant (p-value, 0.007). The common subtype of hMPV circulating determined from the isolates was B2. Common symptoms present in the study patients included Fever, Cough and runny nose and the average percent genetic identity was 88.4% among all isolates.

*Conclusions:* hMPV seems to contribute a lot in child morbidity and data on seasonal strains in Kenya have still not been well elucidated. Further studies on prevalence, impact on human health, age association should be implemented.

*Title:* Factors Associated with Multi-Drug Resistant Tuberculosis in Kenya, 2009.

*Researcher(s):* H. O. Weyenga, J. Sitienei, J. Omolo, J. Oundo and **J. R. Ongus.**

*Background:* Multi-drug resistant tuberculosis (MDR-TB) and weak health systems threaten global tuberculosis control. Kenya is ranked 13th among the 22 high TB burden countries worldwide, and currently has an estimated 2,300 MDR-TB patients.

*Methods:* This was an unmatched case control study conducted in 41 health facilities in 20 districts across the eight provinces in Kenya from September 2009 to January 2010. Cases were confirmed MDR-TB (resistance to at least rifampicin and isoniazid) patients while controls were sputum- smear positive TB patients with clinical response and negative sputum smear at the fifth month of treatment with first-line anti-tuberculosis drugs. Study approval was sought and obtained from relevant institutions. An informed consent was a prerequisite for enrolment of all participants. Using the health facility TB register as the sampling frame, consenting confirmed MDR-TB patients and two randomly selected unmatched controls per case were enrolled. A pretested structured interviewer administered questionnaire was used for patient interviews and to abstract information from records. Data on socio-demographic, behavioural, and clinical exposure history were obtained. We entered and analyzed data using *Epi-info* and Stata versions 3.5 and 9.0 software respectively.

*Results:* A total of 81cases {mean age: 32 years (SD: 10), 62% males} and 162 controls {mean age: 35 years (SD: 13), 59% males} there was no statistically significant difference with respect to baseline socio-demographic characteristics. Six (7.4%) of the MDR-TB cases having no previous history of TB, were exposed to household case a known MDR-TB. Cases were more likely to have history of previous exposure to first line anti-Tuberculosis drugs (OR= 85, 95% CI=29.7- 243.3; P<0.0001) and being of foreign origin (OR=5.5, 95% CI=1.4-21.8; P=0.007). Case-patients with positive HIV status (OR=0.34, 95% CI= 0.1-0.9; P=0.025) and those who had received TB treatment under the Directly Observed Therapy program (DOT) (OR=0.23, 95% CI= 0.1-0.6; P=0.002) were less likely to have MDR-TB.

*Conclusions:* We recommend strengthening of MDR-TB surveillance among previously treated TB cases and refugees and active MDR-TB case finding among HIV infected TB patients. More rapid MDRTB diagnostic tests should be used among the HIV infected patients. Access to TB care services by all population groups including immigrants, implementation of DOT, MDRT-TB contact tracing and screening and infection prevention should be strengthened.

# 5. INSTITUTE OF ENERGY AND ENVIROMENTAL TECHNOLOGY (IEET)

*Title:* Evaluation of Occupational Noise Exposure among Workers in Metal Fabricating Sector in Kamukunji Nairobi.

*Researcher(s):* **C. Mburu**, John Kimani and Ciira Kiiyukia.

*Background:* The study was conducted to determine the level of hearing loss, noise exposure levels and awareness toward noise induced hearing loss among the workers in metal fabricating sheds in Kamukunji, Nairobi.

*Methods:* A structured questionnaire was administered to 384 randomly selected workers to collect information relating to their awareness toward hazardous occupational noise and preventive measures. Noise mapping using sound level meter was carried out in various sheds and audiometric testing was carried out to the sample at frequencies 0.125-16 KHz.

*Results:* The overall measured noise levels in the study area ranged from 72.0 dB (A) to 113.8 dB (A) and 93.8% of the workers were exposed to noise levels of 90 dB (A) and above for more than 8 hrs daily. 90.6% of the workers were aware that noise can cause deafness and 88.8 % of the workers were aware that it can be prevented, but only 2.9% of the workers possessed hearing protectors of which only 1.3% uses them regularly. 34.4% of workers had noise related health problems but only 10.7% had sought medical assistance. 35.2% of the workers had impaired hearing and 83% of those with impaired hearing had worked for more than 6 years.

*Conclusions:* Workers were exposed to hazardous noise level and they recognised noise as a hazard but initiatives are required to increase use of effective preventive measure.

*Title:* Impact of Safety and Health Audits on the Working Conditions in Nairobi Metropolis.

*Researcher(s):* **Stanley Mbatha**, Charles Mburu and Ciira Kiiyukia.

*Background:* The study was conducted to assess the impact of a legal notice No 31 of 2004 enacted by the Minister for Labour that introduced safety and health audits in organizations in relation to improvements of the working conditions in Nairobi.

*Methods:* Document review at the Directorate of Occupational Safety and Health Services offices, Ministry of Labour and a structured questionnaire administered to 130 workers from 10 different workplaces that had been audited continuously from 2005 to 2008.

*Results:*
1. there was over 100% increase in the number of organizations that were audited between 2005 and 2008
2. Only 6.35% of the workplaces were consistently audited from 2005 to 2008
3. 65% of the recommendations from the safety and health audits were implemented.
4. Major impediments to implementation of the recommendations were lack of adequate budgetary allocation

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| | to safety and health, management commitment and follow up by DOSHS. |
| *Conclusions:* | The study found that there has been improvement of the working conditions within Nairobi Metropolis since the introduction of safety and health audits. |
| *Title:* | Analysis of Multi-flow and Coupled Energy Conversion Processes. |
| *Researcher(s):* | **Francis Njoka**, Robert Steinberger-Wilckens and Detlev Heinemann. |
| *Background:* | Analyses of novel energy conversion processes solely based on energy flow quantities and devoid of economic considerations hence facilitating universal application of the findings. |
| *Methods:* | Energy balance, efficiency chains and associated carbon emmissions of both novel and reference systems. Three technologies; Enhanced oil recovery (EOR), High Temperature Electrolysis (HTE) and Ammonia & Methanol as SOFC fuels were analysed. |
| *Results:* | Novel $CO_2$ capture methods reduced $CO_2$ emissions by over 40% but more PE was used; Low-cost high temperature sources greatly reduced electrolysers' electricity demand; Ammonia and Methanol are still potential fuels which could overcome the storage issue with hydrogen at quite impressive efficiencies. |
| *Conclusions:* | These novel technologies have a very high future potential but must of course be vetted economically before adoption. |

# SECTION C: COMPENDIUM OF PUBLICATIONS

# 1. FACULTY OF SCIENCE

## 1.0 DEPARTMENT OF STATISTICS AND ACTUARIAL SCIENCES

*Name of Lecturer/Authors:* **G. M. Ombui,** M. Geofrey and A. W. Gichuhi
*Title of Publication:* Using ordinal regression modeling to evaluate the satisfaction of Jomo Kenyatta University of Agriculture and Technology Faculty of Science students.

*Abstract:* General students' satisfaction of Jomo Kenyatta University of Agriculture and Technology (JKUAT) Faculty of Science students is associated with a combination of qualitative and quantitative predictor variables. Ordinal regression statistical technique was used to model the relationship between the academic programmes, facilities and services, and the outcome variable to determine the explanatory variables that influence students' satisfaction factors that will assist in improved service delivery. Data analysis involved both descriptive and inferential analysis. The factors that were found to influence the satisfaction of the JKUAT Faculty of Science students were four; service delivery at the department office, the library services, accommodation facilities in the university hostels and the accommodation facilities outside the university. Key words: Ordinal regression, clog-log, link function

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Anthony K. Wanjoya**, Nicola Torelli and Gauri Datta.
*Title of Publication:* Small Area Estimation: An Application of a Flexible Fay-Herriot Method.

*Abstract:* The importance of small area estimation in survey sampling is increasing, due to the growing demand for reliable small area estimation from both public and private sectors. In this paper, we address the important issue of using statistical modelling techniques to compute more reliable small area estimates. The main aim is to assess the use of a exible methodology for small area estimation. We formulate new exible small area model by incorporating a tuning (index) parameter into the standard area-level (Fay-Herriot) model. We achieve this using a combination of two methods namely, empirical Bayes (EB) approach and hierarchical Bayes (HB) approach. Our results suggest that the proposed model can be seen as anadvancement over the standard Fay-Herriot model. The novelity here is that we have developed a exible way to handle random e_ects in small area estimation. The Implementation of the proposed model is only mildly more di_cult than the Fay-Herriot model. We have obtained results for both EB approach and

the HB approach. Compared to the corresponding HB procedure, the EB approach saves a tremendous computing time and is very simple to implement. Keywords: Area-level; Empirical bayes; Fay-Herriot Model; Hierarchical Bayes; Small Area.

*Name of Journal/Conference Proceedings/Workshop:* 5th JKUAT Scientific, Technological and Industrialization Conference 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Ananda O. K. and **Mwita P. N.**

*Title of Publication:* Bootstrap uniform confidence bands for a local linear nonparametric estimator and applications to financial risk management.

*Abstract:* This paper considers the problem of bootstrapping a local linear estimator in conditional quantile estimation of a financial time series assuming independent and identically distributed errors. A nonparametric regression bootstrap generating process is estimated, then bootstrap confidence bands fitted to the quantile estimates. Under appropriate assumptions, the local linear bootstrap estimator is known to be consistent. Keywords: quantile estimation, bootstrap, local linear, consistency

*Name of Journal/Conference Proceedings/Workshop:* 5th JKUAT Scientific, Technological and Industrialization Conference 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Orwa, G. O**., Otieno, R. O. and Odongo, L. O.

*Title of Publication:* Nonparametric Estimation in two stage Cluster Sampling.

*Abstract:* We propose a nonparametric estimator of a finite population total under two-stage cluster sampling in a case where complete auxiliary information at cluster level is available. Our input is the demonstration that a thinning process can be done on a set of weights originally constructed by calibrating the imputed points and that these thinned weights can be used to estimate population totals even for multiple variables. The proposed estimator is asymptotically unbiased, design consistent and asymptotically normal under mild assumptions. An empirical study shows that this estimator performs better than model based estimators, model calibrated estimators and design based estimators. Key words and phrases: Local Polynomial, Two-Stage Cluster Sampling, Auxiliary information, Calibration, Model Assisted Estimation, within model calibration.

*Name of Journal/Conference Proceedings/Workshop:* East African Journal of Mathematical Sciences.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **G. O. Orwa**, R. O. Otieno and P. N. Mwita.

*Title of Publication:* Nonparametric Mixed ratio estimator for finite population total in Stratified Sampling.

*Abstract:* We propose a nonparametric regression approach to the estimation of a finite population total in model based frameworks in the case of stratified sampling. Similar work has been done, by Nadaraya and Watson (1964), Hansen et al. (1983) and Breidt and Opsomer (2000). Our point of departure from these works is at selection of the sampling weights within every stratum,

where we treat the individual strata as compact Abelian groups and demonstrate that the resulting proposed estimator is easier to compute. We also make use of mixed ratios but this time not in the contexts of simple random sampling or two stage cluster sampling, but in stratified sampling schemes, where a void still exists. Some key words: Model based surveys, sampling weights, two stage sampling.

*Name of Journal/Conference Proceedings/Workshop:* Pakistan Journal of Statistics and Operational Research: Volume 6, Number 1, Pages 105-119.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Ouma, C. O**., Otieno, R. O. and Orwa, G. O.

*Title of Publication:* Bootstrapping in Model based estimation of a finite population total I two stages Cluster Sampling with unequal Cluster sizes.

*Abstract:* The bootstrap approach to model based inference was first proposed by Chambers and Dorfman. Ouma and Wafula re looked at the conditions and extended this work. However, both cases focused on simple random sampling in cases where the auxiliary variables are known for the entire population. Our contribution is that we now present a bootstrap approach to the same kind of inference in two stage cluster sampling with unequal cluster sizes. Similar work has been done by Kelly and Cumberland, Jan and Elinor. Unlike them however, we consider a case in which the cluster sizes are known only for the sampled clusters, and we make use of the population model arising from the variance component of the auxiliary variables Xi to provide a consistent estimator for the population total. We also choose our initial sampling weights differently as an attempt to address the gaps that emerged from their use of the weights due to Rao and Wu. Our proposed model is unbiased for the population total. The asymptotic behaviour of the error term in our proposed model may also be used to explain the choice of a sampling scheme in which the cluster sizes are fixed. Key words: Model based surveys, two stage sampling.

*Name of Journal/Conference Proceedings/Workshop:* East Journal of Theoretical Statistics. Volume 33, Number 2, Pages 171-184.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Ouma, C. O.,** Otieno, R. O. and Orwa, G. O.

*Title of Publication:* Generalized Model based Confidence Intervals in two stage cluster sampling.

*Abstract:* Chambers and Dorfman constructed bootstrap confidence intervals in model based estimation for finite population totals assuming that auxiliary values are available throughout a target population and that the auxiliary values are independent. They also assumed that the cluster sizes are known throughout the target population. We now extend to two stage sampling in which the cluster sizes are known only for the sampled clusters, and we therefore predict the unobserved part of the population total. Jan and Elinor has done similar work, but unlike them, we use a general model, in which the auxiliary values i X are not necessarily independent. We demonstrate that the asymptotic

properties of our proposed estimator and its coverage rates are better than those constructed under the model assisted local polynomial regression model.

*Name of Journal/Conference Proceedings/Workshop:* Pakistan Journal of Statistics and Operational Research. Volume 6, Number 2, pages 123-139.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **O. O. Ngesa**, G.O. Orwa and R. O. Otieno.

*Title of Publication:* Multivariate ratio estimator of the population total under stratified random sampling.

*Abstract:* Olkin (1958) proposed a ratio estimator considering p auxiliary variables under simple random sampling. We extend this to stratified random sampling. Similar extensions have been done, the latest being that by Ahmad et al, (2008), but unlike them, we consider a case where the strata have varying weights. The proposed estimator has a smaller bias when compared to that due to Olkin (1958). Keywords: Ratio Estimator, Stratification, Auxiliary variables.

*Name of Journal/Conference Proceedings/Workshop:* EAJOSTA.

*Year of Publication:* 2010.

## 1.1 DEPARTMENT OF BOTANY

*Name of Lecturer/Authors:* **G. N. Njoroge.**

*Title of Publication:* Ethnobiology and development: relevance of traditional knowledge in the growth of natural products industry and sustainable environmental management.

*Abstract:* Traditional or indigenous communities have for a long time contributed to the accumulation of world knowledge. Unfortunately, in the context of modern science and technology this knowledge is largely ignored and undervalued. Recent approaches to development and industrialization, however, are geared towards upscaling traditional innovations, technologies and inventions. There are traditional practices especially in utilization biological resources that are likely to contribute to acceleration of development of natural products industry and sustainable environmental management in the 21st century. These may include indigenous knowledge of local plants and forest products, knowledge on important species for integration in pest management, innovative ideas in ecological processes and land use. This paper explores the relevance of ethnobiological data in sustainable natural products industrial development and environmental management. Key words: Traditional knowledge, natural products commercialization, environmental management

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Edward Nderitu Karanja, **Hamadi Iddi Boga**, Anne W. Muigai, Fred Wamunyokoli, Johnston Kinyua 1 and James Oluoch Nonoh.

*Title of Publication:* Growth Characteristics and Production of Secondary Metabolites from Selected Novel Streptomyces species Isolated from Selected Kenyan National Parks.

*Abstract:* The aim of study was to characterize growth of novel Streptomyces isolates as well as the secondary metabolites they were producing. Four Streptomyces isolates from Chyulu National Park (Chy 4-10, Chy 15-10, Chy 15-5 and Chy 2-3) and one from Ruma National Park (Ruj 7-1) were studied. The isolates grew well at pH 6, 7, 9 and temperatures of 27.5 oC, 30 oC, and 32.5 oC. They preferentially utilized glucose and xylose and also required sodium chloride (0 g/l – 17.5 g/l) for growth. Antimicrobial products were extracted using ethyl acetate and the crude secondary metabolite extracts analyzed using Gas Chromatography- Mass Spectrophotometer (GC-MS). 0.54 g/l, 0.62 g/l, 0.41 g/l, 0.3 g/l and 0.14 g/l yields of crude secondary metabolites were extracted from the isolates. The crude secondary metabolites had different levels of activity against Gram positive and Gram negative test bacteria. Characterization of the crude secondary metabolites indicated presence of chemical compounds ranging from amides, amines, acids, pyrrolizidines, butenolides, alcohols and hydrocarbons. Key words: Streptomyces, Antimicrobial activity, Gas Chromatography- Mass Spectrophotometer, secondary metabolites.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Edward Nderitu Karanja**, Hamadi Iddi Boga, Anne W. Muigai, Fred Wamunyokoli, Johnston Kinyua 1 and James Oluoch Nonoh.

*Title of Publication:* Optimization of Growth Conditions and Characterization of Enzymatic Activity of selected novel Streptomyces species from Kenyan soils.

*Abstract:* This study was aimed at unveiling and assessing protease, esterase, amylase and lipase enzymes from selected novel Streptomyces species with biotechnological interest. Four Streptomyces isolates from Jomo Kenyatta University of Agriculture and Technology farm soil were studied. Physiochemical and biochemical characterization of the isolates was carried out. The isolates grew well at pH 6, 7, 9 and temperatures of 27.5 oC, 30 oC, and 32.5 oC. They preferentially required sodium chloride (0 g/l – 17.5 g/l) for growth. All the isolates produced amylase, lipase, protease and esterase enzymes apart from one isolate that did not produce esterase enzyme. Key words: Streptomyces, enzymatic index (EI), amylase, lipase, protease, esterase.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **E. G. O.Omondi**, M. N. Makobe, C. A. Onyango, L. G. Matasyoh, M. O. Imbuga and E. N. Kahangi.

*Title of Publication:* Nutritional Evaluation of Mutants and Somaclonal variants of Sorghum (Sorghum bicolor (L) Moench) in Kenya.

*Abstract:* Moench mutants and somaclone lines (Seredo, Serena, Mtama 1 and El-gardam) were developed towards improvement for drought tolerance at the Jomo Kenyatta University of Agriculture and Technology. Mutants were produced by using mutation techniques. X-ray with the dose of 15000R was used to induce genetic variation. Somaclones were produced through somatic embryogenesis on Linsmaier and Skoog's (LS) media with 0.5 M concentration of Mannitol as an osmoticum to simulate drought conditions. The study was conducted to evaluate the chemical composition, B-vitamins, mineral profile, Antinutrient content and levels of protein digestibility of somaclones, mutants and parents of the Sorghum bicolor (L) Moench local cultivar in Kenya (namely Mtama 1, Seredo, El Gardam and Serena). The proximate composition, B-vitamins, anti-nutrient contents and levels of protein digestibility of the flour from the cultivars were determined. The chemical components of the varieties do not vary among and within varieties ($P \geq 0.05$). Serena and Seredo showed high levels of Anti-nutreint (phytates and Tannins) than Mtama 1 and El-dargam (tannin: 0.03-2.22%, Phytates: 124.3-374mg/100g) ($P \geq 0.05$). The somaclones and mutants of the sorghum cultivars except Mtama 1 were noted to have reduced quantities of tannin. Protein digestibility range between 39.1%-88.4% and were low in Seredo and Serena than in Mtama 1 and El-gardam. No significant differences ($P \geq 0.05$) were observed among and within the treatments of the same varieties of the sorghum for proximate composition, B-vitamins and mineral compositions. It was concluded that Major variations among the varieties arose due to anti-nutrients. High anti-nutrient factors would affect the utilization of the Serena and Seredo varieties since these anti-nutrients reduce the availability other nutrients.
Key words: Varieties, Mutants, Somaclones, Drought-tolerance, Nutritional traits.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Moses M. Njire** and Nancy L.M. Budambula, John N Kiiru.

*Title of Publication:* Efficacy of plant extracts on antibiotic resistant bacteria.

*Abstract:* The rise in antibiotic resistance has resulted in a decreasing number of fully active antimicrobial agents available to treat infections by multi-drug resistant (MDR) bacteria. This has necessitated a search for new antimicrobial agents. Herbal remedies may offer novel treatment options which elicit little or no transferred resistance if used in optimal concentrations. This study evaluated the antimicrobial properties of ten plants traditionally used as herbal remedies against 27 multi-drug resistant Gram-negative bacterial isolates. The herbal extracts were obtained through organic (methanol) and inorganic (water) solvents extraction.

Susceptibility of the test strains to conventional antibiotics was determined by the disc diffusion technique. Determination of the Minimum Inhibitory Concentrations (MIC) and the sub-lethal concentrations of the most effective extracts against the MDR strains was done by broth inoculation followed by colony count method. The effect of sub-lethal extract concentrations was done by a method modified from McMahon et al. (2007). Out of the ten plants, only Warbugia ugandensis was active against the MDR strains and its efficacy was significantly different from that of other plant extracts such as Terminalia brownii, Azaridachta indica, Clausena anisata and Strychnos henningsii ($p<0.001$). The root and bark methanol extracts from W. ugandensis were the most effective with an MIC of 42 µg/ml. Susceptibility of test strains to conventional antibiotics was not significantly different before and after habituation to sub-optimal extract concentration ($p>0.005$). Methanol extracts from the root and bark of W. ugandensis provide potential sources of effective antimicrobial compounds for further development of alternative safe antimicrobial products in form of chemotherapeutic agents or antiseptics. The optimization and standardization of operation procedures and methods of analysing the efficacy of herbal extracts demands serious consideration. Key Words: Multi-drug resistant (MDR) bacteria, Minimum Inhibitory Concentrations (MICs), Sub-Lethal Concentration (SLC)

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Y. M. Muthiani**, V. N. Matiru and Christine Bii.

*Title of Publication:* Potential skin pathogens on second hand clothes.

*Abstract:* This study examined the pathogenic microbial levels in second hand undergarments and compared the effectiveness of disinfection methods used to reduce microbial load in the garments. Of special interest were pathogenic microbes in undergarments such as panties, bras, socks and towels which were collected from various flea markets. The study was planned following prior casual questioning of consumers to find out the most common decontamination methods used on these clothes. Clothe samples collected from the Gikomba second hand market were examined in a biomedical laboratory for evidence of high levels and types of pathogenic microbes and persistence of the pathogenic microbes that can be attributed to skin infection after decontamination procedures. Culture and biochemical methods were used for investigation. A variety of potential skin pathogens were isolated from unwashed second hand undergarments, socks and towels. Several bacteria were isolated including Methicillin-resistant Staphylococcus aureus (MRSA) and Methicillin-sensitive Staphylococcus aureus (MSSA). The fungi isolated from the unwashed clothes included Scopulariopsis brevicalis, Geotrichum candidum, Scytalidium, Trichophyton mentagrophytes, Rhodotorula sp., Cladosporium sp., Candida tropicalis, Candida glabrata and Aspergilus flavus.

Panties and bras had the highest count of both bacteria and fungi. The mycoflora was not limited to dermatophytes such as Trichophyton but other fungi exist such as Alternaria alternata which are pathogenic. In this study, the clothes were washed with grade 2 laundry bar soap. After washing there was a reduction in the bacterial ($t_{12}=9.6$, $P<0.001$) and yeast ($t_{12}=3.5$, $P>0.005$) plate counts but therefore was a no significant reduction in mold counts ($t_{12}=1.1$, $P>0.005$). The kill time for both Jik and Savlon against the MRSA isolates from clothes is 2 minutes. The concentrations of Omo used do not kill the MRSA isolates at 10 min. The study shows that second hand clothes are frequently contaminated by several pathogenic bacteria and fungi, which remain on these clothes even after washing with ordinary bar soaps. The information obtained from this study form a basis of advising consumers, public, ministry of health and health workers dealing with immunocompromised patients in nursing homes and hospitals. The findings from the study also reinforce the need for appropriate disinfection and conscientious contact control precautions. Key words: Skin infections, second hand clothes.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Ochora J. M**, J. M. Onguso and Kanya J. I.

*Title of Publication:* On the Agroforestry system and in situ conservation of medicinal plant germplasm in Kenya.

*Abstract:* In sub-Saharan Africa about 80% of the ever increasing population depends on ethnomedicine for their healthcare since modern medicine is mostly expensive or unavailable in rural homesteads. However, ethnomedicine is the one presently recognised as the most effective in treating new emerging diseases such as HIV/AIDS since no effective conventional medicine exists for their cure. Medicinal plants germplasm, which are the major sources of ethnomedicine form an important part of forests and riverine vegetation in Kenya. These important plants include Warburgia, Rhas spp., Aspilia, Acacia, prunus, Molinga, Brascae, Aloe, and Terminalia. These plants are not only useful to man as a source of medicine but are microhabitats for many animals as well as forming "refugia" to many insects species. In Kenya, due to land degradation and rampant deforestation in agriculturally high potential areas, medicinal plants genetic resource is threatened. The most medicinally popular of these plant species, which are mostly biome restricted, are facing extermination. This paper reports conservation concerns in agriculturally high potential Trans-Nzoia District in Kenya. The study based on field surveys revealed that of the ca. 806 plants species in 92 families about 36 species are used for medicinal purposes. The plants are threatened in their indigenous localities in the District. The study recommends participatory in situ plant conservation in the District along maize and wheat farm hedges. Key words:

Agroforestry, in situ conservation, medicinal plants, indigenous medicines.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Odari E.O, Ochwotto M., **Budambula N.L.M**, Nitschko H. and Kimotho J.H.

*Title of Publication:* Fresh blood samples versus Archived samples in Hepatitis C virus screening: A comparative study.

*Abstract:* A low prevalence of Hepatitis C virus infection ranging from 0.1% to 0.9% has continuously been reported in the Kenyan population. Several studies have however concentrated on special groups like Intravenous Drug Users (IDUs) and blood bank samples, with no major study carried out in the general population. This study aimed at testing and comparing results of fresh and archived Hepatitis C infected samples obtained both from patients in Kenya and in Germany. Fresh and archived samples in Kenya were obtained from patients attending the liver clinic at the Kenyatta National Hospital and those stored at the Kenya Medical Research Institute (KEMRI), respectively. Fresh and archived samples from Germany were obtained from patients attending HCV treatment at the two main Ludwig Maximillian University hospitals in Germany and those stored at the Max von Pettenkofer Institute (MvPI)- Munich Germany, respectively. Freshly obtained samples were subjected to serological assays by Enzyme Linked Immunosorbent assay platforms (Ortho HCV 3.0 ELISA test system with an enhanced SAVe and AxSYM ELISA test system, for German samples and Murex ELISA test system, for Kenyan Samples) commonly used in each individual country before subjecting all the samples to a similar nested PCR diagnosis. All the archived samples had also been subjected to PCR diagnosis and confirmed positive at least once in the course of their storage. A total of 25 and 50 samples from Kenya and Germany, respectively, were tested and compared. All the 50 (100%) ELISA positive German samples were again confirmed PCR positive in the standardized PCR diagnostic system, whereas Kenyan samples realized varied results. Despite 100% (4 out of 4) detection by PCR on fresh samples, no detection, 0% (0 out of 21), was realized on the archived samples. These archived Kenyan samples could not also be detected by the available antibody based rapid detection kits. Based on the results realized with archived samples, whose conditions are deemed similar to the blood bank conditions in Kenya, this study asserts that although stored blood bank samples have continuously been used to estimate the prevalence of Hepatitis C infection in Kenya, this parameter may not be appropriate in estimating the true prevalence of this infection in the general population. The study therefore, concludes and recommends a need to screen and determine the true prevalence of the infection using samples from the general population, since

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| | together with Hepatitis B, Hepatitis C infection are emerging as a major point of focus in blood transfusion screening in Kenya. The study further recommends that together with serological assays, Nucleic Acid based Techniques (NAT) should be employed in screening all freshly obtained blood before storage. Key words: Hepatitis C virus, Fresh and archived samples, Nucleic Acid based Techniques, blood transfusion, blood bank samples. |
| *Name of Journal/Conference Proceedings/Workshop:* | The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology. |
| *Year of Publication:* | 2010. |
| *Name of Lecturer/Authors:* | Odhiambo P.O., **Makobe, M**., Boga, H., Muigai, A. and H. Kiesecker. |
| *Title of Publication:* | In vitro regeneration of *Thevetia peruviana* Pers. K. Schum, Family Apocynaceae. |
| *Abstract:* | *In vitro* culture of higher plants is defined as the culture on nutrient media under sterile conditions of plants, embryos, organs, explants, tissues, cells and protoplasts of higher plants. Murashige and Skoog's culture medium is the most used tissue culture medium. The objective of this study was to develop and optimize in vitro protocol for regeneration of soma clonal variants of *T.peruviana* aimed at obtaining glycoside free or low glycoside plantlets with high oil and proteins content through tissue culture technique in order to develop new varieties which has novel traits compared to the existing landraces. *T.peruviana* seedlings germinated from mature fruits of orange flowering variety of *T. peruviana* trees were used. Young but enlarged leaves next to the shoot tip were excised as source of explant. Callus initiation media consisted of MS salts, vitamins plus 8 g / l agar agar, 30 g / l sucrose, 2.0 mg / l dichlorophenoxyacetic acid (2,4-D) supplemented with 0.1 mg / l of kinetin at pH of 5.75 at 220C to 240C and 12 hour darkness during the night and 12hrs lighting from fluorescent tubes during the day. Shoot regeneration medium consisted of MS media salts, vitamins, supplemented with 3 mg / l of 2 ip, 8 g / l agar agar, 30 g / l of sucrose, at pH of 5.75 were incubated at 250C-270C, with continuous lighting from florescence tubes in the growth chamber. Rooting was initiated by incubating single shoots into each media bottle containing 30 ml of MS media salts, vitamins, 1 g of glycine, 0.2 g of biotin, 3 mg/l of Indole-3- butyric acid (IBA), 8 g of agar agar and 30 g/l sucrose. It was noted that plantlets of *T.peruviana* regenerated after 12-24 months. Key words: *Thevetia peruviana*, in vitro regeneration, Murashige and Skoog, callus. |
| *Name of Journal/Conference Proceedings/Workshop:* | The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology. |
| *Year of Publication:* | 2010. |

## 1.2 DEPARTMENT OF CHEMISTRY

*Name of Lecturer/Authors:* David M. Mburu, **Mary W. Ndung'u**, Nguya K. Maniania and Ahmed Hassanali.

*Title of Publication:* Comparison of volatile blends and gene sequences of two isolates of *Metarhizium anisopliae* of different virulence and repellency toward the termite *Macrotermes michaelseni.*

*Abstract:* Previously, we reported an interesting relationship between virulence and repellency of different isolates of the fungus *Metarhizium anisopliae* towards the termite *Macrotermes michaelseni:* the higher the virulence of a given isolate, the greater its repellency. In the present study, we compared the volatile profiles of two isolates, one that was more virulent (and repellent) and one that was less virulent (and repellent) to the termite. The prominent components of the two blends were characterized by gas chromatography-mass spectrometry and authenticated by gas chromatography co injections with synthetic standards. There were both qualitative and quantitative differences between the two blends. The repellencies of synthetic blends of 10 prominent constituents of the volatiles of the two isolates were compared and that of the more virulent isolate was found to be significantly more repellent. Subtractive bioassays were carried out with one of the constituents of each of the two 10-component blends missing at a time to determine its relative contribution to the overall repellency. The results indicated that the repellency of the volatiles of each isolate was primarily due to synergistic effects of a smaller number of constituents. Intraspecific differences between the two isolates were also reflected in their nucleotide sequences.

*Name of Journal/Conference Proceedings/Workshop:* The Journal of Experimental Biology 214, 956-962 © 2011. Published by The Company of Biologists Ltd doi:10.1242/jeb.050419

*Year of Publication:* 2011.

*Name of Lecturer/Authors:* Mercy Githua, Ahmed Hassanali, Joseph Keriko, Grace Murilla, **Mary Ndungu** and Gathu Nyagah.

*Title of Publication:* New Antitrypanosomal Tetranotriterpenoids from *Azadirachta indica.*

*Abstract:* Organic extracts of the leaves of *Azadirachta indica* A. Juss yielded ten antitrypanosomal terpenoids. Three of these (1 – 3), are novel and are derivatives of nimbolide and nimbin. They were extracted from chloroform fraction of methanol extract. These compounds were found to exhibit strong antitrypanosomal activities against *Trypanosoma brucei rhodesiense* with MIC values ranging of 6.9, 15.6 and 7.8 µg/ml respectively and were moreactive than Cymerlarsan ( a standard drug), which had an MIC value of 187.5 µg/ml when tested against *T. b. rhodesiense* The structures were elucidated by spectroscopic methods including; NMR, MS, UV and IR. Key words*:* Meliaceae, limonoids, *Trypanosoma brucei rhodesiense, Azadirachta indica,* antitrypanosomal activity.

*Name of Journal/Conference Proceedings/Workshop:* *Afr. J. Traditional*, Complementary and Alternative Medicines.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* S. W. Wachira, M. Ndung'u, P. G. N. Njagi and A. Hassanali.
*Title of Publication:* Comparative responses of ovipositing Anopheles gambiae and Culex quinquefasciatus females to the presence of Culex egg rafts and larvae

*Abstract:* Field observations have demonstrated that gravid *Anopheles gambiae* Giles *s.s.* (Diptera: Culicidae) are selective in their choice of oviposition sites. For example, immature stages of *An. gambiae s.s.* are rarely found in water that contains *Culex quinquefasciatus* Say immatures. The possibility that this may, in part at least, reflect a response by ovipositing *An. gambiae s.s.* females to volatile signals associated with *Culex* juveniles was evaluated by testing the response of *An. gambiae s.s.* females to varying densities of *Cx. quinquefasciatus* egg rafts and/or larvae in oviposition choice assays. For comparison, the oviposition choices of *Cx. Quinquefasciatus* to conspecific egg rafts and/or larvae were similarly assayed. At a low density of *Cx. quinquefasciatus* egg rafts (1–15 egg rafts/100 mL water), *An. gambiae s.s.* females laid more eggs in the treatment water than in the control, with a maximum of twice as many in the treatment water at 5 egg rafts/100 mL water. At higher egg raft densities and in all treatments that included *Cx. quinquefasciatus* larvae, oviposition decreased significantly in the treatment dishes in a density-dependent manner. As previous studies have indicated, ovipositing *Cx. quinquefasciatus* females were attracted to and laid egg rafts in dishes containing conspecific egg rafts and, interestingly, also in dishes containing larvae. Key words. *Anopheles gambiae s.s.*, *Culex quinquefasciatus*, attraction, avoidance, egg rafts, larvae, oviposition. Name of the Journal/ conference

*Name of Journal/Conference Proceedings/Workshop:* *Medical and Veterinary Entomology (2010) 24, 369–374.*
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Wanyika, H. N.**, Gatebe, E. G., Gitu, L. M., Ngumba, E. K., Maritim, C. W.
*Title of Publication:* Determination of caffeine content of tea and instant coffee brands found in the Kenyan Market.

*Abstract:* Caffeine (1, 3, 5-trimethylxanthine), a mild addicting drug though used for medicinal purposes is the active ingredient that makes tea and coffee valuable to humans. In this study, the levels of caffeine in certain coffee (Nescafe, africafe, dormans) and tea (chai mara moja, Kericho gold, sasini, finlays premium) brands found in the Kenyan market were determined using high performance liquid chromatography (hplc) and UV/VIS spectrophotometric methods. The levels of caffeine in all the tea and coffee brands were found as follows: chai mara moja > finlays premium > Kericho gold > sasini. In coffee, it was found that the caffeine content of africafe > Nescafe > dormans. Generally, higher concentration of caffeine in all the samples were realized with the UV/VIS spectrophotometric method compared to hplc method indicating that acidified water was a better caffeine extractor than pure water.

*Name of Journal/Conference Proceedings/Workshop:* African Journal of Pharmacy and Pharmacology. Vol.3 (2).pp. 066-069.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Onditi, O.A.,** Mutembei JK, Chacha, J.S. and Oyaro, N.
*Title of Publication:* Determination of Heavy metals and nutrients in water samples of rivers Naka and Irigu, Chuka, Meru-South District – Kenya using atomic absorption Spectroscopy and UV/Visible Spectrophotometry.
*Abstract:* Levels of concentration of heavy metals (lead, cadmium, arsenic and mercury) and nutrients were determined in the first three months (January, February and March) and variation downstream compared. Lead and cadmium were determined using Atomic Absorption Spectroscopy (AAS). Hydride generation method was used to determine concentration of arsenic while that of mercury was determined using cold vapour technique. Colour development methods were used to determine levels of nutrients (nitrates and phosphates) in the water samples. Concentration levels of lead, cadmium and arsenic were found to be beyond the permissible levels stipulated by Kenya Bureau of Standards (KEBS) and World Health Organization (WHO) drinking water specifications. Lead had the highest concentration with a range of 0.0537± 0.103 parts per million (ppm) to 0.765 ± 0.782 ppm followed by cadmium with a concentration range of 0.035 ± 0.006 ppm to 0.24 ± 0.0084 ppm in both rivers Naka and Irigu. The high concentration levels of lead in River Naka could be attributed to disposal of wastes directly into the river from Chuka Town due to poor drainage systems. Mercury was found to be below the detection limit. On the other hand, phosphate specified level of 2.2 ppm in drinking water according to KEBS. Only nitrate was below the recommended levels of 50 ppm and 45 ppm KEBS and WHO guidelines respectively for drinking water.
*Name of Journal/Conference Proceedings/Workshop:* International Journal of Pure and Applied Science, Volume 3, Number 4.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **D. M. Kituyi,** A. M. Salim, A. Onditi, Amir O. Yusuf.
*Title of Publication:* Environmental effects of selected chemical and physical geothermometers at Olkaria Geothemal Power Plant.
*Abstract:* To evaluate environmental implications of the geothermal power plant at Olkaria Kenya. Fluid samples were collected at Olkaria power stations (1 and 2) and Olkaria wells 908 and 701. They were analyzed for $Cl^-$, $H_2S$, $CO_2$, $CH_4$, $O_2$, $H_2$, N, $SO^{-2}_4$, B and $F^-$. The pH was also taken. A UV/VIS spectrophotometer, ion-selective electrode, gas chromatograph, titroprocessor, pH-meter and a Weber separator were used for analysis. The levels of these geothermometers were found to be very low. The pH at the wells was observed to be basic while at the stations, acidic. In conclusion, no significant negative environmental effects were observed.
*Name of Journal/Conference Proceedings/Workshop:* International Journal of Sustainable Development, Volume 3, Number 6.
*Year of Publication:* 2010.

*Name of Lecturer/Authors* **Mbiri A.,** Onditi A., Oyaro N. and Murago E.
*Title of Publication:* Analysis of Kenyan Honey for determination of essential and Heavy metals by atomic spectroscopy.

*Abstract:* Due to the nutritive and medicinal value of honey for both man and animals, qualitative and quantitative analysis of the minerals is of great importance. Heavy metals and high concentration of essential metals can be toxic both to man and animals. Rapid increase in industrialization in Kenya has led to environmental pollution hence increase in these metals in honey. In this project, honey samples collected from different parts of Kenya that is Laikipia, Baringo, Nairobi, Ngong, Mbeere, Embu, Kitui, Kitui, Kibwezi and Lamu were analyzed to determine the levels of selected heavy metals (Pb, Cd, Zn, Cu and As) and essential metals (K, Na, Ca, Mg and Fe). The samples were analyzed using Flame Atomic Emission Spectroscopy (FAES). Hydride generation – Atomic Absorption Spectroscopy (HG-AAS) was used to determine arsenic. The most abundant elements in Kenya honey were found to be K, Na, Ca and Mg with mean values ranging from 781.52 ± 0.09 to 172.83 ± 0.03 ppm, 269.1 to 98.04 ± 0.03 ppm, 70.17 ± 3.9 ppm to 19.33 ± 4.07 ppm and 41.88 ± 0.92 to 12.64 ± 0.43 ppm respectively. The results obtained showed that most of the samples had a high level of Zn concentration of mean value 0.19 ± 0.06 ppm followed by Pb concentration of mean value 0.16 ± 0.10 ppm of then Cu with a mean value of 0.02 ± 0.01 ppm followed by Cd with a mean valued of 0.02 ± 0.01 ppm and finally As with a mean value of 0.01 ± 0.01 ppm. The concentration of Pb in most samples was found to be more than 0.1 ppm which was above the World Health Organization (WHO) AND Kenya Bureau of Standards (KEBS) limits of Pb in food products.

*Name of Journal/Conference Proceedings/Workshop:* International Journal of Physical Science, Volume 2, Number 3.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* P**. G. Muigai,** P. M. Shiundu, F.B. Mwaura and G.N. Kamau.
*Title of Publication:* Correlation between dissolved oxygen and total dissolved solids and their role in the eutrophication of Nairobi Dam, Kenya

*Abstract:* Research on Eutorophication of Nairobi Dam, Kenya and its tributaries has revealed fair negative correlation between Dissolved Oxygen (DO) and Total Dissolved Solids (TDS) Contents ($y = -24.562x + 622.28$, $R^2 = 0.6835$). This indicated that, sampling sites with low dissolved oxygen had high TDS, while those with high DO had low TDS. When the levels of these parameters in the aquatic environment studied were compared with other eutrophic aquatic systems of the word, it was found to be highly eutrophic. Thus, any of these two parameters could be used as an index of Eutrophication in a given water body suspected to exhibit Eutrophic activity. In the current study, it had been postulated that the major source of eutrophication could have been disposal of untreated raw sewage and use of phosphorous-containing surfactants.

*Name of Journal/Conference Proceedings/Workshop:* International Journal of BioChemiPhysics, Vol. 18, PP. 37 – 45.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **P. G. Muigai**, P. M. Shiundu, F.B. Mwaura and G.N. Kamau
*Title of Publication:* Phosphorous as the Limiting Nutrient Element for Eutrophication of Nairobi Dam, Kenya

*Abstract:*

Research work on Nairobi Dam, Kenya and its tributaries revealed Poor negative correlation between Phosphorous (Hydrolysable + $PO_4^{3-}$) and $NO_3^-$ - Nitrogen, giving a regression line of y = -0.2176x + 2.1471 with $R^2$ = 0.1876 on water sampled over a period of one and hald years. On the other hand, there was poor positive correlation between Phosphorous (Hydrolysable + $PO_4^{3-}$) AND Potassium (y = 2.142x + 32.964, $R^2$ = 0.0815 during the same sampling period. The positive phosphorous-potassium intercept, however, showed that phosphorous was more limiting than Nitrogen and Potassium. Overall, a pronounced positive correlation was found between Total Kjeldahl + $NO_3^-$ - Nitrogen and Potassium contents in water sampled from the water hyacinth zone, giving a regression line of y = 0.6484x + 18.309 with $R^2$ = 0.4801. This demonstrated that nitrogen was more limiting than potassium. Combining the two results suggested that the limiting element was either nitrogen or phosphorous. However, when the linear regression-correlation approach among the three nutrients (N, P, K) was employed, the best correlation was found between Hydrolysable + $PO_4^{3-}$ - Phosphorous and Total Kjeldahl + $NO_3^-$ - Nitrogen (y = 6.1118x + 8.424, $R^2$ = 0.5244). This final positive Potassium, Phosphorous was the most limiting element, i.e., it gave a negative intercept. It got exhausted first and was responsible for the proliferation of the water hyacinth in the aquatic environment studied. Any future eradication and control of water hyacinth in the eutrophic Nairobi Dam will have to deal with phosphorous nutrient.

*Name of Journal/Conference Proceedings/Workshop:* International Journal of BioChemiPhysics, Vol. 18, PP. 47 - 55.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **H. N. Wanyika,** A. N. Gachanja, G. M. Kenji , J. M. Keriko and A. N. Mwangi.
*Title of Publication:* *A rapid method based on UV spectrophotometry for quantitative determination of allicin in aqueous garlic extracts.*

*Abstract:*

Garlic (Allium sativum) is known for its medicinal and health food use. However, garlic extracts are also used in bio-pesticides. This study reports research on the optimization of a fast and cheap method for assaying allicin, the active constituent of garlic extract, based on UV spectrophotometry. Garlic cloves were extracted using water. The allicin content of the garlic extracts was analysed after passing the extract through SPE cartridge and eluted with solvents of various polarities. The most polar solvent used was water which eluted the allicin in 4 ml, while methanol and ethanol did not. The absorbance of UV radiation at 240 nm and 254 nm wavelengths by the garlic fraction eluted with water gave a ratio of A240 nm/ A254 nm H" 1.4 – 1.5, which is typical for allicin.The garlic available in the Kenyan market was assayed for allicin using the optimised method. Some pesticides in the market containing garlic were also assayed for allicin. The results obtained compared well with documented values. Key words: UV spectrophotometry, high performance liquid chromatography, allicin, garlic cloves

*Name of Journal/Conference Proceedings/Workshop:* Journal of Agriculture, Science and Technology, Volume 12 (1).
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Keriko, J. M.,** Chege, C. W.; Magu, M. M., Mwachiro, E. C.; Murigi, A. N. and Githua, M. N.

*Title of Publication* Fish lipids contents and classes of selected fish species found in Lake Naivasha (Kenya) and the fish feeding habits of the lake's inhabitants.

*Abstract:* The aims of this paper were to investigate the total lipid content, lipid class composition of some fresh water fish species from Lake Naivasha and to establish the fish eating habits of the Naivasha community. The fish species, Cyprinus carprio (Common carp), Cyprinus carprio specularis (Mirror carp), Micropterus salmoides (Largemouth bass) and Oreochromis leucosticus (Tilapia), were purchased directly from the fishermen at the Central landing in L. Naivasha. The consumption of marine natural products especially fish has many benefits especially on reducing the attack by diseases such as coronary heart diseases, cancer, diabetes, high blood pressure, gout and other diseases that arise as a result of excessive consumption of foods containing high cholesterol levels. The total lipid content, lipid class composition of the fish tissues which included the muscle, pancreas and liver were analysed and determined individually. The total lipid content was highest in the O. leucosticus muscle tissue, M. salmoides pancreas, and the liver of Cyprinus carprio. These results suggest that the fish specimens are lean type of fishes. Triacylglycerol (TAG) was the dominant lipid class in the muscle tissue of all the four fish species. The order of the lipid class in the muscle tissue was as follows; TAG > PC > PE > other lipids > DAGE > FFA > WE > ST. The pancreas and the liver tissues of the four freshwater fish species had the same order of the lipid class. The phospholipids (PC and PE) were the dominant lipid classes in the two tissues. The order of the lipid class in the pancreas and the liver tissues were as follows; PC > PE > TAG > FFA > other lipids > ST > DAGE > WE. Fish eating habits of the Naivasha community was established using questionnaire method. The results suggest that 36% of the respondents consume fish more than once per week while only 6% do so few times a year because of the unavailability of fish (24%) and the cost of fish (25%) when available. Respondents are willing to consume more fish if they become available at subsidized prices.

*Name of Journal/Conference Proceedings/Workshop:* African Journal of Pharmacy and Pharmacology, Vol. 4(10), 745 – 753.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Muthaura, C. N., **Keriko, J. M.,** Derese, S.; Yenesew, A., Rukunga, G. M.

*Title of Publication:* Investigation of some medicinal plants traditionally used for treatment of malaria in Kenya as potential sources of anti-malarial drugs.

*Abstract:* Malaria is a major public health problem in many tropical and sub-tropical countries and the burden of this disease is getting worse, mainly due to the increasing resistance of *Plasmodium falciparum* against the widely available anti-malarial drugs. There is an urgent need for discovery of new anti-malarial

agents. Herbal medicine for the treatment of various diseases including malaria is an important part of the cultural delivery and traditions of which Kenya bio-diversity has been an integral part. Two major anti-malarial drugs widely used today came originally from indigenous medical systems, which are quinine and artemisinin, from Peruvian and Chinese ancestral treatment, respectively. This ethnopharmacology is a very important resource in which new therapies may be discovered. The present review is an analysis of ethnopharmacological publication on anti-malarial therapies from some Kenyan medicinal plants.

*Name of Journal/Conference Proceedings/Workshop:* Experimental Parasitology, Vol.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* Njogu, P. M., **Keriko, J. M. and** Kitetu, J. J.
*Title of Publication:* Distribution of heavy metals in various Lake matrices; Water, Soil, Fish and Sediments: A case study of the Lake Naivasha basin, Kenya.
*Abstract:* Water, sediments, soil and fish; Common carp (*Cuprinus carpio*), Blackbass (*Micropterus salmoide*), Tilapia (*Oreochromis leucostictus*) and Mirror carp (*Cyprinus spectacularlus*) from the Lake Naivasha basin were analyzed for lead (Pb), cadmium (Cd), zinc (Zn), copper (Cu), nickel (Ni) and mercury (Hg). Samples were collected from the Main lake, Lake Oloidien, Cresent Lake, River Malewa, River Gilgil, Naivasha Municipal Council Sewer entry point, Flower farm discharge canals and the Kenya Wildlife Service (KWS) Sanctuaary (Joan Roots Farm). Fish samples were bought from fishermen and identified by the Kenya Marine and Fisheries (KMF) staff. The metal concentrations were determined using Atomic Absorption Spectrophotometer (AAS). Results indicated that, there was introduction of the metals from other sources other than the parent soil in the catchment. Most soil samples from the catchment had more heavy metals contents compared to the KWS Sanctuary samples which was used as control. There was also an indication of bioaccumulation of metals in fish.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Agriculture, Science and Technology.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* Mwangi, E. S. K., **Keriko, J. M.;** Machocho, A. K., Wanyonyi, A. W., Malebo, H. M., Chhabra, S. C. and Tarus, P. K.
*Title of Publication:* Antiprotozoal activity and cytotoxicity of metabolites from leaves of *Teclea trichocarpa.*
*Abstract:* Chromatographic separation of the leaves of *Teclea trichocarpa* (Engl.) (Rutaceae) used traditionally by Akamba tribe in Kenya yielded three acridone alkaloids, a furoquinoline alkaloid and two triterpenoids. The total extract (methanol) of the leaves of this plant and the isolated compounds were screened for *in vitro* for cytotoxicity and against parasitic protozoa, *Plasmodium falciparum*, *Trypanosoma brucei rhodesiense*, *Trypanosoma cruzi* and *Leishmania donovani*. Among the compounds α-amyrin had the best anti-plasmodial activity ($IC_{50}$ = 0.96 μg/ml), normelicopicine and skimmianine had the best anti-trypanosomal activity against *T. b. rhodesiense* ($IC_{50}$

= 5.24 µg/ml) and T. cruzi ($IC_{50}$ = 14.50 µg/ml), respectively. Normelicopicine also exhibited best anti-leishmanial activity ($IC_{50}$ = 1.08 µg/ml). Arborinine exhibited moderate cytotoxicity ($IC_{50}$ = 12.2 µg/ml) against L-6 cells. The compounds with low anti-protozoal and high cytotoxicity $IC_{50}$ values potential source of template drug against parasitic protozoa.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Medicinal Plant Research Vol. 4 (7).
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Keriko, J. M.,** Chege, C. W., Magu, M. M., Mwachiro, E. C., Murigi, A. N. and Githua, M. N.

*Title of Publication:* Fish Lipid contents, lipid classes of Fish species of Lake Naivasha, Kenya.

*Abstract:* The aims of this paper were to investigate the total lipid content, lipid class composition of some fresh water fish species from Lake Naivasha and to establish the fish eating habits of the Naivasha community. The fish species, *Cyprinus carprio* (Common carp), *Cyprinus carprio specularis* (Mirror carp), *Micropterus salmoides* (Largemouth bass) and *Oreochromis leucosticus* (Tilapia), were purchased directly from the fishermen at the Central landing in L. Naivasha. The consumption of marine natural products especially fish has many benefits especially on reducing the attack by diseases such as coronary heart diseases, cancer, diabetes, high blood pressure, gout and other diseases that arise as a result of excessive consumption of foods containing high cholesterol levels. The total lipid content, lipid class composition of the fish tissues which included the muscle, pancreas and liver were analysed and determined individually. The total lipid content was highest in the *O. leucosticus* muscle tissue, *M. salmoides* pancreas, and the liver of *Cyprinus carprio*. These results suggest that the fish specimens are lean type of fishes. Triacylglycerol (TAG) was the dominant lipid class in the muscle tissue of all the four fish species. The order of the lipid class in the muscle tissue was as follows; TAG > PC > PE > other lipids > DAGE > FFA > WE > ST. The pancreas and the liver tissues of the four freshwater fish species had the same order of the lipid class. The phospholipids (PC and PE) were the dominant lipid classes in the two tissues. The order of the lipid class in the pancreas and the liver tissues were as follows; PC > PE > TAG > FFA > other lipids > ST > DAGE > WE. Fish eating habits of the Naivasha community was established using questionnaire method. The results suggest that 36% of the respondents consume fish more than once per week while only 6% do so few times a year because of the unavailability of fish (24%) and the cost of fish (25%) when available. Respondents are willing to consume more fish if they become available at subsidized prices.

*Name of Journal/Conference Proceedings/Workshop:* Acccepted for review in the African Journal of Pharmacy and Pharmacology.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* Njogu, P. M., **Keriko, J. M**., Madadi, O. V., Wandiga, S. O., Kitetu, J. J., Muttia, T. M. and Wanjau, R.N.

*Title of Publication:* The levels of heavy metals in the waters from the Lake Naivasha basin, Kenya

*Abstract:* Water samples from the Lake Naivasha ecosystems were analyzed for the levels of lead (Pb), cadmium (Cd), zinc (Zn), copper (Cu), calcium (Ca), iron (Fe), manganese (Mn) and nickel (Ni) to assess heavy metals pollution status in the basin. Water samples were collected from eleven sampling sites in the Main Lake, Lake Oloidien, Crescent Lake, River Malewa and canals that connect the lake to the flower farms. The concentrations were determined using the Atomic Absorption Spectrophotometry (AAS) as total concentration (mg/L). The results show wide variations between samples and were found to be in the ranges; 0.01 – 0.36 mg/L for Pb, 0.004 – 0.038 mg/L for Cd, 0.81 – 1.9 mg/L for Zn, 0.08 – 0.45 mg/L for Ni, 0.001 – 0.014 mg/L for Cu, 0.57 – 10.63 for Fe, 0.035 – 1.95 for Mn and 3.07 – 30.62 mg/L for Ca. Samples from Lake Oloidien and discharge canals show high levels of heavy metals compared to samples from other sites. The metal concentrations in the inflowing rivers were also high but decreased downstream as the rivers enters the lake indicating removal through natural processes. The agricultural sector is a major source of copper, lead, zinc and cadmium. Vehicles traffic pollution along the inflowing rivers was another important source of the metals. This was indicated by high heavy metal concentrations at points where the rivers cross the highways. The study also indicates rapid removal of lead and copper from the waters which is thought to be due to water hyacinth. Dilution was also an important factor as the rivers and the canals discharge into the lake. The most important sources of heavy metals in the lake in order of volume of discharges are; flower farms, inflowing rivers, and Naivasha Municipal Council respectively. The heavy metals concentrations in the lake were lower than the maximum allowable limits in freshwater ecosystems.

*Name of Journal/Conference Proceedings/Workshop:* Re-submitted to Green Chemistry Letters and Reviews.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Kigondu, E. V. M., Geoffrey, M. Rukunga, **Joseph M. Keriko**, Isaiah O. Ndiege; Willy K.Tonui, Jeremiah W. Gathirwa, Peter G. Kirira, Beatrice Irungu, Johnston M. Ingonga.

*Title of Publication:* Anti-parasitics activity studies of some selected medicinal plants from Kenya.

*Abstract:* Indigenous rural communities in the tropics manage parasitic diseases like malaria and leishmaniasis using herbal drugs. The efficacy, dosage, safety and active principles of most of the herbal preparation are known. Extract from 6 selected plants species, used as medicinal plants by indegenous local communities in Kenya, were screened for *in vitro* anti-plasmodial and anti—leishmanial activity against a laboratory-adapted *Plasmodium falciparum* isolates (D6, CQ-sensitive and W2, CQ-resistant) and *Leishmania major* (IDU/KE/83 = NLB-144 strain). The investigation demonstrated the efficacy and safety of some extracts of plants that are used by rural indigenous communities for the treatment of parasitic diseases.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Ethnopharmacology 123: 504 – 509.
*Year of Publication:* 2009.

*Name of Lecturer/Authors:* **A. Mbiri,** A. Onditi, N. Oyaro and E. Murago.
*Title of Publication:* Determination of essential and heavy metals in Kenyan honey by atomic absorption and emission spectroscopy.
*Abstract:* Due to the nutritive and medicinal value of honey for both man and animals, qualitative and quantitative analyses of the minerals is of great importance. Heavy metals and high concentration of essential metals can be toxic both to man and animals. Rapid increase in industrialisation in Kenya has led to environmental pollution, hence increase of these metals in honey. In this project, honey samples collected from different parts of Kenya, namely, Laikipia, Baringo, Nairobi, Ngong, Mbeere, Embu, Kitui, Kibwezi and Lamu were analysed to determine the levels of selected heavy metals (Pb, Cd, Zn, Cu, As) and essential metals (K, Na, Ca, Mg, Fe). The samples were analysed using flame atomic absorption spectroscopy (FAAS) and flame atomic emission spectroscopy (FAES). Hydride generation – atomic absorption spectroscopy (HG - AAS) was used to determine arsenic. Results obtained from this study showed that K, Na, Ca and Mg had mean values ranged from 781.52±0.09 to 172.83±0.02 ppm, 269.1 to 98.04±0.03 ppm, 70.17±3.9 ppm to 19.33±4.07 ppm and 41.88 ±0.92 to 12.64 ±0.43 ppm respectively. Most of the samples had a high level of Zn with mean value 0.19±0.06 ppm followed by Pb with of mean value 0.16±0.10 ppm, then Cu with a mean value of 0.02±0.01 ppm followed by Cd with a mean value of 0.02±0.01ppm and finally As with a mean value of 0.01±0.01 ppm. The concentration of Pb in most samples was found to be above the World Health Organisation (WHO) and Kenya Bureau of Standards (KEBS) limits of 0.1 ppm in food products. Key words: Honey, heavy metals, essential metals, atomic spectroscopy.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **G.T. Thiongo**, P.N. Kioni, S .N. Mirie, P.N. Kariuki, and W.S. Namaru.
*Title of Publication:* *Passiflora edulis* seed oil methyl ester as a potential source of biodiesel.
*Abstract:* The fact that fossil energy reserves are limited coupled with the environmental pressure resulting from their use has encouraged research on biodiesel and other biofuels. Biodiesel is a nontoxic, biodegradable and renewable source of energy made by the transesterification of oils or fats with short chain alcohols. This study was focused on the use of Passiflora edulis seed oil (Passion fruit).This oil was obtained from an industrial fruit juice processing waste. The oil was evaluated as a good potential feedstock for production of biodiesel. In this study Passiflora edulis seed oil was successfully transesterified using methanol and KOH as a catalyst.A biodiesel yield of 80% was obtained. The biodiesel had a viscosity of 4.60 mm2/s, acid value 0.45 mgKOH/g, density of 0.89g/ml, colour 1.60, water content

0.2%, copper strip corrosion-No tarnish, and flash point > 150 0C .The fuel parameters measured were within range according to the American Society for Testing and Materials (ASTM) and International Standards Organization (ISO) test methods apart from the percentage water content. Keywords: Passiflora edulis seed oil; Biodiesel; Transesterification; Catalyst.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **S .N. Mirie**, G.T. Thiongo, P.N. Kioni, P.N. Kariuki and W.S. Namaru.

*Title of Publication:* Optimization of biodiesel production from cotton seed oil using KOH and NaOH as catalysts

*Abstract:* Biodiesel is commonly produced by the transesterification of plant oil or animal fat with short chain alcohols. This biomass fuel has received much attention, since it is a kind of alternative, biodegradable, nontoxic, and renewable energy. It can be used as an alternative fuel in diesel engines with little or no modification in blended or neat form depending on the source of biodiesel. In this study transesterification reactions using cotton seed oil and methanol were performed using NaOH and KOH as catalysts so as to compare the two catalysts and also obtain the optimum reaction parameters which include temperature, and amount of alcohol. The reactions were optimized by varying the amount of methanol and the temperature. The optimum conditions when using KOH as a catalyst were obtained when using 150 % excess methanol at room temperature. Biodiesel of viscosity 4.27 mm2/s, acid value 0.26 mgKOH/g and a yield of 83.94 % was obtained The optimum conditions when using NaOH as a catalyst were obtained when using 150% excess methanol and at temperature of 600C .The Biodiesel had a viscosity of 4.14 mm2/s, acid value of 0.26 mgKOH/g and a yield of 68.60%.The best catalyst was found to be KOH as it gave higher yields under optimum conditions compared to NaOH. At optimum conditions when using both catalysts, the fuel parameters measured were within range according to the American Society for Testing and Materials (ASTM) and International Standards Organization (ISO) test methods. Keywords: Biodiesel; Transesterification; Cottonseed oil; Catalyst.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

## 1.3 DEPARTMENT OF PHYSICS

*Name of Lecturer/Authors:* **David M. Mulati**, Timonah N. Soitah and Witt Bjorn.
*Title of Publication:* The absorption spectra of natural dyes and their suitability as a sensitizer in organic solar cell application.

*Abstract:* This paper analyses the suitability of organic dyes (hibiscus, solanaum nigrum and eggplant) that are locally available in East Africa for low-budget Dye Sensitized Solar Cells (ASSC). The results show that eggplant fail due to a difficult extraction process. Beetroot turns out to be a poor candidate since it contains betanin which does not chelate to the $TiO_2$-surface of the cell. Hibiscus shows good performance, while Solanum Nigrum is stong in terms of voltage but poor in terms of current. It is also seen that the process of chelating to the $TiO_2$ shifts the absorption spectra of the dyes slightly towards the lower wavelengths. The analysis of Solanum Nigrum and hibiscus mixtures shows that these mixtures do not lead to better performance. The most promising results are obtained from hibiscus extracted in water at 50°C, which exhibit significantly better performance in $U_{mpp}$ (311.35mV), $I_{mpp}$ (236.43μA) and efficiency (0.43%). The importance of =O and –OH groups for chelating to $TiO_2$ is demonstrated with the help of beetroot. After analyzing molecules structures of betanin and certain anthocyanins it was seen that the nummer of atoms per molecules is higher for most anthocyanins, so that they can connect better to $TiO_2$ than betanin. *Keywords*: Dye-sensitized solar cells hibiscus, Solanum Nigrum, beetroot, egg-plant, complex dye-molecules.

*Name of Journal/Conference Proceedings/Workshop:* Elsevier (Accepted).
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **J. G. Githiri**, J. P. Patel, J. O. Barongo, P. K. Karanja.
*Title of Publication:* Application of euler deconvolution technique in determining depths to magnetic structures in Magadi Area, Southern Kenya Rift.

*Abstract:* Magadi area is located in the southern part of the Kenyan rift, an active continental rift that is part of the East African Rift system. Thermal manifestations in the form of hot springs in the northern and southern shores of Lake Magadi and high heat flows suggest geothermal potential in the area. A ground magnetic survey was carried out in the study area with the aim of locating depths to bodies with sufficient magnetic susceptibility that may represent magmatic intrusions. The magnetic data was corrected, a total intensity magnetic contour map produced and profiles drawn across identified anomalous regions. Magnetic survey data in profile form over anomalous regions was interpreted rapidly for source positions and depths by Euler deconvolution technique. Geologic constraint was imposed by use of a structural index 1.0 that best describes prismatic bodies such as intrusive dykes. The magnetic bodies were imaged at depths ranging from 0 km to about 11 km along the profiles. The imaged depths along the profiles display discontinuities in magnetic markers due to presence of numerous faults in the area. The detected magnetic

bodies may be cooling dykes that heat the underground water responsible for the numerous hot springs surrounding Lake Magadi. Such a dike is suspected to originate from a magma chamber conducting heat to the underground water. A model whereby the faults in the region provide escape of water as hot springs is proposed. Key words: Magnetic, magadi area, geothermal, deconvolution.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Ombati Wilson**, Kinyua Robert, Mutuku Joseph and Ogongo Chrispine.
*Title of Publication:* Monitoring of radiofrequency radiation from selected mobile telephones in Kenya.
*Abstract:* The use of mobile phones in Kenya has escalated in the recent past. This has increased the general population exposure to mobile phone radiation. Numerous mobile phone manufacturers, producing different handset models with varying standard qualities, have also emerged. Consequently, pegged on these circumstances, various questions arise: Is the radiation from the mentioned gadgets within the safe limits or not? How does the physical condition of handset under different exposure conditions affect the radiation thereof? Do anti-radiation filters suppress the said emissions or not? In regard to these, the intensity of radiation around various GSM phone models has been measured using broadband radiofrequency meter and spectrum analyzer and the results assessed based upon the established international safety standards on non-ionizing radiation. The results obtained in this study have shown the presence of radiation levels from all the selected mobile phone models, ranging from 0.01134 to 0.4671 mWcm-2 with the highest from Nokia Series (China) N95 and lowest from Nokia 1110. These radiation levels are within the recommended exposure limits. It has further been established that high radiation intensities from a transmitting handset appear between the dial and reception of a call. The use of different anti-radiation filters in abating mobile phone radiation has also been found effective, but with different degrees of efficiencies of which none meets the 99% efficiency asserted by the respective manufacturers. It has also been established that the radiation levels from a mobile phone are affected by the physical condition of the body. Key words: Broadband RF meter, Mobile phone, radiation, radiofrequency (RF), safety standards.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Monitoring of Radiofrequency radiation from selected mobile telephones in Kenya.
*Title of Publication:* W. Ombati, **R. Kinyua**, J. Mutuku, C. Ogongo.
*Abstract:* The use of mobile telephones in Kenya has increased

tremendously in the recent past. This has increased the general population exposure to mobile phone radiation. However the exposure levels and the effects of the various anti-radiation filters has not been determined. In this study the intensity of radiation around various GSM phone models was measured using broadband radiofrequency meter and spectrum analyzer. The results were then assessed based on the established standards on non-ionizing radiation. The radiation levels were found to be within the recommended levels. However it was found that high radiation levels arise when the phone is in the ringing mode and when the phone has missing covers. All anti-radiation filters checked did not meet the 99% efficiencies given by their manufacturers while many handsets did not meet the International Mobile Equipment Identifier (IMEI) standards.

*Name of Journal/Conference Proceedings/Workshop:* Baraton Interdisciplinary Research Journal (BIRJ) **V1**. No1 pp 5-13. ISSN 2079-4711.

*Year of Publication:* 2011.

## 1.3 DEPARTMENT OF PURE AND APPLIED MATHEMATICS

*Name of Lecturer/Authors:* **A. N. Wali.**

*Title of Publication* Some results on anti-invariant maximal spacelike submanifolds of an indefinite complex space form.

*Abstract:* This paper looks into the geometry of an n-dimensional anti-invariant maximal spacelike submanifold M immersed in an indefinite complex space form M(c), c ≠ 0. Let M be an n-dimensional compact anti-invariant maximal spacelike submanifold of M. Then we show that either M is totally geodesic or In this paper, we studied the geometry of an n-dimensional anti-invariant maximal spacelike submanifold M immersed in an indefinite complex space form by computing the square of the length of the second fundamental form. In conclusion, we find that either M is totally geodesic or or at some point of M, Moreover, if the second fundamental form of the submanifold is parallel then the submanifold is totally geodesic. or at some point of M, Key words: Anti-invariant submanifold, complex space form.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Science and Technology, Volume 12 (1).

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **J. Sigey**, F. Gatheri and M. Kinyanjui.

*Title of Publication:* Buoyancy driven free convection turbulent heat transfer in an enclosure.

*Abstract:* Equations governing natural convection have been solved using a fast and stable finite difference approximation, which has been developed and validated. The low–Reynolds number $k$ – e model has been used in this case because of its high accuracy in turbulence flows. Turbulent flow in an enclosed cavity or box is a model for many flows of practical interest: cooling of electronic

equipment; heating of a room; flow in a double glazing unit or ventilation is encountered in a number of situations of practical importance in our every day encounters. A three-dimensional enclosure in form of a rectangular enclosure containing a convectional heater built into one wall and having a window in the same wall have been studied. The heater is located below the window and the other remaining walls are insulated. The size and position of the window and heater are fixed. The localized heating and cooling induces two boundary layers that collide in the region between the window and heater. The timed averaged equations for Continuity, Momentum and Energy, which are coupled to the Turbulence equations, were solved using a finite difference approximation (F.D.A) technique. The vorticity-vector potential formulation has been employed. A further use of difference false transient factors in different flow regions coupled with non-linear partial differential equations has been employed to fasten convergence of the numerical solution. The results were that the enclosure is stratified into three regions: a cold upper region, a hot region in the area between the heater and the window and a warm lower region. Key words: Free convection, turbulent buoyancy driven flows.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Science and Technology, Volume 12 (1).
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Exploring a non factor method of decrypting the RSA Code.
*Title of Publication:* J. Nyaga and **C. Mwathi.**
*Abstract:* Breaking of the RSA cryptosystem remains an unsolved intriguing mathematical problem. The security of the RSA code rests on the fact that factoring large integers is a hard problem. These are numbers having exactly two large prime factors. Several such numbers with 129 digits or more, known as RSA numbers, have been factored. In spite of this achievement, no progress in breaking the code seems to be forthcoming from the factoring approach. This difficulty arises from availability of a prime number greater than n, where n is a natural number. In this work, we explore a method that is independent of factoring methods. With the RSA code, a public key (e, n) is given to the public. We set $pe = c(\text{mod } n)$ where p is a plaintext word and c is its corresponding ciphertext word. Some secret key ($d$,f ($n$) (where f ($n$) is the Euler phi function of n) is held by the receiver and is unknown to anybody else. It is known that $ed$ = 1modf ($n$) So by letting the non-reduced value of c be $c + nx, x\square\$! + pe = c + nx$ ( ) (mod ) 1 $p = c + nx$ *e n* We develop mathematical algorithm for calculating the first integral eth root of $c + nx$ .This integer is the required value of p. Using the algorithm we successfully deciphered messages of plaintexts sent in blocks of up to five. This method requires that the block size is determinable by the decoder. There is need however to develop a system of inferring the length of the blocks used in the plaintext before applying the encryption algorithm in which case the method can be extended to decrypting messages sent in any block length. In the paper we also have two results regarding the choice of the public key in this code. 1. If $p = q$ , then n and f ($n$) are both perfect squares

and computing the secret key d becomes trivial. 2. If both p and q are twin primes, that is $p = q \pm 2$, n is of the form $q\ 2q\ 2 \pm$. *The integer $k = n + 1$ is therefore a perfect square and can be used to estimate the factors of n, hence reducing to the first case.* Key words: Cryptography, cryptanalysis, cryptology, encryption, plaintext, ciphertext, decryption, key, public key cryptography.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **J. R. Akanga,** C. Mwathi and A. N. Wali.
*Title of Publication:* The spectrum of the norlund q operator on 0 *c* space.
*Abstract:* In this paper, we determine the spectrum of the Norlund Q operator on. In which case we show that the spectrum comprises of all complex number, such that. We achieve this by solving the system for x in terms of y to obtain the matrix of We then subject the matrix to analysis using summability methods to determine the conditions for Key words: Boundedness, operator, spectrum, norm, convergence, sequences, matrix Notations: , will denote respectively, the set of complex numbers, the spectrum of T, the set of real numbers, the set of sequences converging to zero, the norm of an operator T, the Cesaro matrix of order 1.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors*: **S. M. Uppal.**
*Title of Publication:* **Poincar'e conjecture solved.**
*Abstract:* The Clay Mathematics Institute (CMI) announced on 18th March, 2010 the award of its Millennium prize to Dr Grigoriy "Grisha" Perelman of St.Petersburg, Russia for resolution of the 106 years old Poincar'e conjecture . The Poincar'e conjecture posed by the French mathematician Henri Poincar'e in 1904 was regarded as such an important problem in mathematics that it was identified as one of the seven Millennium prize problems by the CMI in 2000. The CMI carries the prize of one million dollars for the resolution of each problem. According to the CMI, the Millennium prizes' were recorded as some of the most difficult problems with which mathematicians were grappling at the turn of the second millennium increase consciousness of the general public the fact that in mathematics, the frontier is still open and abounds in important unsolved problems. The CMI was also convinced that the recognition of the problems would emphasize the importance of working towards a solution of the deepest most difficult problems and to recognize achievement in Mathematics of historical magnitude. In 2006, Dr. Perelman, an eccentric genius had famously rejected the Fields Medal, the highest award in mathematics, generally regarded as the Mathematics equivalent of the Nobel Prize. The important difference being that the Fields Medal is awarded to mathematicians not over the age of 40 years.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.

## 1.4 DEPARTMENT OF ZOOLOGY

*Name of Lecturer/Authors:* P. Nanaa, N.K. Manianiaa, R.O. Maranga, **H.L. Kutima**, H.I. Boga, F. Nchu, J.N. Eloff.

*Title of Publication:* Attraction response of adult *Rhipicephalus appendiculatus* and *Rhipicephalus pulchellus* (Acari: Ixodidae) ticks to extracts from *Calpurnia aurea* (Fabaceae).

*Abstract:* Experiments were carried out to investigate the response of two tick species *Rhipicephalus pulchellus* Gerstaker, 1873 and *Rhipicephalus appendiculatus* Neumann, 1901 to three different extracts (acetone, aqueous and oil) of the dried leaves of *Calpurnia aurea* (Aiton) Benth in both an inverted glass tube and a dual choice T-olfactometer. The relative attraction of both tick species to plant extract was also tested in semi-field plot experiments using a trap baited with different concentrations of emulsifiable extract of *C. aurea*.

Results: The oil extract at 50 and 100 mg/ml attracted 46.7% and 65.9% of *R. appendiculatus*, respectively, in the inverted glass tube assay, which was comparable to 47.8% of the attraction-aggregation attachment pheromone (AAAP) used as positive control. At a dose of 100 mg/ml the oil extract attracted 52.4% of *R. pulchellus* in the T-olfactometer bioassay. A dose of 100 mg/ml attracted 52.2% of *R. pulchellus* and 44.4% of *R. appendiculatus* from a distance of 1m while 14.4% of *R. pulchellus* and 12.2% of *R. appendiculatus* were attracted from 5m distance at the same dose. Addition of CO2 to the plant extract-baited-trap at the dose of 100 mg/ml increased the range of attraction of adult *R. pulchellus* (44.4% from 5mdistance) and up to 33.3% of adult *R. appendiculatus* tick from a distance of 4m. Conclusion: The results of this study suggest that extracts from *C. aurea* can potentially be used as baits in a trap for the control of ticks in the field. Key words: Plant extract, *Rhipicephalus appendiculatus*, *Rhipicephalus pulchellus*, Attraction Pheromone/kairomone, *Calpurnia aurea*.

*Name of Journal/Conference Proceedings/Workshop:* Veterinary Parasitology: www.elsevier.com/locate/vetpar.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* F. B. Kaingu1, A. C. Kibor, R. Shivairo, **H. Kutima**, T. O. Okeno, R. Waihenya and A. K. Kahi.

*Title of Publication:* Prevalence of gastro-intestinal helminthes and *Coccidia* in indigenous chicken from different agroclimatic zones in Kenya

*Abstract:* Background and objectives: A study on the prevalence of gastro-intestinal endoparasites in indigenous chicken was carried out in three regions in Kenya. The objective of the study was to determine the species and their prevalence rates.

Methods: A total of 710 adult free-ranging local chickens were sampled from six districts, Kakamega (162), Bondo (81), Narok (81), Bomet (150), Turkana (70) and West Pokot (166). Qualitative and quantitative microscopic parasitological examinations were used for faecal examination.

Results: The survey showed that 192 (27.04%) was infected with Coccidial oocysts, 182 (25.63%) with *Ascaridia galli,* 10 (1.41%)

with *Heterakis gallinarum*, 2 (0.3%) with *Syngamus trachea*, 37 (5.21%) with *Capillaria retunsa*, 8.45% with *Capillaria annulata,* 21 (2.96%) with *Raillietina tetragona,* 94 (13.24%), while 112 (15.8%) were negative, with no helminthes infestation. Conclusion: The findings suggested that endoparasites are a common health problem in free range indigenous chicken in Kenya and agro-climate significantly influenced the distribution of endoparasites. Key words: Prevalence, endoparasites, indigenous chicken.

*Name of Journal/Conference Proceedings/Workshop:* African Journal of Agricultural Research Vol. 5(6), pp. 458-462, 18 March, 2010.Available online at http://www.academicjournals.org/AJAR. ISSN 1991-637X © 2010 Academic Journals.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Sichangi Kasili, **Helen Kutima**, Charles Mwandawiro, Philip M. Ngumbi and Christopher O. Anjili.

*Title of Publication:* Laboratory and semi-field evaluation of long-lasting insecticidal nets against leishmaniasis vector, *Phlebotomus* (*Phlebotomus*) *duboscqi* in Kenya

*Abstract:* *Background & objectives*: Phlebotomine sandflies are vectors of leishmaniases and other diseases. Long-lasting insecticidal nets (LLINs) as possible tools for control have not been widely tested against them. The objective of this study was to determine the efficacy of Olyset® Net and PermaNet® LLINs alongside a local brand, K-O Tab® treated net (Supanet) against *Phlebotomus duboscqi* female sandflies.

*Methods*: Four replicates of unwashed and 20x washed Olyset Nets and PermaNets, K-O Tabtreated and untreated Supanet and 'no net' treatments were evaluated against sandflies within the laboratory by tunnel tests and in semi-field conditions in the greenhouse model for their efficacy.

*Results*: All bednets allowed entry of *P. duboscqi* sandflies and subsequent blood-feeding. Olyset net's blood feeding inhibition was significantly higher than that of Supanet in the laboratory but not in semi-field condition. Of the LLINs, only Olyset net had sandflies that could not feed significantly more than those of Supanet. Additionally, no significant efficacy difference was observed between LLINs washed 20x and unwashed ones. The only significant difference noted in number of sandflies that were found dead or paralyzed within bednets in the semi-field condition was between Olyset and K-O Tab treated Supanet. In the laboratory, unwashed Olyset had a significantly higher number of sandflies killed than all other bednet treatments. *Conclusion*: Olyset net use in areas where sandflies are nuisance biters and/or disease vectors could be more beneficial in preventing sandfly bites than other tested bednets. *Recommendations*: It is recommended that mesh sizes of LLINs should be smaller for control of sandflies than those used for control of mosquitoes. Key words: Blood-feeding inhibition; Olyset® Net; PermaNet®; *Phlebotomus duboscqi;* Supanet®

*Name of Journal/Conference Proceedings/Workshop:* Journal of Vector Borne Diseases 47, March 2010, pp. 1–10.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Sichangi Kasili, Nicholas Odemba, Francis G. Ngere, John B. Kamanza, Alexander M. Muema and **Helen L. Kutima**

*Title of Publication:* Entomological assessment of the potential for malaria transmission in Kibera slum of Nairobi, Kenya.

*Abstract:* *Background & objectives:* Malaria in urban and highland areas is emerging as a significant public health threat in Kenya which has seen a dramatic increase in malaria transmission in low risk highland areas. The objectives of the study were to find and incriminate potential vectors of malaria in Kibera, Nairobi. *Methods:* One hundred and twenty houses within Lindi area of the southern central section of Kibera slum in Nairobi were chosen randomly and global positioning system (GPS) mapped. Day resting indoor mosquitoes were collected from January 2001 to December 2003. Larvae were collected between 2002 and 2004 and reared in the insectary to adults.
*Results:* A total of 176,993 mosquitoes were collected. Out of this, 176,910 were *Culex fatigans* and 83 were *Anopheles gambiae* s.l. Mosquito population peaked during the long rains in April to May and the short rains in November and December. Blood meal analysis of *An. gambiae* s.l. female mosquitoes revealed 0.97 human blood index. No mosquito was found positive for *Plasmodium falciparum* sporozoites. *Anopheles gambiae* s.l. mosquitoes were found breeding in polluted water and 95% of the larvae were identified as *An. arabiensis*. *Interpretation & conclusion: Anopheles gambiae* s.l., malaria vector is present in Nairobi and it breeds in polluted water. *Anopheles arabiensis* predominantly prefers humans as blood meal source, thus, showing ecological flexibility within the species. Key words *Anopheles arabiensis* – *Anopheles gambiae* – Kenya – malaria transmission – urban area

*Name of Journal/Conference Proceedings/Workshop:* *J Vector Borne Dis* 46, December 2009, pp. 273–279.
*Year of Publication:* 2009.

*Name of Lecturer/Authors:* Sichangi Kasili, **Helen Kutima**, Charles Mwandawiro, Philip Ngumbi and Christopher O. Anjili.

*Title of Publication:* Comparative attractiveness of CO2-baited CDC light traps and animal baits to *Phlebotomus duboscqi* sandflies.

*Abstract:* *Background & objectives:* In order to understand sandfly bionomics, vector species identification, and to develop methods for sandfly control, there is a need to sample sandflies in any particular habitat. This survey was aimed at determining the best method of sampling *Phlebotomus (Phlebotomus) duboscqi* (Diptera: Psychodidae) in the field.
*Methods:* Different animal baits and CO2-baited CDC light traps were used to attract sandflies released in an insect-proof screen-house located in the sandfly's natural habitat in Marigat, Baringo district of Kenya. *Results*: Attraction of hungry *P. duboscqi* female sandflies by the goat (*Capra hircis*) was significantly higher than that of hamster (*Mesocricetus auretus*), Nile grass rat (*Arvicanthis niloticus*), gerbil (*Tatera robusta*) and chicken (*Gallus domestica)*. However, two rodent species, *A. niloticus* and *T. robusta* did not differ significantly. A linear regression analysis of weights of animal baits and number of sandflies attracted revealed an insignificant result. The fluorescent dyes used to distinguish sandflies of different day experiments seemed not to influence the sandfly numbers in relation to the studied

sandfly behaviour. *Interpretation & conclusion:* The similar attraction pattern of *P. duboscqi* in semi-field environment by CO2-baited CDC light trap and the goat provides hope for solution to the problem of fast dissipating dry ice (CO2 source) in the field. Recommendations: Goats can, therefore, also be utilized as deflectors of vectors of cutaneous leishmaniasis from humans in zooprophylaxis in *Leishmania major* endemic areas where the sandfly is found. Key words Animal baits – CO2-baited light traps – *Phlebotomus duboscqi*

*Name of Journal/Conference Proceedings/Workshop:* *J Vector Borne Dis* 46, September 2009, pp. 191–196.
*Year of Publication:* 2009.

*Name of Lecturer/Authors:* Benjamin K. Muli, Fritz Schulthess, Rosebella O. Maranga, **Helen L. Kutima** and Nanqing Jiang.

*Title of Publication:* Interspecific competition between *Xanthopimpla stemmator* Thunberg and *Dentichasmias busseolae* Heinrich (Hymenoptera: Ichneumonidae), pupal parasitoids attacking *Chilo partellus* (Lepidoptera: Crambidae) in East Africa

*Abstract:* Interspecific competition between *Xanthopimpla stemmator* and *Dentichasmias busseolae* was studied using pupae of the invasive crambid stemborer *Chilo partellus* as the host. While *X. stemmator* is an old association, *D. busseolae* formed a relatively new association with *C. partellus* in East Africa. Two different time intervals between parasitism (0 and 48 h) and two parasitoid sequences [i.e., *X. stemmator* before *D. busseolae* (Xs–Db) and *D. busseolae* before *X. stemmator* (Db–Xs)] were chosen. In addition, the parasitoids' performance on pupae in maize stems and ears was assessed. For both *X. stemmator* and *D. busseolae*, there was no difference in foraging time between unparasitized pupae and pupae previously parasitized by the other species, indicating that the two species were not capable of interspecific host discrimination. In the Xs–Db sequence, the time interval between parasitism did not have an influence on the percentage of pupae producing either parasitoid species. By contrast, in the Db–Xs sequence, the percentage of pupae producing *X. stemmator* was almost 8 times higher in the 0-h than the 48-h interval, while for *D. busseolae* it was the reverse. In the 0-h interval, *X. stemmator* outcompeted *D. busseolae* irrespective of whether it parasitized first or second, while in the 48-h interval, the parasitoid parasitizing first won. While *D. busseolae* successfully searched for and parasitized pupae in stems and ears, parasitism of pupae in ears by *X. stemmator* was negligible. It was concluded that the two species could co-exist because they partly exploit different ecological niches. Keywords: Pupal parasitoids; Host discrimination; Interspecific competition; *Chilo partellus*; *Xanthopimpla stemmator*; *Dentichasmias busseolae*

*Name of Journal/Conference Proceedings/Workshop:* Biological Control Volume 36, Issue2. February 2009, Pages 163-170.
*Year of Publication:* 2009.

*Name of Lecturer/Authors:* Naftaly Githaka, Richard Bishop, Stephen Mwaura, **Helen Lydia Kutima,** Marion Mutugi, Satoru Konnai and Robert Skilton.

*Title of Publication:* Additional sequence analysis and recombinant expression of RIM36, a 36 kDa cement protein of the ixodid tick *Rhipicephalus appendiculatus.*

*Abstract:* Although a limited number of protective antigens against tick infestations have been identified and characterized, discovery of novel antigens remains a limiting step for improving the efficacy of tick vaccines. Components of tick saliva/salivary glands, some of which are cement proteins, are being considered as candidates for future vaccines. Vaccination with the C-terminal of 36 kDa *Rhipicephalus appendiculatus* immuno-dominant molecule (RIM36), a component of the proteinous cement cone that anchors rhipicephalus ticks to their host, results in a strong antibody response targeting RIM36 in cattle exposed to feeding ticks. The protective capacity of the recombinant antigen against tick challenge has not been fully investigated. Using a sequence based on the *R. appendiculatus* gene index (RAGI), the glycine-rich N-terminal domain of RIM36 was expressed and the recombinant protein purified. Sequence analysis revealed polymorphism among several RIM36 variants. In addition, N-terminal RIM36 protein reacts strongly with sera from tick-infested cattle, highlighting its possible use as a marker for tick exposure, and perhaps as a candidate for vaccine studies.

*Name of Journal/Conference Proceedings/Workshop:* Experimental and Applied Acarology Script Number: APPA669.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Andrew Ambogo Obala; **Helen Lydia Kutima**; John H. Ouma.

*Title of Publication:* The Seasonal Abundanceof *Anopheles gambiae* and Malaria Transmission in a Fringe Area of Western Kenya

*Abstract:* Retrospective malaria and weather data from Chemelil in western Kenya were analyzed to provide clues on critical weather components responsible for malaria epidemics in the neighbourhood highland districts. Cross-sectional study design and two-stage sampling techniques were used to collect prospective malaria and mosquito vectors' data. A sub-sample of captured indoor-resting mosquitoes was investigated for species composition, feeding preference, parity and sporozoite rates, and the EIR. Malaria prevalence, mean parasites densities (MPD) and gametocytaemia were determined using finger-prick blood from study subjects. All malaria positive subjects were treated with SP, and repeat BS done quarterly to detect SP resistance, while the spatial and temporal malaria transmission were demonstrated using GIS plots on the digital map of the study area. Malaria prevalence of 49.5 and 46.8 percent were obtained using retrospective and prospective data respectively with significant non-uniform prevalence detected in the latter (t=8.40, p=0.14). The GIS plots demonstrated residual transmission within homesteads proximal to breeding habitats. 1,426-parasite/μℓ cumulative MPD among children 2-9 years was in excess of 1,000-parasite/μℓ required for gametogony, which confirms malaria transmission is stage specific and density dependent. Children from 1-4 years were more parasitaemic making this age-group the main parasite reservoir which feed local malaria

transmission cycle, while SP efficacy of 70.8% was high since the time lapse between the parasite surveys was long. Anopheles gambiae ss and An. arabiensis, the two cryptic species of the An. gambiae group comprised of 75.2 and 24.8 percent respectively with significant differences detected between monthly mean densities of these malaria vectors (ANOVA; F=1.852, p=0.256). Stepwise multiple regression showed significant association between the mosquito densities and RH% ($r^2$=0.721; t=0.5501, p=0.5995), while HBI, parity and sporozoite rates, and EIR were moderately high (57.7, 62.0, 5.7 percent and 259.4bites/person/year respectively) suggesting efficient in malaria transmission in spite of low numbers of vector mosquitoes captured. Rainfall and RH were critical for malaria parasite reservoir in fringe transmission buffers, with epidemic outcomes in the highlands. Malaria control should aim at reduction of mean parasite densities to less than 1,000-parasite/μℓ blood to temper gemetogony and reduce transmission. This study has shown that this score is easily amenable to control than often used malaria parasite prevalence rates. 29.2 percent SP resistance obtained exceeds 25 percent upper limit recommended by WHO, and this drug has since been replaced by ACT combination therapy in Kenya, although it is recommended for IPT among pregnant women and malaria treatment in infants.

*Name of Journal/Conference Proceedings/Workshop:* Journal: Kenyan Journal of Health Sciences.
*Year of Publication:* 2010.

# 2. FACULTY OF AGRICULTURE

## 2.0 DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

*Name of Lecturer/Authors:* **Michael W. Wawire**, I. Oey, F. Mathooko, C. Njoroge, D. Shitanda and M. Hendrickx.

*Title of Publication:* Thermal stability of ascorbic acid and ascorbic acid oxidase in African cowpea leaves (*Vigna unguiculata*) of different maturity.

*Abstract:* Cowpea, an African leafy vegetable (*Vigna unguiculata*), contains a high level of vitamin C. The leaves harvested at 4 to 9 weeks old are highly prone to vitamin C losses during handling and processing. Therefore, the purpose of this research was to study the effect of thermal treatment on the stability of ascorbic acid oxidase (AAO), total vitamin C content (L-ascorbic acid, L-AA) and dehydroascorbic acid (DHAA) and L-AA/DHAA ratio in cowpea leaves harvested at different maturity (4, 6 and 8-week-old). The results showed that AAO activity, total vitamin C content and L-AA/DHAA ratio in cowpea leaves increased with increasing maturity (up to 8 weeks). Eight-week-old leaves were the best source of total vitamin C and showed a high ratio of L-AA/DHAA (4:1). Thermal inactivation of AAO followed first order reaction kinetics. Heating at temperature above 90°C for short times resulted in a complete AAO inactivation, resulting in a protective effect of L-AA towards enzyme catalyzed oxidation. Total vitamin C in young leaves (harvested at 4 and 6 weeks old) was predominantly in the form of DHAA and therefore temperature treatment at 30-90°C for 10 min decreased the total vitamin C content, whereas total vitamin C in 8 weeks old cowpea leaves were more than 80% in the form of L-AA so that a high retention of the total vitamin C can be obtained even after heating and/or reheating (30-90°C for 10 min.) before consumption. The results indicated that the stability of total vitamin C in situ was strongly dependent on the plant maturity stage and the processing conditions applied.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Agricultural and Food Chemistry, Vol. 59 (5), pp. 1774–1783.

*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Arnold N. Onyango** and Naomichi Baba.

*Title of Publication:* New Hypotheses on the Pathways of Formation of Malondialdehyde and Isofurans.

*Abstract:* Malondialdehyde (MDA) is a mutagenic compound that has been widely used as a biomarker of oxidative stress. However, the nonenzymatic mechanisms of its formation are not well understood. Some lipid oxidation products were previously suggested to be MDA precursors and found to afford MDA heterolytically under acidic conditions. We predict that some of these compounds are not important MDA sources under the autoxidative conditions under which the bulk of MDA should be formed in vivo and that others require further oxidative modifications to generate MDA homolytically. Thus, we outline the likely important pathways of MDA formation in vivo. All these

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| | pathways are intense aldehyde producers, generating two other aldehydic products for every MDA molecule formed. Some of the predicted aldehydes are new and may merit further analytical and biological studies. Peracids derived from the aldehydes are proposed to participate in the formation of isofurans (which at high oxygen tensions are excellent markers of oxidative stress) as well as important bioactive epoxides such as leukotoxins. This generates interest in the biological relevance of lipid aldehyde-derived peracids. The suitability of tissue MDA determination methods is discussed based on their likelihood of involving acid-catalyzed artifactual MDA formation. |
| *Name of Journal/Conference Proceedings/Workshop:* | Free Radical Biology and Medicine Vol. 49 (10), pp. 1594-1560. |
| *Year of Publication:* | 2010. |
| *Name of Lecturer/Authors:* | Dihydroperoxidation Facilitates the Conversion of Lipids to Aldehydic Products via Alkoxyl Radicals. |
| *Title of Publication:* | **Arnold N. Onyango** and Naomichi Baba |
| *Abstract:* | The mechanisms of formation of many aldehydic lipid oxidation products remain unclear, and the involvement of peroxyl radical additions in some cases was recently suggested. Here, the effect of □-tocopherol, a peroxyl radical trap, on the formation of aldehydic phospholipids from a phosphatidylcholine hydroperoxide was studied by electrospray ionization mass spectroscopy (ESI-MS). Based on the observed differential enhancement or suppression of formation of different aldehydes, new pathways are deduced for aldehyde formation via alkoxyl radicals derived from dihydroperoxy derivatives. |
| *Name of Journal/Conference Proceedings/Workshop:* | Food Research International Vol. 43, pp. 925-929. |
| *Year of Publication:* | 2010. |
| *Name of Lecturer/Authors:* | **Paul N. Karanja**, M.A, Mwasaru, H. Koaze, Y. Kubo, and N. Baba. |
| *Title of Publication:* | Utilizing Immature Macadamia Nuts in prevention of Thermal Decomposition of Polyunsaturated Fatty Acids (PUFA): Case study with Docosahexaenoic Acid (DHA) |
| *Abstract:* | *Background:* It has been found that most of the reject nuts during the processing of macadamia nuts in Kenya consist of nuts which have not attained full maturity at the time of harvest causing poor quality of nuts. This is a common phenomenon. This work tested the polyphenol content in both the immature nuts and the reject nuts. The oil's antioxidant potential in stabilizing docosahexaenoic acid (DHA) against thermal decomposition was also tested. *Methods:* Macadamia nuts were harvested at four different stages of maturity after flowering namely 90,150,210, and 270 days at a Nuts' company in Kenya. Rejects nuts were obtained from the same company. The polyphenol content of the kernel at each stage of maturity and in the rejects nuts was determined. Varying quantities of oil extracted from actual reject nuts was used to conduct model antioxidants tests with DHA at 55°C incubated at 5 hours. DHA degradation was monitored by Liquid Chromatography technique *Results:*The immature nut kernels were found to contain upto 0.7% polyphenols at 90 |

days after flowering reducing gradually to 0.13% at 210 days. Reject kernels were found to contain 0.13% which compares with 210 days. On DHA tests, about 96% of DHA decomposed in the control (with no nut oil), whereas only 30%, 21% and 16% of DHA decomposed where 5,10, and 15 % of nut oil was used respectively. A comparison between the effect of nut oil and BHT (artificial antioxidant) showed that the nut oil is a better antioxidant. *Conclusion:* Oil from reject nuts has potential to inhibit thermal decomposition of DHA-containing foods. This may be due to high amount of antioxidants present.

*Name of Journal/Conference Proceedings/Workshop:* Tropical Agriculture and Development Vol. 54, pp. 140-142.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Florence M. Kyallo**, A. M. Mwangi, A. O. Makokha
*Title of Publication:* Demographic and socioeconomic determinants of overweight and obesity among school children in Nairobi, Kenya.

*Abstract:* *Introduction*: Obesity is an increasingly prevalent nutritional disorder throughout the world and is a risk factor for many chronic diseases. Childhood obesity is also on the increase worldwide. Family characteristics form part of the environment that influences excess weight gain. *Objective:* To determine the risk factors for overweight and obesity among school children in Nairobi. *Materials and methods*: A cross-sectional study was conducted in five randomly selected primary schools in Nairobi. A questionnaire was used to determine family socio-economic and demographic characteristics. Weight and height were measured and BMI calculated. Nutrition status was classified using the WHO age-and-gender specific BMI z-scores. *Results:* 255 females (56.3%) and 199 males (43.7%) aged 9-14 years participated. Overall, 11.4% of the children were overweight while 4% were obese. Overweight and obesity in private schools (17.4% and 9.8% respectively) were significantly higher than in public schools (9% and 1.6% respectively, $p<0.05$). Though not significantly different, girls were 1.7 times more likely to be overweight than boys. Children without siblings were 2.2 times and 4.2 times more likely to be overweight and obese respectively compared to those with one or more siblings. Obesity among children with access to a family computer was significantly higher (7%, $p<0.05$) than among those without access to a family computer (1.7%). Similarly, obesity rates were significantly higher (6.8%, $p<0.05$) among children with access to play station than among those without access (2.5%). Other electronic leisure gadgets that increased risk of overweight and obesity insignificantly were having access to a cell phone and presence of a television set in a child's room. Conclusion: Attending a private school, having access to a computer and play-stations were risk factors for having excess body weight among the school children in the study group.

*Name of Journal/Conference Proceedings/Workshop:* 4th African Nutrition Epidemiology Conference (ANEC 4), Safari Park Hotel, Nairobi, 3rd -8th October 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* De Roeck A, Mols J, **Sila DN**, Duvetter T, Van Loey A, Hendrickx Marc.

*Title of Publication:* Improving the hardness of thermally processed carrots by selective pretreatments.

*Abstract:* The aim of this study was to improve the texture of thermally processed carrots by selective pretreatments modifying plant –intrinsic properties. Pretreatments were a combination of thermal or high-pressure (HP) treatments followed by a one hour soak in a specific solution. After a subsequent thermal process, the residual texture (hardness) of the carrots was determined using a texture analyzer. Lowering the degree of methyl-esterification (DM) of the carrot pectins was confirmed to be one strategy to reduce texture degradation. The thermal or HP pretreatments stimulated pectinmethylesterase (PME), activity, resulting to pectin with lower DM which is less susceptible to β–eliminative depolymerisation. At the same time, the plant tissue was permeabilized, facilitating uptake of $Ca^{2+}$ ions during subsequent calcium soak, resulting in an even better texture by enhancing the amount of $Ca^{2+}$ crosslinks within the cell wall. Lowering the pH of the carrots was proven to be another strategy. A pretreatment followed by soaking the carrots in a solution of low pH proved to be effective in lowering the internal carrots pH, hereby retarding β–elimination and subsequently texture degradation. The composition of the the low pH solution was shown to be important; soak solutions containing cations and/or $Ca^{2+}$ complexing agents should be avoided. Since there is a move from food additives, use of natural occuring ferulic acid proved to be a good acidifying candidate, due to its natural presence in fruits and vegetables. In conclusion, for texture improvement of thermally processed carrots, lowering the susceptibility to β–elimination and enhancing cell wall crosslinking are the two main ways used for manipulating the plant intrinsic properties.

*Name of Journal/Conference Proceedings/Workshop:* Food Research International 43:1297-1303.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Sila DN.** Van Loey A. Hendrickx M.

*Title of Publication:* Pectin structural manipulations during processing: towards a better understanding of carrot texture

*Abstract:* Pectin, a heterogeneous and abundant matrix component in plant cell walls, functions as an intercellular adhesive. During processing and/or strorage, pectin can be demethoxylated and/or depolymerized enzymatically and/or non-enzymatically. Transformations in pectin structural features can yield profound alterations in its functional properties. In view of texture engineering in solid plant foods, insight on directed pectin structural modifications, the extent of modification and the influence of the change on functionality is important. Herein, pretreatment conditions (blanching; high pressure pretreatment; calcium soaking (0.5% $CaCl_2$) ferulic acid soaking (0.1% diferulic acid)) were used for *in situ* modification of carrot pectin structural properties prior to thermal processing. Pectin isolates were fractionated: water soluble (WSP), chelator soluble (CSP)

and sodium carbonate soluble pectin (NSP). Changes in pectin solubility, degree of methoxylation (DM), degree and pattern of depolymerization of the isolates were fingerprinted and related to thermal texture degradation (90-110°C). Pretreatment conditions resulting in pronounced DM reduction in 'mother' pectin showed reduced β-elimination and better texture. Decreasing *in situ* DM by pretreatment resulted in decreasing WSP solubility at the expense of increasing NSP, a condition which was reversed by subsequent thermal processing. Thermal digestion of the WSP revealed a random depolymerization pattern marked by a non-homogeneous molecular weight distribution contrary to the homogeneous fragments observed for CSP and NSP. At constant temperature, the concentration of unsaturated galacturonides increased with increasing process time in the WSP (pH=6.5). β-elimination kinetics (k-value) of the WSP followed zero-order model, the $Q_{10}$ factor being 2-3.5. Pretreatment conditions didn't affect the temperature dependence of the k-values. Texture changes in thermally processed carrots are partly explained by the structural transformations and depolymerisation kinetics of the WSP. Enzyme aided pectin-structure-engineering is the key to understanding and optimization of plant foods texture.
Keywords: pectin, degree of methoxylation, depolymerization

*Name of Journal/Conference Proceedings/Workshop:* IUFOST, 15th World Congress of Food Science and Technology, pg 33.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **J. N. Kinyuru,** G. M. Kenji, S. N. Muhoho and M. Ayieko.

*Title of Publication:* Nutritional potential of Longhorn Grasshopper (*Ruspolia differens*) consumed in Siaya District, Kenya.

*Abstract:*
The longhorn grasshopper (*Ruspolia differens*) forms a major part of the food culture of communities in the Lake Victoria Region of East Africa. The aim of this research was therefore to assess the nutritional potential of this insect to the human diet in the region in combating nutritional deficiencies that are of public health concern. The green and brown coloured grasshoppers were studied. They were found to contain a protein content of 37.1% and 35.3%, fat content of 48.2% and 46.2%, ash content of 2.8% and 2.6%, a fibre content of 3.9% and 4.9% for the green and brown grasshoppers respectively. Among the macro minerals, potassium (K) was the most abundant with a value of 370.6 mg/100g and 259.7 mg/100g, phosphorus (P) 140.9 mg/100g and 121.0 mg/100g while calcium (Ca) levels showed overall means of 27.4 mg/100g and 24.5 mg/100g in the green and brown grasshopper respectively. Iron (Fe) was the most abundant among the trace minerals with a value of 16.6 mg/100g and 13.0 mg/100g while zinc showed a mean value of 17.3 mg/100g and 12.4 mg/100g in the green and brown grasshopper respectively. The insects showed a retinol concentration of 2.1 μg/g and 2.8 μg/g, α-tocopherol 201.0 μg/g and 152.0 μg/g, riboflavin 1.2 mg/100g and 1.4 mg/100g, 2.1 mg/100g and 2.4 mg/100g of niacin for the green and brown grasshopper respectively. Lipid analysis revealed that the insects' oil comprised of high amounts of polyunsaturated fatty acids,

89.4% and 84.3% neutral lipids, 7.4% and 9.3% phospholipids, 3.2% and 6.4% glycolipids for green and brown grasshopper respectively. These values suggest that *Ruspolia differens* has potential for exploitation to combat nutritional deficiencies that are of public health concerns. The insect could form a base for new food products of considerable nutritive value. Key words: Nutritional potential, *Ruspolia differens,* longhorn grasshopper, public health.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Agriculture, Science and Technology, Volume 12 (1).
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* John N. Kinyuru; **Kinyanjui P. Kahenya**; Margaret Muchui; Hellen Mungai; and M. Ithiga.

*Title of Publication:* Influence of Storage Temperatures on the Post-Harvest Quality of Snap Bean (Phaseolus vulgaris L.)

*Abstract:* Snap bean (Phaseolus vulgaris L.) is a major vegetable export crop in Kenya. The market is dynamic and hence the need to introduce new varieties to meet market requirements. The introduction of new snap bean varieties requires evaluation of their post-harvest quality in order to ascertain optimum handling procedures. A preliminary study was conducted where mature snap beans of samantha variety, were collected from small holder farmers in 2 growing seasons and data was collected with a view to developing a model for short term storage for prediction of the relationship between storage conditions, physical and nutritional quality under low density polythene bags. Half of the samples were packed separately in open polythene bags while the other half was packed in closed polythene bags and stored at 5oC, 10oC, 15oC and 25oC and observations made for 9 days. It was observed that the higher the temperature, the higher the weight loss although the loss was higher in open polythene bags in all the storage temperatures. Similar trends were also observed in the loss of chlorophyll in both samples with samples stored at 25oC showing 5.5mg/L of chlorophyll content at day 9. There was a higher loss in total soluble solids in the samples stored in open polythene bags at 25oC with the samples showing 5.3% by day 9. There was a slower loss of vitamin C in samples stored in closed bags; however, the samples stored at 25oC for both treatments had the greatest loss by day 9. The results show that packaging in polythene bags has to be coupled with low temperature storage in order to receive a desirable shelf life. Keywords: Snap beans, storage temperatures, polythene bags, postharvest quality.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.
*Year of Publication:* 2010.

## 2.1 DEPARTMENT OF HORTICULTURE

*Name of Lecturer/Authors:* Mbaka J.N., **Losenge T.,** Waiganjo M. M. and Wamocho L.S.
*Title of Publication:* Phenotypic variation in three *Phytophthora cinnamomi* populations from macadamia growing areas in Kenya.

*Abstract:* In Kenya macadamia (*Macadamia integrifolia* Maiden and Betche and *Macadamia tetraphylla* L.A.S. Johnson) is grown by over 100,000 small scale rural farmers. However root rots and trunk cankers caused by *Phytophthora cinnamomi* Rands are major production constraints. Macadamia tree death due to the two diseases is currently estimated at 60%. No single effective method exists for management of the *Phytophthora* induced root rots. Knowledge on variability within species is a pre-requisite to development of strategies for effective disease management. In this study morphological and physiological characteristics of 76 *P. cinnamomi* isolates recovered from rhizospheres, stems and roots of symptomatic macadamia trees in different regions of Kenya were investigated. Phenotypic variations were demonstrated in radial growth rate, colony morphology and sporangial dimension. To determine pathogenicity and virulence, green apples were inoculated with each of the isolates. The isolates differed significantly (P=0.001) in growth rate on apples. There was a significant relationship (X2 4 =94.1, P<0.001) between colony type and isolate sub-population. Colony morphology was influenced by temperature. Colonies were predominantly petaloid at 24 °C. Thirty five out of the 76 isolates were pathogenic. The homothallic isolates were the most virulent and killed macadamia seedlings 29 days after inoculation. *Phytophthora cinnamomi* was isolated 10 cm above the inoculation point from asymptomatic seedlings. These findings of large phenotypic variation among isolates have important taxonomic and disease management implications. This is the first such study undertaken in Kenya. The knowledge generated will be crucial in development of integrated management strategies for macadamia root rots and trunk canker in Kenya

*Name of Journal/Conference Proceedings/Workshop:* Journal of Animal & Plant Sciences, 2010. Vol. 8, Issue 1: 900-911. ISSN 2071 – 7024 900.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Turoop, L** and Faust, J E.
*Title of Publication:* Supplementing nutrition with calcium and potassium silicate to control Botrytis cinerea in poinsettia stock plants

*Abstract:* Root application of silicon (Si) on poinsettia stock plants was evaluated for its effects in reducing B. cineria and promoting cutting performance in storage and propagation. Fertilization of two poinsettia varieties raised on soilless media was supplemented with calcium or potassium silicates at the concentrations of 125, 250 and 500 ppm. Control plants were drenched with same amount of distilled water, leaf tissue were inoculated with a spore suspension and the development of botrytis was monitored. Shelf life and performance of cuttings

in propagation was assessed. Calcium and potassium silicate significantly reduced the severity and incidence of B. cineria on Si treated plant tissue compared to the control. Applying 500 ppm Si reduced the disease severity by up to 27.8% and disease incidence by 33.1%. The losses associated with botrytis in storage were reduced by >30% in high Si fertilized plants. Performance and incidence of botrytis in propagation was significantly influenced by Si application. Although infection occurs on tissue treated with high Si rate, lesion expansion was significantly reduced. The net effect of Si on poinsettia stock plants is an overall reduction in disease development, by eliciting a defense reaction as indicated by a significant increase in total tissue phenolic content with increase in Si rate, thereby slowing the infection rate of B cineria.

*Name of Journal/Conference Proceedings/Workshop:* Phytopathology. Vol. 100, no. 6, suppl. 1, p. S128. Jun 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Turoop, L.**, James, F. E. Simon, S.W.
*Title of Publication:* The transmission and management of Tobacco mosaic virus in a greenhouse environment.

*Abstract:* Tobacco Mosaic Virus (TMV) is a troublesome virus in greenhouse production. Experiments were carried out to investigate the ease with which the virus spreads from infected greenhouses plants to non-infected plants through workers clothing, cutting tools, and contaminated greenhouse benches. Two tobacco cultivars (Nicotiana tabacum cvs White Burley and Samsun NN were used as indicator plants. Two commonly used clothing materials (Cotton and Polyethylene fibre, Tyvek) for greenhouse dustcoats and latex for gloves was tested as vehicles for transmission of the virus. Workers contacts on plants were simulated by applying various contact grades on infected and then healthy plants. The slightest brushing of the materials against infected plants and to healthy ones caused a disease incidence of >70% for cotton, 60% for Latex, and 30% for Tyvek. However, cleaning of these materials using various cleaning agents in a simulated laundry condition eliminated the virus. The efficacy of various disinfectants used in cleaning greenhouse cutting tools depended on the concentration and time of exposure. A simple dip into a 2% dry milk solution, 3% Menno-Florades (MF) or 14.6 g/liter of trisodium phosphate (TSP) eliminated the virus. The potential of these disinfectants to clean contaminated workers clothing, cutting tools and benches may allow reuse of these resources hence cutting down on production costs

*Name of Journal/Conference Proceedings/Workshop:* Phytopathology Vol. 99, no. 6, suppl., p. S131. Jun 2009.
*Year of Publication:* 2009.

*Name of Lecturer/Authors:* Mbaka J. N., Wamocho L.S., **Turoop L.** and Waiganjo M. M.
*Title of Publication:* The incidence and distribution of Phytophthora cinnamomi Rands on macadamia in Kenya.

*Abstract:* In Kenya, macadamia (Macadamia integrifolia Maiden and Betche and Macadamia tetraphylla L.A.S. Johnson) is grown by over 100,000 small-scale rural farmers. Eighty three percent

of the Kenyan macadamia nuts are exported to Japan, USA and China. Root rot and stem canker are major macadamia nut production constraints. This study was carried out to establish the incidence and distribution of the causal organism (Phytophthora cinnamomi) in different macadamia growing areas of Kenya. Disease surveys were carried out between December 2005 and April 2006 in all the macadamia growing areas of Kenya. A questionnaire was administered to capture data on macadamia production practices. The location of each sampling site was marked using a Global Positioning Satellite (GPS) instrument, Gamin®. Phytophthora cinnamomi was recovered from soil and diseased plant parts by plating onto synthetic media (corn meal agar). The recovered isolates of P. cinnamomi were characterised on the basis of pathogenicity and growth. Determination of mating types was done by matching with isolates of known mating types acquired from Australia. Root rot was described as the major disease of macadamia (by 85% of the respondents in the survey areas). Reported yield losses due to macadamia root rot were as high as 36.6% in one of the districts. Disease incidence was higher in flat areas. The Phytophthora root rots affected all macadamia cultivars across the regions but the most commonly affected cultivar was M. tetraphylla. Ninety percent of the interviewed farmers reported that they did not manage the disease in any way. The results show that P. cinnamomi associated with root rots and stem canker of macadamia has a wide distribution in all macadamia growing areas of Kenya. There is need to develop, validate and disseminate the best bet technologies for management of the disease to save the macadamia nut industry in Kenya. Development of integrated pest management (IPM) options for macadamia root rot has been initiated at KARI-Thika and training of farmers and extension field officers is planned to be done through the farmer field school approach.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Animal & Plant Sciences, 2009. Vol. 4, Issue 1: 289 - 297.

*Year of Publication:* 2009.

*Name of Lecturer/Authors:* Peter Mwaura, Thomas Dubois, **Turoop Losenge**, Daniel Coyne and Esther Kahangi1

*Title of Publication:* Effect of endophytic *Fusarium oxysporum* on paralysis and mortality of *Pratylenchus goodeyi*

*Abstract:* Three bioassays were conducted to investigate the antagonistic effect of secondary metabolites produced by 5 endophytic *Fusarium oxysporum* isolates from banana (*Musa* spp.) plants in Kenya, against *Pratylenchus goodeyi*. Percentage paralyses were recorded 3, 6 and 24 h after exposure to culture filtrates. Percentage mortality was evaluated after 48 h. All isolates caused significantly higher percentage paralysis (17.5 - 25.9%) and percentage mortality (62.3 - 72.8%) of *P. goodeyi* motile stages compared to the control (8.4 - 10.9% and 17.3 - 34.6%, respectively). Percentage paralysis of motile stages of *P. goodeyi* decreased as the length of time exposure to culture filtrates increased, while mortality increased as length of nematodes

exposure to culture filtrates increased. Kenyan isolates performed equally as good as the Ugandan isolate (V5W2) in causing paralysis and mortality. Results from this study demonstrated that endophytic *F. oxysporum* antagonizes *P. goodeyi* through production of secondary metabolites.

*Name of Journal/Conference Proceedings/Workshop:* African Journal of Biotechnology Vol. 9 (8), pp. 1130-1134, 22 February, 2010 ISSN 1684–5315 © 2010 Academic Journals.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **J. M. Wambua,** M. N. Makobe, E. M. Njue and A. B. Nyende.

*Title of Publication:* Hydroponic screening of Sorghum (*Sorghum bicolor* L. Moench) cultivars for salinity tolerance

*Abstract:* Sorghum *(Sorghum bicolor* L. Moench*)* crop has been considered relatively more salt tolerant than other cereals and has the potential as a grain and fodder crop in saline soils. However, only a few of the cultivars can thrive under relatively high levels of salinity. Genetic improvement of *Sorghum bicolor* for salt tolerance is of importance due to limited arable land and increasing salinity coupled with population pressure. The objective of this study was to evaluate the salinity tolerance of four selected Kenyan sorghum cultivars (Mtama1, El-gadam, Seredo and Serena) obtained from KARI-Katumani. Seeds of the named cultivars were pregerminated in petri dishes lined with moistened 12.5 mm diameter Whatman filter paper in a germination chamber at 270C for 3 days prior to transfer into the hydroponics system using the Shive and Robbin's nutrient solution {constituted of Macronutrients contained in the following salts namely: KH2PO4, Ca(NO3)2, MgSO4.7H2O, NH4SO2 and micronutrients in the following salts: FeSO4, MnCl2.4H2O, H3BO3, (NH4 ) 6 MO7 O24.4H2O, ZnSO4.7H2O, CuSO4.5H2O} for testing of seedling salinity tolerance. The hydroponics was placed at controlled environmental conditions with supplemental lighting of 4750 lux for twelve hours of day and twelve hours of darkness in the biotron. Four salinity levels were established using different NaCl concentrations corresponding to a nutrient solution electrical conductivity (EC) of 5, 10 and 15dS/m and a control of Shive and Robbin's nutrient solution (0.22dS/m). Shoot length, root length, fresh and dry weights of the seedlings were recorded in order to quantify seedling growth under salinity pressure. The factorial experiment was set up in a CRD. There were significant intercultivar differences in shoot growth (pd"0.01), where Serena had the highest growth at high NaCl concentrations (10 and 15 dS/m) while Mtama1 had the least shoot growth among the four cultivars. Even though increment of salinity level, continued to contribute to growth inhibition at an electrical conductivity above 5dS/m Seredo and Serena showed adaptation to the high levels of salinity as compared to Mtama 1 and El-gadam. Results further indicated that root development (presence of root hairs and root length) was significantly inhibited at 10 and 15 dS/m for both Mtama 1 and El-gadam while Seredo and Serena were less affected. The sensitivity and tolerance levels in the cultivars suggest that there were two classes of tolerance levels: those that were tolerant and not inhibited in shoot and root growth and those that were

sensitive. Based on this study it was concluded that, Sorghum bicolor L. Moench cultivars differ in their ability to grow under different levels of salinity during the early seedling growth stages. This is an important characteristic to be taken into account when selecting cultivars that can survive in saline soils. Key words: Salt tolerance, seedling nutrient screening, electrical, conductivity, sorghum cultivars.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* M. A. Otiende, J. O. Nyabundi, M. O. A. Onyango and **K. Ngamau.**

*Title of Publication:* Survival of Self-rooted Rose *(Rosa hybrida)* as affected by Harvest Stage, Cultivar and Storage period of Budwood wood

*Abstract:* Roses are the leading cut flower produced in Kenya contributing 70% of total cut flower revenue. Roses may be offered as gifts during occasions such as valentines', Christmas, and Mothers' Day. They can also be used for decoration of houses and wedding ceremonies. Low percentage survival rates (less than 50%) of self-rooted cuttings of highly demanded cut rose cultivars ('Milva' and 'Shocking Vasila') adversely affect their production. This results in increased cost of production and shortage of planting materials consequently delaying planting during the peak periods when export demand is high. In an effort to further understand factors affecting percentage survival in these cultivars, the bud wood development stage and cold storage period of cut wood and their relationship to survival of the two *Rosa hybrida*, cultivars were evaluated. The bud wood was harvested at flower bud initiation, tight flower bud and full bloom stages and then stored for 0, 3 or 7 days at 2 – 4oC. The treatments were arranged in a completely randomised design with three replications. Bud wood harvested at full bloom stage exhibited significantly ($p < 0.05$ higher percentage survival than bud wood harvested at flower bud initiation stage in 'Milva'. Percentage survival of bud wood from tight flower bud and full bloom stages were not significantly different from each other in 'Shocking Vasila' though survival from full bloom stage was higher. Storage for 7 days yielded significantly higher percentage survival than 0 days storage in 'Milva'. Non-storage produced significantly lower percentage survival than 3 and days storage in 'Shocking Vasila'. Results suggest that the cut wood of the two cultivars should be harvested at full bloom stage and stored for 7 days to achieve higher percentage survival. The cultivars differed significantly in their ability to root. 'Shocking Vasila' was found to be an easy to root cultivar compared to 'Milva' as more than 70% survival was achieved. 'Milva' exhibited less than 45% survival hence difficult root cultivar. In order to improve percentage survival in this cultivar, other methods of propagation such as top grafting and tissue culture should be employed. In addition the effects of exogenous auxin and carbohydrate concentrations on percentage survival of this cultivar should be examined. Key words: Rose, cultivar, harvest, storage, period, self-rooted, budwood, period.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Ngamau, C. N**., Hunja, M., Tani, A.
*Title of Publication:* Determination of Endophytic bacteria of rice seed using DGGE.
*Abstract:*

Endophytic bacteria have a potential role in promoting plant growth and suppressing disease pathogens in a cost effective and environmentally friendly manner. This study was therefore conducted with the aim of determining the endophytic bacteria composition of rice seeds collected in Kenya in view of their agronomic importance. Different varieties of rice seeds were collected from Bunyala, Hola, Kaloleni, Mwea, Msabweni, and Taveta in Kenya. Rice seeds were surface-sterilized and bacterial DNA isolated from husked rice. Partial 16SrRNA genes of endophytic bacteria were PCR-amplified. Amplified products were then subjected to denaturing gradient gel electrophoresis (DGGE) and a total of 41 bands were excised from the gel. The fragments were then re-amplified and 31 out of the 41 PCR products obtained were sequenced for endophytic bacteria identification. Bacteria strains were identified as *Methylobacteriaceae*, *Sphingomonadaceae*, *Enterobacteriaceae*, *Pseudomonadaceae, Flavobacteriaceae* and *Rhizobiaceae*. *Methylobacterium* species, for example, are very important organisms, which have been shown to stimulate seed germination and plant development, perhaps through production of phytohormones. The next stage of this study will be to isolate such specific bacterial strains and determine their agronomic importance on rice production in Kenya. Key words: Denaturing Gradient Gel Electrophoresis (DGGE), endophytic bacteria, rice.

*Name of Journal/Conference Proceedings/Workshop:* JKUAT Annual Scientific Conference Proceedings.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Ngamau, C. N.**, Matiru, V. N., Muthuri, C. W., Tani, A.
*Title of Publication:* Isolation and Identification of Endophytic Bacteria of Bananas in Kenya.
*Abstract:*

This study was conducted with the aim of isolating and identifying banana endophytic bacteria on the basis of their potential as biological fertilizer. Banana material was collected from five different geographical regions to enhance diversity. Isolation of bacteria was done using five (5) different isolation media and the isolates were characterized on the basis of their morphology, biochemical and molecular characteristics. A total of 214 bacterial isolates were obtained and characterized. Microorganism profiling was done using MALDI-TOF/MS and the isolates were clustered into 53 genotypes. Based on their functional characteristics, 43 isolates were selected for 16S rRNA gene sequencing. The 43 strains showed varied levels of positive nitrogenase activity as measured by the acetylene reduction assay and 37 strains were observed to solubilize phosphates by the formation of visible dissolution halos on agar plates (NBRIP medium). Siderophore production of the isolates was determined using Chrome Azurol S (CAS) agar plates and all the isolates were observed to be positive for siderophore production with

3 strains showing distinctively high level of production. Using the 16S rRNA gene sequencing, the 43 strains were identified as Serratia spp. (17 strains), Pseudomonas spp. (12 strains), Enterobacter spp. (4 strains), Rahnella spp. (4 strains), Raoultella spp. (2 strains), Bacillus spp. (1 strain), Klebsiella spp. (1 strain), Yersinia spp. (1 strain) and Ewingella spp. (1 strain). In conclusion, banana endophytic bacteria were successfully isolated and identified, and some of the isolates showed potential of being biological fertilizers. However, greenhouse and field investigations are necessary to confirm this potentiality. Key words: endophytic bacteria, diazotrophic endophytes, phosphate-solubilizing microorganisms (PSM), banana.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **C W.Muriithi**, E.N. Mugai and A.W. Kihurani.

*Title of Publication:* Effect of nitrogen and silicon on management of rice blast (*Pyricularia oryzae*) in Mwea irrigation scheme of Kenya.

*Abstract:* Plant health is an important factor for plant growth and development. Nitrogen is essential and is usually required in large quantities by plants. However, many studies have shown that high nitrogen concentration in plant increases the severity of disease infection by plants pathogen. On the other hand, Silicon though regarded as non essential element, has several benefits in crop growth. Its application to the rice plant has been shown resistance to increase resistance to rice blast Pyriularia oryzae as well as increased crop yield. This study aimed to establish an effective level of nitrogen and silicon in the management of the rice blast disease. The experiment was carried out at Mwea Irrigation Agricultural Development (MIAD) research station in Kirinyaga district. Seedlings were raised in the nursery before culturing in vertisol filled pots with various treatment combinations of nitrogen (40, 80 and 120kgN ha-1) and silicon (0,500, 1000 and 1500kgSi ha-1) in Split plots and in completely randomized design (CRD). Plants were inoculated after two weeks with the Pyricularia oryzae spore after transplanting and disease assessed in a scale of (0-9) according to IRRI standard. Higher rice blast was realized at 120KgN and 0kgSi ha-1 and in the plots that had neither nitrogen nor silicon. The organic husk ash at 2ton-1 before burning and 0.7ton-1 was shown to be good source of silicon and gave results equivalent to those of 120KgN and 1000KgSi. combination.The study established that interaction of nitrogen and silicon at 80kgN ha-1 and 1000kgSi ha-1 was the optimal rate for management of the rice blast disease. Key words: Silicon, Nitrogen, Rice blast, rice, hush ash.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Dr. Hunja Murage** and Gichuhi Emily.

*Title of Publication:* Dissemination of Senbakoki (rice threshing tool) in Mwea

*Abstract:* Manual threshing of rice in Kenya has been carried out for a long time. The process is tedious, laborious and time consuming. This

poor threshing technique is counter-productive from the point of view of milling and final quality of the rice. Post-harvest losses obtained while threshing using the traditional method is also quite high. Improved threshing techniques have been developed over the years. However, the adoption of these by the Kenyan small scale rice farmers is hampered by their high cost. As a result the small scale farmers have to employ traditional technologies that are inefficient and they often cannot improve this technology because of the leap in scale and capital cost to commercially available equipment. the goal of intermediate technology proponents is to help fill this gap with good quality rice threshing equipment that are affordable and suited to the scale of operations of the small farmers. However, there is a tendency for equipment development and commercial firms to concentrate their energies on rice threshers that are affordable only to the wealthier farmers' e.g a combined harvester whose cost ranges from Kshs 4 million to 8 million. The Senbakoki is a cheap and easy to fabricate rice thresher whose origin is Japan. The components used to make the parts of the Senbakoki are cheap and easily available in Kenya. The design is simple and therefore the Jua Kali artisans can easily construct it. The objective of this survey was to introduce a new rice threshing technology to the rice farmers in Mwea that is efficient and affordable. From the results obtained most farmers felt that the Senbakoki was less tedious and less time consuming. However, the results showed that the adoption rate of the Senbakoki by the farmers was low due to the constraints faced while using the Senbakoki such as sticking of the straw on the combs. Key words: rice thresher, Senbakoki, rice threshing efficiency.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **John Bosco Njoroge** and Paul Kariuki Nda'Nganga.

*Title of Publication:* Seasonal characteristics of avifauna in Nairobi metropolitan landscape.

*Abstract:* The landscape structure of Nairobi city is experiencing rapid transformation as once wild and pristine spaces are converted to anthropocentric uses. In order to understand how the changing urban structure affects urban habitats, the seasonal variation in occurrence and composition of avifauna within the metropolitan landscape of Nairobi city was investigated. The relationship between bird occurrence and spatial characteristics of surrounding urban matrix was quantified. Bird survey was conducted for two consecutive seasons in the wet and dry seasons. Landscape features within the study sites were derived from remote sensing image and used to account for bird distribution. Birds were classified according to their biological families and their naturally preferred habitat. Ordination analysis was done to find underlying correlation between species occurrence and site characteristics. About 50 different families of birds were observed between the two seasons with a total of 307 different species. Families of finches, raptors, warblers and weavers, sunbirds and thrushes were the most common. Bush and scrub

habitats were most naturally preferred habitat at a rate of about 31%, followed by grassland species at about 20% and forest species at about 16% rate. Unique species recorded between the seasons constituted 22% and 17% of total observed for the dry and wet seasons respectively. The first axis of principle component analysis revealed a gradient of change from forested and woody sites to savannah vegetated sites while the second axis was change from sites with agriculture patches to sites with urban patches. The occurrence and distribution of the species was highly dependant on site use and management. As the city continues to expand, landscape and urban planners must promote urban designs that will integrate habitat conservation for healthy urban space development. Key words: urban landscape, site characteristics, species richness, habitat type, management.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Mounde, L. G. Ateka, E. M. **Kihurani, A. W**., Wasilwa, L. and Thuranira, E. G.

*Title of Publication:* Morphological Characterization of *Phytophthora* Species Causing Citrus Gummosis in Kenya.

*Abstract:* *Background*: *Phytophthora* gummosis is a major disease of citrus trees in Kenya but identification of causal species has not been done. *Methods*: Samples of plant tissues from symptomatic plants and rhizosphere of infected plants soil were evaluated. Direct isolation and baiting system of *Phytophthora* from plant tissues and soil, respectively were used in this study. A total of 59 samples were processed using *Phytophthora* semi-selective media. *Results*: Three *Phytophthora* species were identified based on their morphological, cultural and physiological profiles. Forty five (45) isolates were identified as *P. citrophthora* whereas thirteen (13) isolates were identified *as P. nicotianae (syn. P. parasitica).* One isolate was identified as *P. syringae*. Virulence tests on lemon fruits and stem-inoculation studies on lemon seedlings confirmed pathogenicity of the identified pathogens. *Conclusions*: The study showed that *P. citrophthora, P. nicotianae* and *P. syringae* were the causal agents of gummosis in Kenya. However it is recommended that molecular characterization of these species be done to confirm their true genetic identity. This is because proper isolation, characterization and identification of *Phytophthora* pathogens associated with citrus gummosis disease is crucial for practical control and clear scientific communication.

*Name of Journal/Conference Proceedings/Workshop:* African Journal of Food, agriculture and Development (AJFAND).

*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **C. Muriithi,** E. Mugai**,** A.W. Kihurani**,** C.J Nafuma, and S. Amboga.

*Title of Publication:* Determination of silicon from rice by-products and chemical sources on Rice blast management.

*Abstract:* *Background*: Rice (*Oryza sativa*) is an important crop in Kenya. It ranks third after wheat and maize contributing to over 20% of the total calorie intake. ITA 330, IR2793-80-1, BW 196 and basmati/pishori 370 are varieties commonly grown in Kenya. Basmati 370 is most preferred for commercialization because it commands premium prices and occupy over 80% of the land. However, it is susceptible to rice blast, caused by *Pyricularia oryzae*. This is one of the most important diseases of rice causing an economic loss of 70-80% thereby threatening Kenyan food security. The objective of this study was to evaluate different rice blast management approaches using different sources of silicon, rice by-products and chemical control. *Methods*: The experiment was carried out in Mwea Irrigation Scheme in Kirinyaga district. It was laid out in completely randomized design (CRD) with six treatments; Calcium silicate (1000Kg/ha), Potassium silicate (1lit/ha) and rice by-products (rice straw, ash husk and ash straw at 2tons/ha). Basal fertilizers were added at 30Kg $K_2O$/ha, 58kg$P_2O_5$/ha and N which was applied as a top dress (80kgN) in two splits. Inoculum of *Pyricularia oryzae* ($4 \times 10^5$ conidia/ml) was used to infect the rice plants. Disease was assessed using a scale of 0-9, the IRRI standard. *Results*: Calcium silicate, Potassium silicate, rice husk ash and rice straw ash significantly (P=0.05) enhanced rice performance and disease resistance. However, there was no significant difference (P=0.05) among the four treatments. Rice straw was not significantly different from the control. *Conclusions*: Silicon from chemical and rice by-products sources enhanced rice performance and resistance to infection by *Pyricularia oryza* the causal agent of rice blast. It is recommended that these silicon sources be integrated with other commonly used nutrient management practices in rice production in order to reduce rice blast infection in Kenya.

*Name of Journal/Conference Proceedings/Workshop:* East African Agriculture and Forestry Journal (EAAFRO).

*Year of Publication:* 2011.

# 3. FACULTY OF ENGINEERING

## 3.0 DEPARTMENT OF BIOMECHANICAL AND ENVIRONMENTAL ENGINEERING

*A student at BEED explains how a water grill innovated at the Department works*

*Name of Lecturer/Authors:* **G. M. Ndegwa** and I. Kiiru.
*Title of Publication:* Investigations on soil and water quality as affected by in Turkana District, Kenya.

*Abstract:* Irrigation technology can ensure food security in arid and semi-arid regions. However, its adoption requires efficient systems that ensure sustainable agricultural production. The aim of this study was to investigate soil and water quality as affected by irrigation in the Turkwel Scheme of the semi-arid Turkana District of Kenya. Soil samples were collected spatially and with depth from intensively, moderately and non-irrigated fields and analysed for physical and chemical properties. Irrigation and ground waters were also collected and analysed for quality determination. Phreatic water levels of shallow wells were determined through inspection pits and open shallow wells dug in the scheme. Results of non-irrigated fields indicated a non-saline soil surface with ECe of 1.31 ds/m, which turned saline at depth of 0.20 m with ECe of 5.57 ds/m, indicating salt deposits at this depth. Periodically irrigated fields were strongly saline on the soil surface with ECe of 8.86 ds/m, but decreased to non-saline level of 3.41 ds/m at 0.40 m. However, intensively irrigated fields had low salinity with depth due to frequent leaching of salts. Irrigation and groundwater were of acceptable quality with ECw of 0.13 and 0.33 ds/m, while sodicity hazard

was low at SAR of 1.50 and 3.89, respectively. Water table depth had risen from about 1.80 m to 0.70 m from the soil surface between 1982 and 2006, respectively. Soil salinisation in non-irrigated and periodically irrigated fields was therefore attributed to direct phreatic evapotranspiration. Leaching of salts from the root zone, lowering the water table through drainage, and shortening the long fallow period through agronomic practices such as growing drought-resistant vegetable crops can mitigate this land degradation. These would improve food security and living standards of farmers in the scheme. Key words: Irrigation, soil salinisation, water quality, food security, sustainability

*Name of Journal/Conference Proceedings/Workshop:* Journal of Agriculture, Science and Technology, Volume 12 (1).
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **J. M. Gathenya,** P. K. Kinyari and P. G. Home.
*Title of Publication:* Domestic roof rainwater harvesting tank sizing calculator and nomograph.

*Abstract:*

The importance of roof rainwater harvesting as strategy to meet domestic water demand and to reduce run-off in built-up areas is growing worldwide. Indicators that measure the performance of rainwater harvesting systems have been developed. One such indicator is reliability, which is dependent on the rainfall and water consumption patterns, tank size and effective roof area. A good design should aim at highest reliability at the lowest cost. The aim of this study was to develop a tool that can aid decision making with regard to a question such as 'What size of tank should be installed in a specific location to provide V litres of water per day and with a reliability of R%?'A computer-based calculator that accounts for tank inflow and outflow and computes system reliability based on monthly rainfall data, effective roof area, daily water consumption and tank size was developed. Based on the results of the calculator, a nomograph for a reliability of 67% was developed. The nomograph can be used to optimally size rainwater harvesting systems in situations where water users do not have access to computers. This tool can be employed by water users to decide on the configuration of tank size and effective roof area that meets the required daily water consumption rate at 67% reliability for a specific location. Nomographs of different reliabilities can be developed based on the rainfall data in the calculator. The higher the reliability, the greater the investment costs in water storage and roof area. However these nomographs can only be used for areas for which the rainfall data used in the calculator is representative. Hardware dealers selling rainwater tanks or contractors in building industry can use it to advice customers on the size of tank to buy or construct. Key words: Domestic rainwater harvesting, reliability, calculator, nomograph.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.
*Name of Lecturer/Authors:* **J. T. Makanga**, V. M. Salokh and D. Gee-Clough.
*Title of Publication:* Deformation and force characteristics caused by inclined tines in loam soil with moisture content below liquid limit.

*Abstract:* Deformation and force characteristics caused by flat rigid tines (inclined at an angle of 500 to the horizontal soil surface) in loam soil with moisture content below the liquid limit were studied using a glass-sided soil bin. The tines moved in the soil bin in a quasi-static speed and the soil deformation was observed through the glass side of the soil bin. Strain gauge bonded L- shaped force transducers were used in recording soil forces. Three moisture content levels (viz 5.2%, 21% and 33.5% (d.b.)) were used. The results obtained indicated that soil deformation and force characteristics for loam soils are greatly affected by variations in soil moisture content. For 5.2% and 21% soil moisture contents, deformation patterns were progressive shear types. Soil forces for these moisture content levels were cyclic in nature and generally did not differ in magnitude. The deformation process was in regular cycles resulting in corresponding periodic variations in the soil reactions on the tines. There were no distinct zones as described in the passive soil pressure theory. Plastic type of soil deformation was observed in 33.5% soil moisture content with comparative high corresponding soil forces whose periodicity died off. Key words**:** Deformation, force characteristics, inclined tines, soil moisture

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **D.M. Mburu**, F.K. Lenga and M.W.K. Mburu.
*Title of Publication:* Assessment of maize yield response to nitrogen fertiliser in two Semi-Arid Areas of Kenya with similar rainfall pattern.

*Abstract:* Five maize varieties were evaluated for two seasons in two -arid areas of Kenya; at Jomo Kenyatta University of Agriculture and Technology (JKUAT) Farm and at Longonot, in Naivasha Division. Three of the maize varieties were imported, and the other two were locally produced. Nitrogen fertiliser was applied as urea at 0 and 36 kg N/ha; the latter was split applied in equal quantities at 20 and 40 days after emergence. The experimental design was a randomised complete block laid as split plot and replicated three times. The fertilizer and maize variety were main plots and sub-plots respectively. The phenological, biomass accumulation and grain yield data were analysed using Genstat Version 6.1 software. There were no significant differences in grain yield among the varieties between the sites within season but there were grain yield differences between the sites and seasons. Grain yield response to nitrogen fertiliser was significant only at JKUAT in 2004, where there was some rainfall received during the reproductive phase. Water use efficiency was 60% higher at JKUAT than at Longonot possibly due to high evaporation rate at Longonot and late season drought. Key words: Maize variety, nitrogen, water use efficiency, semi-arid, Kenya.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **W. Kaluli**, H. M. Mwangi and F. N. Sira.
*Title of Publication:* Sustainable solid waste management strategies in Juja, Kenya.

*Abstract:* Integrated solid waste management includes source reduction, source separation, recycling and reuse as well as materials recovery. The waste materials that remain should be safely disposed into a sanitary landfill. Up to 2010 when this study was done, no Kenyan city had a sanitary landfill and solid waste piles along inner city streets was a common sight in Nairobi. This study found that the solid waste in Juja consisted of 80% food and other organic wastes, 10% plastics, 2% metal and glass, and 3% mixed refuse. The waste had a very low level of toxic substances. The majority of the households produced less than 3 kg per day, which translated to less than 0.5 kg/person/day. JKUAT-SWMM, a solid waste management model developed in this study, suggested that if 25% of the population would do composting using household compost digesters of 288 L, the area of a disposal site required for 1 million people would be 16 ha. The identified site was on fallow land that received an annual rainfall of 600-800 mm. A waste disposal facility in Juja Farm could cater for most of the towns in the area of interest, including Juja, Mangu, Kimunyu, Gatundu, Thika, Ruiru and Kahawa. The landfill would be accessible to institutions such as Jomo Kenyatta University of Agriculture and Technology in Juja, Mount Kenya University in Thika, Kilimambogo Teachers' College in Kilimambogo, and numerous secondary schools in the area. Key words: Sustainable, solid waste management, Juja.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **J. W. Kaluli**, C. Githuku, P. Home and B. M. Mwangi.
*Title of Publication:* Towards a national policy on wastewater reuse in Kenya.
*Abstract:* Kenya is a water-scarce country with the capital city, Nairobi, receiving less than 100 l/capita/day. Potable water for irrigation and industrial use is generally unavailable, and this calls for alternative water sources. Despite use of wastewater being illegal in Kenya, it is used to irrigate over 720 ha in Nairobi. In order to justify the formulation of a national policy to support wastewater reuse, secondary data which included the authors' previous work was reviewed. In a study done between 2006 and 2007, the levels of nitrates (100 mg/l) and TDS (630 mg/l) in the wastewater were found to be within the acceptable NEMA standards. The concentration of lead was 0.1 mg/lwhile cadmium and chromium were non-detectable. However, levels of BOD and Coliform bacteria were higher than NEMA limits. This implied that Nairobi sewage needed to be treated for the removal of BOD, turbidity and microbial contamination. In order to allow for safe use of wastewater in Kenya, there is need to formulate a national wastewater reuse policy which provides guidelines for maximum allowable levels of pesticides, herbicides, and heavy metals in wastewater reuse. Such a policy should also indicate the required water quality monitoring frequency for faecal indicators (Escherichia coli, faecal coliforms, enterococci), and suggest the maximum allowable concentration of nutrients (nitrogen and phosphorus) which may are usually abundant in wastewater. Key words: National policy, policy, wastewater,

reuse, Kenya.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Muriuki, A. W**., Gathenya, M. and Kaluli, W.
*Title of Publication:* The role of agroforestry in Semi-Arid Eastern Kenya: The case of Kaiti Watershed.

*Abstract:* Kaiti watershed is located in Makueni District in Kenya's Eastern Province. Covering 660 km2, and spanning over five administrative divisions (Kilungu, Kee, Kalama, Kaiti and Wote), this semi-arid sub-catchment of the Athi River basin receives <500 mm rainfall annually, usually falling over a few days, so droughts are frequent and household water and food shortages widespread. Agriculture, the main source of livelihood for residents, is constrained by a myriad of problems including diminishing land holdings, drought, declining soil fertility, soil erosion, elevated termite activity, distant markets and low disposable incomes. In a project that assessed water supply with a view to improving its management for domestic use and agricultural production, one objective was to investigate how farmers had integrated agroforestry into farming. The survey found agroforestry to be widespread, but mainly concentrated in the wetter Kaiti and Kilungu Divisions. Most trees were grown along hedges or interspersed between crops. Fruit trees were preferred over other tree types. Avocado (68%) and mango (68%) were more widely grown than citrus (16%), papaya (13%), or indigenous fruit trees like loquats, guava, custard apple and croton (<5% each). The most popular non-fruit trees were eucalyptus (27%), Grevillea spp (24%) and neem (21%) but cypress, red pod terminalia, cedar, acacia, wattle and pine were also present. Residents preferred multipurpose trees and used them for food (84%), fuel (83%), construction (38%), bee-keeping (5%), fencing (29%), medicine (3%) and soil fertility improvement (19%). Most residents grew trees on-farm for subsistence, because earnings from this enterprise were low (<KSh 5000 yr-1) and relied mostly on themselves for information. Future efforts should focus on growing indigenous fruit trees to enhance food security, mitigate the impacts of climate change and generate income. Keywords: agroforestry, multipurpose trees, income generation, Information sources.

*Name of Journal/Conference Proceedings/Workshop:* 5th JKUAT Scientific, Technological and Industrialization Conference 2010.
*Year of Publication:* 2010.
*Name of Lecturer/Authors:* **C.Ngeera**, J.M Gathenya and P.G Home.
*Title of Publication:* Trends, Rates, Causes and Impacts of Land Use/Cover Changes in River Buathonaro Catchment in Meru County, Kenya.

*Abstract:* Land use/cover (LUC) changes are important processes affecting both natural and human environment through many ecological and socio-economic impacts. LUC information provides means of discerning and analyzing geospatial relationships between the socio-economic trends, change drivers, and impacts on the environment. The rates and trends of LUC changes in River Buathonaro catchment were analyzed from orthorectified multi-

temporal Landsat imageries of 1979 and 2000.The images were classifies into four broad LUC classes using supervised classification method. The results show in the period 1979-2000, forests reduced by 33%, agriculture increased by 11 %, open woodland/pasture and built-up area increased by 14% and 8% respectively.The major driving forces for LUC change were found to be agricultural expansion, deforestation, infrastructural development driven by economic, demographic and social/ cultural factors. The major environmental degradation in the catchment attributable to LUC changes include loss of wetlands and springs of the catchment.The two main wetlands in the Athindi and Mporoko have been converted into agriculture. Sixty per cent of the original 60 acres of Athindi is now under agriculture, while only fifty per cent of the 130 acres of Mporoko is natural habitat. Currently out of the fifty nine permanent springs in 1979 only thirty two are remaining. Soils degradation is now on increase, as evidenced by erosion and formation of deep. In light of the deteriorating environmental conditions, especially declining water resource in the catchment, there is an urgent need to halt the environmental degradation and destruction. Keywords: Land use/cover, Buathonaro catchment, Remote Sensing, LandSat images, Change detection, Kenya.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **C.Ngeera**, J.M Gathenya and P.G Home.

*Title of Publication:* Participatory mapping of historical changes of water resources in the River Buathonaro catchment in Meru County, Kenya.

*Abstract:* The historical changes of water resources in River Buathonaro catchment were investigated using participatory GIS and local historical knowledge of Water Resource Users Association (WRUA) of the catchment. The study mapped and characterized all the springs and streams in the catchment, indicating their status as either permanent, seasonal or completely dry. The time periods when the status changed were also noted. Between 1970 and 2007 seventeen springs and five streams completely dried up. Currently, only thirty two out of fifty nine springs in the 70s are flowing permanently. These results were presented as time series maps and databases showing the changes. Through the involvement of WRUA as co-investigators, the knowledge generated by the research is appropriated at the local level. This in line with the Water Act 2002, which elucidates the need for active involvement of local communities in accounting and managing local water resources. The output of this work illustrated a constructive blend of authors' knowledge of catchment and the local community detailed knowledge of local hydrology. The study findings elicit various policy interventions and the need for further research. Key Words: PGIS, Buathonaro catchment, historical knowledge, water resources, Kenya.

*Name of Journal/Conference*

*Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **E. K. Ronoh**, C. L. Kanali, J. T. Mailutha, D.Shitanda.

*Title of Publication:* Thin layer drying characteristics of amaranth grains in a natural convection solar tent dryer.

*Abstract:* Harvesting of amaranth grains is done at moisture content of about 30% dry basis (d.b) which requires necessary artificial drying to safe storage moisture level. A natural convection solar tent dryer would be a useful drying technique for safe preservation of these grains. The study aimed at determining thin layer drying characteristics of amaranth grains in this type of dryer. Initially, temperature distribution in the dryer was evaluated using nine discrete points spread in two planes (Planes 1 and 2). Planes 1 and 2 were set at 0.75 and 1.5 m above the concrete base of the dryer. The drying characteristics were determined by drying the grains at two levels (Layers 1 and 2) in the dryer. The control treatment involved drying the grains in the open sun. The mean temperatures and standard deviations for Plane 1 ranged from 38.2–38.40C and 6.8–7.30C, respectively. The corresponding values for Plane 2 were in the range of 38.8–39.20C and 6.6–6.90C, respectively. At 5% level of significance, there was no significant difference in temperature distribution within and between the planes. Further, the grains dried in the dryer attained an equilibrium moisture content of 7% d.b from an initial value ranging from 61.3–66.7% d.b after 4.5 hours of drying as opposed to 7 hours for the open sun. The effective moisture diffusivity of the grains ranged from 5.49×10-12–6.20×10-12 m2/s. The findings demonstrate the potential of natural convection solar tent dryers in enhancing drying of amaranth grains in vertical layers. Key words: Solar tent dryer, thin layer, amaranth grains, temperature, moisture diffusivity.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **John Mogaka Nyagwencha**, James Wambua Kaluli, Patrick Home and Murage Hunja.

*Title of Publication:* Access to safe drinking water and water-borne diseases Masaba North District, Kenya.

*Abstract:* Consumption of contaminated water is a major cause of illness in the world and particularly in rural communities, especially in developing countries like Kenya. The objectives of this research were to evaluate access to safe drinking water, water purification techniques and water-borne disease incidence in Masaba North District. Some 100 households were randomly selected with structured interview questions being administered to 25 households in each of the four divisions in the District. Water testing was carried out in a make-shift laboratory using the Oxfam DelAgua kit to determine the number of E. coli colony

forming unity (CFU) per 100ml while a Hach Turbidimeter was used to measure water Turbidity. A high percentage of the households have access to 'improved' water sources including protected springs (79%) with 64% of the households boiling their water before consumption. However, water from "protected sources" is not necessarily safe for drinking. Only 17% of the households had access to water free from fecal contamination. The most effective method of purification was Biosand filtration which provided 57% reduction in turbidity and 92% reduction in E. coli. Out of the 100 households, 20 households indicated that at least one member of the household had suffered from water-borne diseases in the past year. Whereas many households can easily access improved water sources, access to safe drinking water is still a major challenge. There is inconsistent and inadequate utilization of water purification techniques leading to consumption of contaminated water even after purification has been carried out. Key words: Water treatment, Boiling, Chlorination, Biosand filtration, Solar disinfection.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **James Wambua Kaluli**, Cecilia Wageci and Patrick Home.

*Title of Publication:* Surface water quality in Kenya's urban environment: Githurai Case Study.

*Abstract:*

Safe, clean drinking water and sanitation facilities are key to economic development and public health in Kenya. Rapid urbanization and population growth mean worsening conditions for millions of Kenyans, especially the poorest. Sanitation is one of the greatest problems especially in the informal settlements where 60% of the people in the urban centers reside. In fact, 50% of all preventable illnesses in Kenya are water, sanitation and hygiene related. This study was done to establish the level of indicator water quality parameters, and establish water borne disease prevalence in Githurai and adjacent communities. Water samples were collected from 6 points distributed uniformly along Kiu River in Githurai. Using standard methods, the samples were analyzed for Dissolved Oxygen (DO), BOD, TSS and TDS in the JKUAT environmental laboratory. A survey was also done in Githurai, Kahawa Sukari and Kahawa Wendani to establish the prevalence of water borne diseases. Data was collected from local medical clinics and Ruiru District Public Health Office. Randomly selected individuals were also interviewed to establish the frequency of visits to health facilities. The study revealed that dissolved oxygen in surface water was between 1.5 and 8.5 mg/L while biochemical oxygen demand (BOD) was between 200 and 400 mg/L. This was much higher than NEMA standards for surface water which demand that the BOD of any effluents to be discharged into surface water should be less than 30 mg/L. Total suspended solids (TSS) varied from 900 to 950 mg/L. NEMA allows domestic water not to have TSS of more than 30 mg/L. Total dissolved solids (TDS) were in the range of 3000 to 9000

mg/L compared to a maximum of 1200 mg/L which is allowed by NEMA. Surface water in Githurai is highly polluted and poses public health risks. Some 30-40% of all patients visiting hospitals in the study area suffered from diarrheal diseases and the average resident in Githurai was treated for water borne diseases once every three months. Therefore, an urgent intervention is required to clean up Kiu River and stop further contamination of the river. Key Words: Sanitation, informal settlement, water quality, BOD, TSS, TDS.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **J.T. Makanga.**

*Title of Publication:* Deformation and force characteristics caused by inclined tines in loam soil below liquid limit.

*Abstract:*

One of the methods of reducing costs in tillage is through efficient design of tillage tools. These tools have for a long time been designed on trial and error basis as the soil-tool interactions involved have not been well defined and quantified. Classical soil mechanics theories have extensively been used in various attempts to study soil-tool interactions and predict tool forces. Soil-tine interactions in other types of soils indicated some results which necessitated the undertaking of related research in loam soils. Studies were conducted in a glass-sided laboratory soil bin. Soil deformation patterns were analysed for failure angle, soil wedges and forward rupture and surcharge profiles. They were also observed for purposes of correlation with the corresponding soil reactions. Forward rupture profiles were determined by using two parallel scales and a measuring scale while soil surcharge profiles were determined with the use of a three-way coordinate measuring system. Soil reactions (horizontal and vertical) from two identical tines (glass-sided and central) were measured by L-shaped force transducers while a ten-turn potentiometer recorded the forward speed. The data was amplified, logged and transferred to a computer for saving and further processing. Observed cyclic variations in the force-time curves of the soil reactions were analysed in terms of wave length, peak to trough ratio and amplitude. The behaviour and magnitudes of forces caused by flat rigid tines (inclined at an angle of 50 deg. to the horizontal soil surface measured in a clockwise direction) in loam soil below the liquid limit were studied using a glass-sided soil bin. The tines were moved in the soil bin in a quasi-static condition and the deformation observed through the glass. Three moisture content levels (5.2%, 21% and 33.5% (d.b.)) were used. The results under the above conditions indicated that soil reactions (horizontal and vertical) were cyclic in nature and in phase as observed from the force-time curves and matched quite well with the soil deformation characteristics. Soil force magnitudes for 5.2% and 21% moisture contents were basically the same in all aspects while those for 33.5% were relatively higher but with dying off cyclicity. Correlation of these

observations with previous research showed that soil moisture content has a strong effect on force deformation and force characteristics. Key words: Deformation, Force, Characteristics, Tines, Loam, Soil, Liquid.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **J.T. Makanga**, D. Shitanda, C. Njoroge and M.G. Ong'era.

*Title of Publication:* Application of renewable energies for storage of horticultural produce in marginal areas of Kenya: the performance evaluation of a prototype solar-charcoal cooler.

*Abstract:* Kenya relies heavily on agriculture for food and employment particularly in the rural areas. It is therefore of great importance that efforts resulting in high agricultural productivity be handled with all the degree of seriousness. Due to the drastic fall in world prices of coffee and tea, there has been a steady shift to horticultural crops production such that the sector is now the second foreign exchange earner after tea. Most of the produce is marketed in many developed countries including Europe and the United States of America. There are however, some serious challenges the sector is facing including lack of ideal facilities for proper storage of perishables and semi-perishables at the farm level in Kenya particularly between harvesting and the time when the crop is accepted by the customer. This has resulted in tremendous losses and loss of morale for the farmers. Simple and effective storage systems should therefore be developed and used to minimize losses thus improving the net returns on farmers. Refrigeration plays an important role in many countries, particularly for the preservation of food, medicine and for air conditioning. Cooling can be provided in different ways. The method adopted in industrialized countries depends heavily on grid electricity, supplied continuously and reliably to every part of the country. Less than 20% of the Kenyan population has access to electricity thus making it not only impossible but also expensive to use cold storage systems at the rural level. Alternative methods are therefore necessary. The main objective of the research was to investigate the possibility of using renewable energies for storage of horticultural produce in marginal areas of Kenya with specific objectives mainly including the development of a prototype solar-charcoal cooler and testing its performance as related to temperature, humidity and products storageability. A prototype solar-charcoal cooler was developed at the Biomechanical and Environmental Engineering Department (BEED), College of Engineering and Technology of the Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya and performance tested. It mainly consisted of two components: A solar air drift which included a solar power driven fan to blow air through the charcoal to facilitate evaporation of water from the charcoal. A cooling chamber which was lined with an aluminium sheet on the inside, charcoal layer on the outside and a water pan at the top for

water supply. The performance of the cooler indicated positive results as regards to ideal parameters affecting produce storage. These parameters mainly included variations in temperature and humidity to levels ideal to product storage. The results also indicated that various fruits and vegetables including paw paws and spinach could be stored in the cooler for longer periods as compared to when they were under ambient conditions. Key words: Renewable, Energies, Storage, Horticultural, Produce, Solar-charcoal, Cooler.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Muraguri Philip, **Thiong'o G.T**., Gathenya J.M. and Olago D.

*Title of Publication:* Study of groundwater quality in Nairobi, Kenya.

*Abstract:*

The objective of the present study was to assess the quality of groundwater in Nairobi to ascertain its quality and compare with World Health Organization (WHO) drinking water standards. Water samples were obtained during the wet and dry seasons from thirty boreholes, distributed in six administrative zones (A to F) of Nairobi. The administrative zones are: Kasarani/ Roysambu area (Zone A), Dagoretti/Kawangware area (Zone B), Embakasi area (Zone C), Karen/Langata area (Zone D), City Centre area (Zone E) and Industrial area (Zone F) according to land use. Physical parameters varied; total dissolved solids; 207-688 mg/L, turbidity; 1.7-19.7 N.T.U., conductivity; 0.32-0.99 µS/cm, temperature; 22.8-27.30C and colour; <5-5 TCU. pH; 5.7-8.8 and chemical parameters also varied; 9.6-44.8 mg/L, Zn; 0.01-0.38, Cd; 0.00-0.03, Cu; 0.0-2.6, Ni; 0.024-0.38, Cr; 0.0-0.49 and Pb; 0.11-0.30, As; 0.00-0.013 and Hg; 0.001-0.003 all in ppm. The parameters that were measured, namely, total dissolved solids (TDS), turbidity, conductivity, pH, as well as the heavy metals Zn, Cd, Cu, Ni, Cr, Pb, As, and Hg all varied widely. TDS, total hardness, Zn and Hg were within the WHO consumers' acceptable limits. The highest pH mean value of 8.75 was recorded from Karen/Langata area. Cu was found to be below detection limit except for two boreholes in industrial area (A.C 29 and F.E.30) which were above WHO limits during the wet season. High levels of Cd and Cr were detected in boreholes in zones A, B and F during the dry season with zone B recording the highest mean value of 0.03±0.01 ppm and 0.49±0.02 ppm of Cd and Cr respectively. Arsenic was within WHO standards for most sampled boreholes except for boreholes E.A.21 and M.W.25 in the city centre. All the sampled boreholes gave high concentrations of Ni during the dry season and Pb during the two seasons which were above WHO drinking water standards. The results suggest that groundwater from Nairobi boreholes need to be treated so that the water could meet WHO drinking water standards. Plain sedimentation or use of cloth/membrane filters may be used remove turbidity while reverse osmosis could be one of the appropriate methods for water treatment that could be used where heavy metals are present. Key words: groundwater

quality, heavy metals, Nairobi, Kenya.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **P.G. Home**, T.N. Njenga, T.G. Kinuthia, E. Kimutai, H. Mango and J.W. Kaluli.

*Title of Publication:* Assessing the efficiency of subsurface constructed wetlands planted with different macrophytes in removing heavy metals from wastewater.

*Abstract:* Municipal effluent is a complex and highly polluted wastewater. The constituents in the waste comprise organic and inorganic materials such as heavy metals. While a conventional treatment system could provide adequate treatment of wastewater, the system is usually costly and complex. Constructed wetlands are potentially good, low-cost and appropriate technological treatment systems for treating heavy metal laden wastewater. This project was undertaken to assess the efficiency of macrophyte plants in removing heavy metal in municipal wastewater using laboratory scale quarry dust vertical constructed subsurface wetlands. Plants used were Typha latifolia, Phragmites australis and Polygonam spp. The control treatment was not vegetated. The parameters evaluated were the concentration of lead, cadmium and zinc in the influent and effluent sewage after different retention periods in the wetland. At the end of experiment the macrophytes were harvested and the concentration of the heavy metals in shoots and roots determined. Polygonam spp. absorbed highest amounts of Zinc while Phragmites australis absorbed the highest amount of lead and cadmium. The roots had a higher concentration of the heavy metals than the shoots. Planted beds differed in the removal rates of the heavy metals which were found to be dependent on the plant species.

The percentage removal of the heavy metals from the raw sewage by the vegetated system was 87%, 83% and 84% for lead, cadmium and zinc respectively after a retention period of 8 days. The control surprisingly showed a percentage removal in excess of 60%, indicating that the removal of heavy metals was mainly accomplished by the quarry dust medium. The concentrations of the three heavy metals in the effluent sewage were all below the maximum allowable concentrations for discharge into the environment. The constructed wetlands were therefore effective in reducing the heavy metals concentrations from the raw sewage to tolerable levels. Key words: constructed wetlands, wastewater, macrophytes, heavy metals, quarry dust.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Riungu N. J., **Hesampour M.**, Pihlajamaki A., Manttari M., Sirén H., Home P. G., Ndegwa G. M.

*Title of Publication:* Investigating removal of pesticides from water by nanofiltration membrane technology.

*Abstract:* Agricultural activities form the backborne of Kenya´s economy. Inorder to control crop losses, pesticides are used and in the recent past, more of the pesticides have been used to increase production. However, the effect of pesticides on the environment is very complex as undesirable transfers occur continually among different environmental sections. This eventually leads to contamination of drinking water source especially for rivers, lakes located near active agriculture areas such as flower farms around Lake Naivasha where poisoning of lake water by pesticides caused fish deaths whose impact was felt in the whole country. The aim of this paper was to investigate application of nanofiltration membrane technology in the removal of pesticide from water. A pesticide, atrazine was selected for the study to to its extensive in controlling weeds and the adverse environmental effects associated with it. Membrane filtration was used using a laboratory scale crossflow filtration units that operated in total recycle mode to ensure even concentration of atrazine in the feed solution to seperate atrazine form water. Concentration of atrazine in aqueous solution was analyzed using high performance liquid chromatography (HPLC). Retention of atrazine by four nanofiltration membranes i. e. NF90, NTR7250, and NF270 was investigated. Effect of feed solution pH, concentration and feed pressure were also investigated. Of concern also was the effect of humic substances and titanium dioxide catalyst on retention by membranes. pH and feed pressure showed influence on retention of atrazine while initial feed concentration had little influence. The presence of HA led to improved atrazine rejection efficiency but led to flux decline on all membrane tested while TiO2 led to high rejection efficiency and low flux decline. Of all four membranes, NF90 showed the best performance in retention of atrazine in water while NTR7250 showed the least. This indicated thatWith proper membrane selection, its possible to treat water contaminated with pesticides to acceptable levels.
Key words; Pesticides, Nanofiltration, Membranes, Retention.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **S.N. Kang'au**, P.G.Home, J.M.Gathenya.

*Title of Publication:* Performance and Economic Evaluation of Pumped Irrigation System: A case of smallholder horticultural farmers.

*Abstract:* Irrigated agriculture is a vital component of total agriculture and supplies many of the fruits, vegetables, and cereal foods consumed by humans; the grains fed to animals that are used as human food; and the feed to sustain animals for work in many parts of the world. Kenya's agricultural sector is on an upward trend with the recent increase in irrigation practices which has been promoted by the rapid increase in growth of the horticultural industry. The objectives of this paper are (i) To evaluate the technical performance of the pumps used in

smallholder irrigated agriculture, (ii) To study the energy uses during pumping and identify the possible causes of inefficient energy use, (iii) To evaluate the costs of pumping particularly fuel used during irrigation. Observational study to identify occurrence of pumped irrigation systems in Kakuzi division and Yatta division was done. Semi structured questionnaires were administered to 80 respondents in the study areas to investigate the challenges of pumped irrigation as well as find the socio-economic status of the people and the agricultural practices carried out. A detailed study was carried out on 10 different pumps during irrigation to evaluate their efficiency as well as energy uses. The results showed that numerous challenges faced smallholder pumped irrigation systems some of which are irrigation component selection, design and operation as well as irrigation water management. 60% of the pumps evaluated operated below the recommended design efficiency. The pumps further showed different fuel consumption rates, while the cost of fuel used to irrigate1 hectare of land varied for all the 10 pumps assessed. The lowest and highest fuel consuming pump used fuel valued at 350ksh/ha and 8,426 ksh/ha respectively. The huge difference is as a result of several factors such as pump consumption rate, farmer's irrigation timing among others. The result therefore means that some enterprises made huge profits while others operated at marginal profits or no profit at all. Without proper selection of the irrigation equipments, poor designs as well as lack of operational and management skills, the farming enterprises can be rendered uneconomical. With diminishing natural resources, increased need for irrigation, rising in energy/fossil fuels costs, the cost of production is envisaged to rise. This calls for embracing of the engineering, agronomic as well as management techniques at farm level in order to ensure sustainability of irrigated agriculture as well as enhance its economic viability. The study therefore recommends a thorough evaluation of smallholder irrigation system improvement possibilities to enhance increased profits as well as ensure sustainability. Keywords— Pump performance, Economic evaluation, Pumped irrigation, Kenya.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* G.M. Kituu, D. Shitanda, **C.L. Kanali**, J.T. Mailutha, C.K. Njoroge, J.K. Wainaina and V.K. Silayo.

*Title of Publication:* Thin layer drying model for simulating the drying of Tilapia fish (*Oreochromis niloticus*) in a solar tunnel dryer.

*Abstract:* Mathematical models for predicting the plenum chamber temperatures developed by a solar tunnel dryer and the drying of Tilapia fish (*Oreochromis niloticus*) in the solar tunnel dryer was developed, and simulated in Visual Basic 6 (Microsoft Visual Basic 6.0™). Based on Student's *t*-test, the simulated and actual data for both plenum chamber temperature and moisture ratio did not differ significant at 5% level of significance. In addition,

the simulated and actual moisture ratios showed similar trends, and reduced exponentially with drying time. Further, the performances of models at 10% residual error interval were 83% and 81% for plenum chamber temperature and moisture ratio, respectively. Finally, strong linear correlations existed between simulated and actual data for plenum chamber temperature ($R^2$ = 0.961), and for moisture ratio ($R^2$ = 0.995). Therefore, the model can be used to predict the drying of Tilapia fish in a solar tunnel dryer. Copyright ©

*Name of Journal/Conference Proceedings/Workshop:* Journal of Food, Engineering. Vol. 98, Number 3. June, 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* G.M. Kituu, D. Shitanda, **C.L. Kanali**, J.T. Mailutha, C.K. Njoroge, J.K. Wainaina and V.K. Silayo.
*Title of Publication:* A Simulation Model for Solar Energy Harnessing by the Tunnel Section of a Solar Tunnel Dryer.
*Abstract:* Models were developed to predict global solar radiation and the energy harnessed by a solar tunnel dryer, and simulated in Visual Basic 6. In addition, the simulated data were compared with actual data. Using a 10% absolute residual error interval, the developed model achieved 78.4% and 83.3% performance for global solar radiation and energy harnessing, respectively. Further, the relationship between global solar radiation and the ten year mean satellite solar radiation, and that between the actual and simulated plenum chamber temperatures were linear, with coefficients of determination ($R^2$) of 0.788 and 0.962. Thus, there is the existence of a strong correlation between satellite and predicted global solar radiation, and between predicted and actual plenum chamber temperatures. Furthermore, Student's t-test did not show any significant difference between simulated and actual data for solar radiation and energy harnessing. Finally, this study shows that the developed model can be used to predict solar radiation and the energy harnessed by the solar tunnel dryer. Copyright ©

*Name of Journal/Conference Proceedings/Workshop:* Agricultural Engineering International: the CIGR Ejournal. Manuscript 1553. Vol. XII. January, 2010.
Year of Publication: 2010.

*Name of Lecturer/Authors:* E.K. Ronoh, **C.L. Kanali**, J.T. Mailutha and D. Shitanda.
*Title of Publication:* Thin layer drying characteristics of amaranth grains in a natural convection solar tent dryer.
*Abstract:* In this study, a natural convection solar tent dryer was used to analyze thin layer drying characteristics of amaranth (Amaranthus cruentus) grains. Initially, temperature distribution in the dryer was evaluated using nine discrete points spread in the two planes, Planes 1 and 2. Planes 1 and 2 were set at 0.75 and 1.5 m above the concrete base of the dryer. The thin layer drying characteristics were determined by drying the grains at two levels (Layers 1 and 2) in the dryer. The control treatment involved drying the grains in the open sun. The mean temperatures and standard deviations for Plane 1 ranged from 38.2–38.4°C and 6.8–7.3°C,

respectively. The corresponding values for Plane 2 were in the range of 38.8–39.2°C and 6.6–6.9°C, respectively. At 5% level of significance, there was no significant difference in temperature distribution within and between the planes. Further, the grains dried in the dryer attained an equilibrium moisture content of 7% dry basis (d.b) from an initial value ranging from 61.3–66.7% d.b after 4.5 hours of drying as opposed to 7 hours for the case of open sun drying. There was no significant difference between the drying rates for grains dried on Layers 1 and 2. The effective moisture diffusivity of the grains in Layer 1, Layer 2 and the open sun were $5.88\times10^{-12}$, $6.20\times10^{-12}$ and $5.49\times10^{-12}$ m²/s, respectively. These findings demonstrated the potential of applying natural convection solar tent dryers to enhance harnessing of solar energy for drying amaranth grains in vertical layers. Copyright ©

*Name of Journal/Conference Proceedings/Workshop:* The Kenya Journal of Mechanical Engineering. Vol. 6, Number 2. September, 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* E.K. Ronoh, **C.L. Kanali**, J.T. Mailutha and D. Shitanda.

*Title of Publication:* Thin layer drying characteristics of amaranth grains in a natural convection solar tent dryer.

*Abstract:*

An experimental solar tent dryer under natural convection was used to study thin layer drying kinetics of amaranth (*Amaranthus cruentus*) grains. Drying of grains in the dryer was carried out on the drying rack having two layers; top and bottom. The ambient temperature and relative humidity ranged from 22.6–30.4°C and 25–52%, respectively, while the inside temperature and relative humidity in the solar dryer ranged from 31.2–54.7°C and 22–34%, respectively. Freshly harvested amaranth grains with an average moisture content of 64% (dry basis) were dried under a solar tent dryer for seven hours to a final moisture content of 7% (dry basis). A non-linear regression analysis was used to evaluate six thin layer drying models (viz., Newton, Page, Modified Page, Henderson & Pabis, Logarithmic and Wang & Singh) for amaranth grains. The models were compared using coefficient of determination ($R^2$), root mean square error (RMSE), reduced chi-square ($\chi^2$) and prediction performance ($\eta_p$) in order to determine the one that best described thin layer drying of amaranth grains. The results show that the Page model satisfactorily described the drying of amaranth grains with $R^2$ of 0.9980, $\chi^2$ of 0.00016 and RMSE of 0.01175 for bottom layer and $R^2$ of 0.9996, $\chi^2$ of 0.00003 and RMSE of 0.00550 for top layer of the drying rack. Based on a ±5% residual error interval, the Page model attained the highest prediction performance ($\eta_p$ = 80%) when drying the grains in both layers of the dryer. This shows that there was a good agreement between the predicted and experimental moisture changes during solar drying of amaranth grains under natural convection. The transport of water during dehydration was described by applying the Fick's diffusion model and the effective moisture diffusivity for solar tent drying of amaranth grains was found to be $5.88\times10^{-12}$ $m^2s^{-1}$

at the bottom layer and $6.20\times10^{-12}$ $m^2s^{-1}$ at the top layer. High temperatures developed at the top layer of the dryer led to high effective moisture diffusivity and this showed that temperature strongly influences the mechanism of moisture removal from the grains. Copyright ©

*Name of Journal/Conference Proceedings/Workshop:* African Journal of Food, Agriculture, Nutrition and Development. Vol. 10, Number 3. March, 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **E.K. Ronoh**, C.L. Kanali, J.T. Mailutha and D. Shitanda.

*Title of Publication:* Thin layer drying characteristics of amaranth grains in a natural convection solar tent dryer.

*Abstract:* In this study, a natural convection solar tent dryer was used to analyze thin layer drying characteristics of amaranth (Amaranthus cruentus) grains. Initially, temperature distribution in the dryer was evaluated using nine discrete points spread in the two planes, Planes 1 and 2. Planes 1 and 2 were set at 0.75 and 1.5 m above the concrete base of the dryer. The thin layer drying characteristics were determined by drying the grains at two levels (Layers 1 and 2) in the dryer. The control treatment involved drying the grains in the open sun. The mean temperatures and standard deviations for Plane 1 ranged from 38.2–38.4°C and 6.8–7.3°C, respectively. The corresponding values for Plane 2 were in the range of 38.8–39.2°C and 6.6–6.9°C, respectively. At 5% level of significance, there was no significant difference in temperature distribution within and between the planes. Further, the grains dried in the dryer attained an equilibrium moisture content of 7% dry basis (d.b) from an initial value ranging from 61.3–66.7% d.b after 4.5 hours of drying as opposed to 7 hours for the case of open sun drying. There was no significant difference between the drying rates for grains dried on Layers 1 and 2. The effective moisture diffusivity of the grains in Layer 1, Layer 2 and the open sun were $5.88\times10^{-12}$, $6.20\times10^{-12}$ and $5.49\times10^{-12}$ $m^2/s$, respectively. These findings demonstrated the potential of applying natural convection solar tent dryers to enhance harnessing of solar energy for drying amaranth grains in vertical layers. Copyright ©

*Name of Journal/Conference Proceedings/Workshop:* The Kenya Journal of Mechanical Engineering. Vol. 6, Number 2. September, 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* E.K. Ronoh, **C.L. Kanali**, J.T. Mailutha and D. Shitanda.

*Title of Publication:* Thin layer drying characteristics of amaranth grains in a natural convection solar tent dryer.

*Abstract:* An experimental solar tent dryer under natural convection was used to study thin layer drying kinetics of amaranth (*Amaranthus cruentus*) grains. Drying of grains in the dryer was carried out on the drying rack having two layers; top and bottom. The ambient temperature and relative humidity ranged from 22.6–30.4°C and 25–52%, respectively, while the inside temperature and relative humidity in the solar dryer ranged from 31.2–54.7°C and 22–34%, respectively. Freshly harvested amaranth grains with an average moisture content of 64% (dry basis) were dried

under a solar tent dryer for seven hours to a final moisture content of 7% (dry basis). A non-linear regression analysis was used to evaluate six thin layer drying models (viz., Newton, Page, Modified Page, Henderson & Pabis, Logarithmic and Wang & Singh) for amaranth grains. The models were compared using coefficient of determination ($R^2$), root mean square error (RMSE), reduced chi-square ($\chi^2$) and prediction performance ($\eta_p$) in order to determine the one that best described thin layer drying of amaranth grains. The results show that the Page model satisfactorily described the drying of amaranth grains with $R^2$ of 0.9980, $\chi^2$ of 0.00016 and RMSE of 0.01175 for bottom layer and $R^2$ of 0.9996, $\chi^2$ of 0.00003 and RMSE of 0.00550 for top layer of the drying rack. Based on a ±5% residual error interval, the Page model attained the highest prediction performance ($\eta_p$ = 80%) when drying the grains in both layers of the dryer. This shows that there was a good agreement between the predicted and experimental moisture changes during solar drying of amaranth grains under natural convection. The transport of water during dehydration was described by applying the Fick's diffusion model and the effective moisture diffusivity for solar tent drying of amaranth grains was found to be $5.88\times10^{-12}$ $m^2s^{-1}$ at the bottom layer and $6.20\times10^{-12}$ $m^2s^{-1}$ at the top layer. High temperatures developed at the top layer of the dryer led to high effective moisture diffusivity and this showed that temperature strongly influences the mechanism of moisture removal from the grains. Copyright ©

*Name of Journal/Conference Proceedings/Workshop:* African Journal of Food, Agriculture, Nutrition and Development. Vol. 10, Number 3. March, 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **J.M. Gathenya**, H. Mwangi, R. Coe and J. Sang.

*Title of Publication:* Climate- and land use-induced risks to Watershed services in the Nyando river basin, Kenya.

*Abstract:*

Climate change and land use change are two forces influencing the hydrology of watersheds and their ability to provide ecosystem services, such as clean and well-regulated stream flow and control of soil erosion and sediment yield. The Soil Water Assessment Tool, SWAT, a distributed, watershed-scale hydrological model was used with 18 scenarios of rainfall, temperature and infiltration capacity of land surface to investigate the spatial distribution of watershed services over the 3587 km2 Nyando basin inWestern Kenya and how it is affected by these two forces. The total annual water yield varied over the 50 sub-basins from 35 to 600 mm while the annual sediment yield ranged from 0 to 104 tons ha−1. Temperature change had a relatively minor effect on streamflow and sediment yield compared to change in rainfall and land surface condition. Improvements in land surface condition that result in higher infiltration are an effective adaptation strategy to moderate the effects of climate change on supply of watershed services. Spatial heterogeneity in response to climate and land use change is large, and hence it is necessary to understand it if interventions to modify hydrology or adapt to climate change are to be effective.

*Name of Journal/Conference Proceedings/Workshop:* Experimental Agriculture, Volume 47 (2), pp. 339–356.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **B.M. Mati**, R. Wanjogu, B. Odongo and P.G. Home
*Title of Publication:* Introduction of the System of Rice Intensification (SRI) in Kenya: Experiences from Mwea Irrigation Scheme

*Abstract:* There are various avenues for intensifying agricultural production, the most common being increased use of fertilizers, supplemental irrigation of crops, and adoption of high-yielding varieties. These options are rather widely known to farmers around the world, but they have not been widely adopted by smallholders in sub-Saharan Africa. The low adoption rate is related to complex technical and socio-economic issues, such as poor extension services, lack of capital, failure to mobilize the requisite water, or simply, poverty. The System of Rice Intensification (SRI) is in a special category of innovation in that, farmers stand to gain multiple benefits from its use, including the possibility of increasing rice yields substantially, saving water, and getting better grain quality, by using differently the assets that they already have. A major impediment for the adoption of SRI in Africa has been lack of knowledge about this intervention, especially for farmers already practicing irrigated agriculture. Farmers generally have good business sense and will adopt technologies or practices once the benefits are proven and the risks are seen as minor. SRI should be attractive for these reasons, but there are various issues to be resolved before large numbers of farmers can adopt the method. This paper reports on the steps taken and the technical and socio-economic issues addressed in efforts to introduce SRI and promote it in Kenya, specifically in the Mwea Irrigation Scheme. A diverse set of individuals and institutions in Kenya together embarked on the evaluation and dissemination of SRI methods in this East African country beginning in July 2009. If the new methods can perform in Kenya as in other countries, this will bring much benefit to rice farmers and rice consumers in the region. SRI is coming to Kenya relatively late, as it was the 39$^{th}$ country from which favorable SRI results have been reported. This means that Kenyans can learn from others' experience and evaluations, and there is also now more of a supportive institutional framework. The initial results from on-farm SRI trials have been positive, although not conclusive. They have given impetus to Kenyan farmers and institutions to collaborate within a multi-sectoral, multi-level coalition that has provided an informal, multi-faceted platform for the evaluation, adaptation and dissemination of SRI practices. The initiative in Kenya is now gaining more formal status and more resources. This experience is presented to show the kinds of things that have been and can be done to utilize the SRI opportunity for raising land, labor and water productivity in the rice sector. Key words: Farmer participation; irrigation management; monitoring and evaluation; on-farm trials; profitability; rice yields; System of Rice Intensification; water saving

*Name of Journal/Conference Proceedings/Workshop:* Paddy Water Environment, Vol.9.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **B. M. Mati**, R. Wanjogu, B. Odongo, P. G. Home.
*Title of Publication:* Introduction of the System of Rice Intensification in Kenya: experiences from Mwea Irrigation Scheme.

*Abstract:* There are various avenues for intensifying agricultural production, the most common being increased use of fertilizers, supplemental irrigation of crops, and adoption of high-yielding varieties. These options are rather widely known to farmers around the world, but they have not been widely adopted by smallholders in sub- Saharan Africa. The lowadoption rate is related to complex technical and socio-economic issues, such as poor extension services, lack of capital, failure to mobilize the requisite water, or simply, poverty. The System of Rice Intensification (SRI) is in a special category of innovation in that, farmers stand to gain multiple benefits from its use, including the possibility of increasing rice yields substantially, saving water, and getting better grain quality, using differently the assets that they already have. A major impediment for the adoption of SRI in Africa has been lack of knowledge about this intervention, especially for farmers already practicing irrigated agriculture. Farmers generally have good business sense and will adopt technologies or practices once the benefits are proven and the risks are seen as minor. SRI should be attractive for these reasons, but there are various issues to be resolved before large numbers of farmers can adopt the method. This article reports on the steps taken and the technical and socio-economic issues addressed in efforts to introduce SRI and promote it in Kenya, specifically in the Mwea Irrigation Scheme. A diverse set of individuals and institutions in Kenya together embarked on the evaluation and dissemination of SRI methods in this East African country ginning in July 2009. If the new methods can perform in Kenya as in other countries, this will bring much benefit to rice farmers and rice consumers in the region. SRI is coming to Kenya relatively late, as it was the thirty-ninth country from which favorable SRI results have been reported. This means that Kenyans can learn from others' experience and evaluations, and there is also now more of a supportive institutional framework. The initial results from on-farm SRI trials have been positive, although not conclusive. They have given impetus to Kenyan farmers and institutions to collaborate within a multi-sectoral, multilevel coalition that has provided an informal, multi-faceted platform for the evaluation, adaptation and dissemination of SRI practices. The initiative in Kenya is now gaining more formal status and more resources. This experience is presented to show the kinds of things that have been and can be done to utilize the SRI opportunity for raising land, labor, and water productivity in the rice sector. Keywords Farmer participation, Irrigation management, Monitoring and evaluation. On-farm trials, Profitability, Rice yields, System of Rice Intensification, Water saving.

*Name of Journal/Conference Proceedings/Workshop:* Paddy Water Environment, Vol. 9.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* Martin I. Kamami, George M. Ndegwa, **Patrick G. Home.**
*Title of Publication:* Fuzzy based decision support method for selection of sustainable wastewater treatment technologies.

*Abstract:* Inadequate decision support tools have led to selection of inappropriate wastewater treatment technologies. The objectives of this research were to investigate performance data for wastewater treatment technologies, develop a Decision Support Method (DSM) for evaluating performance of technologies, and to validate the developed method. The method was developed through evaluation of performance of wastewater treatment technologies against environmental and economic indicators. Fuzzy logic techniques in form of linguistic variables were applied in order to support decision making under uncertainty. The DSM relied on performance evaluation in order to rate effectiveness of wastewater treatment technologies. DSM was validated through a training tool in ED-WAVE, a model developed by a consortium of European and Asian countries. The reliance of the DSM on performance evaluation was an improvement on the existing decision support tools such as ED-WAVE that relied on retrieval of past performance data. As DSM integrated environmental and economic factors in evaluating wastewater treatment technologies, it was thus able to select a process that was not only environmentally sustainable but also economically affordable. Keywords: decision support method, wastewater treatment technologies, environmental indicators, performance rating, fuzzy logic, ED-WAVE.

*Name of Journal/Conference Proceedings/Workshop:* International Journal of Agricultural and Biological Engineering, Vol 4(1).
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* Gathenya, J. M., Kinyari, P. G. and **Home, P. G.**
*Title of Publication:* Domestic Roof rainwater Harvesting Tank Sizing Calculator and Nomograph.

*Abstract:* The importance of roof rainwater harvesting as strategy to meet domestic water demand and to reduce run-off in built-up areas is growing worldwide. Indicators that measure the performance of rainwater harvesting systems have been developed. One such indicator is reliability, which is dependent on the rainfall and water consumption patterns, tank size and effective roof area. A good design should aim at highest reliability at the lowest cost. The aim of this study was to develop a tool that can aid decision making with regard to a question such as 'What size of tank should be installed in a specific location to provide V litres of water per day and with a reliability of R%?' A computer-based calculator that accounts for tank inflow and outflow and computes system reliability based on monthly rainfall data, effective roof area, daily water consumption and tank size was developed. Based on the results of the calculator, a nomograph for a reliability of 67% was developed. The nomograph can be used to optimally size

rainwater harvesting systems in situations where water users do not have access to computers. This tool can be employed by water users to decide on the configuration of tank size and effective roof area that meets the required daily water consumption rate at 67% reliability for a specific location.n Nomographs of different reliabilities can be developed based on the rainfall data in the calculator. The higher the reliability, the greater the investment costs in water storage and roof area. However these nomographs can only be used for areas for which the rainfall data used in the calculator is representative. Hardware dealers selling rainwater tanks or contractors in building industry can use it to advice customers on the size of tank to buy or construct. Key words: Domestic rainwater harvesting, reliability, calculator, nomograph.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Agriculture, Science and Technology. ISSN: 1561-7645.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **P.G. Home**, T. Njenga, T. Kinuthia and H. Mango.

*Title of Publication:* Assessing the efficiency of subsurface constructed wetlands planted with different macrophytes in removing heavy metal from wastewater.

*Abstract:* Municipal effluent is a complex and highly polluted wastewater. The constituents in the waste comprise organic and inorganic materials such as heavy metals. While a conventional treatment system could provide adequate treatment of wastewater, the system is usually costly and complex. Constructed wetlands are potentially good, low-cost and appropriate technological treatment systems for treating heavy metal laden wastewater. This project was undertaken to assess the efficiency of macrophyte plants in removing heavy metal in municipal wastewater using laboratory scale quarry dust vertical constructed subsurface wetlands. Plants used were Typha latifolia, Phragmites australis and Polygonam spp. The control treatment was not vegetated. The parameters evaluated were the concentration of lead, cadmium and zinc in the influent and effluent sewage after different retention periods in the wetland. At the end of experiment the macrophytes were harvested and the concentration of the heavy metals in shoots and roots determined. Polygonam spp. absorbed highest amounts of Zinc while Phragmites australis absorbed the highest amount of lead and cadmium. The roots had a higher concentration of the heavy metals than the shoots. Planted beds differed in the removal rates of the heavy metals which were found to be dependent on the plant species. The percentage removal of the heavy metals from the raw sewage by the vegetated system was 87%, 83% and 84% for lead, cadmium and zinc respectively after a retention period of 8 days. The control surprisingly showed a percentage removal in excess of 60%, indicating that the removal of heavy metals was mainly accomplished by the quarry dust medium. The concentrations of the three heavy metals in the effluent sewage were all below the maximum allowable concentrations for discharge into the environment. The constructed wetlands were therefore effective

in reducing the heavy metals concentrations from the raw sewage to tolerable levels. Key words: constructed wetlands, wastewater, macrophytes, heavy metals, quarry dust.

*Name of Journal/Conference Proceedings/Workshop:* 5th JKUAT Scientific, Technological and Industrialization Conference: Scientific Technological and Innovation for Industrialization and sustainable.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **James Wambua Kaluli**, Cecilia Wangechi and Patrick Home

*Title of Publication:* Sustainable Solid Waste Management Strategies in Juja, Kenya.

*Abstract:* Safe, clean drinking water and sanitation facilities are key to economic development and public health in Kenya. Rapid urbanization and population growth mean worsening conditions for millions of Kenyans, especially the poorest. Sanitation is one of the greatest problems especially in the informal settlements where 60% of the people in the urban centers reside. In fact, 50% of all preventable illnesses in Kenya are related to water, sanitation and hygiene. This study was done to establish the level of indicator water quality parameters, and establish water borne disease prevalence in Githurai and adjacent communities. Water samples were collected from 6 points distributed uniformly along Kiu River in Githurai. Using standard methods, the samples were analyzed for Dissolved Oxygen (DO), BOD, TSS and TDS in the JKUAT environmental laboratory. A survey was also done in Githurai, Kahawa Sukari and Kahawa Wendani to establish the prevalence of water borne diseases. Data was collected from local medical clinics and Ruiru District Public Health Office. Randomly selected individuals were also interviewed to establish the frequency of visits to health facilities. The study revealed that dissolved oxygen in surface water was between 1.5 and 8.5 mg/L while biochemical oxygen demand (BOD) was between 200 and 400 mg/L. This was much higher than NEMA standards which demands that the BOD of any effluents to be discharged into the environment should be less than 30 mg/L. Total suspended solids (TSS) varied from 900 to 950 mg/L. NEMA allows domestic water not to have TSS of more than 30 mg/L. Total dissolved solids (TDS) were in the range of 3000 to 9000 mg/L compared to a maximum of 1200 mg/L which is allowed by NEMA. Surface water in Githurai is highly polluted and poses public health risks. Some 30-40% of all patients visiting hospitals in the study area suffered from diarrheal diseases and the average resident in Githurai was treated for water borne diseases once every three months. Therefore, an urgent intervention is required to clean up Kiu River and stop further contamination of the river. Key Words: Sanitation, informal settlement, water quality, BOD, TSS, TDS

*Name of Journal/Conference Proceedings/Workshop:* Journal of Civil Engineering.

*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **U.U. Mutwiwa.**

*Title of Publication:* Environmental challenges hindering certification of small scale coffee farmers in Kenya.

*Abstract:* Coffee is a key industry of Kenya being among the main export earners for the country. Only the Arabica variety is grown in the country and processed using the wet method. Despite the fact that Kenya produces low volumes compared to other countries, the beans are widely sought after because of their high quality. In order to overcome the challenges in today's world coffee market, the emphasis is to move production to higher-value Arabica and branding of the Kenyan coffee. The coffee industry is a mixture of smallholder and large estates. Management systems range from high input intensive systems to smallholders with low inputs and yields. The country has the potential to be a source of high quality Arabica coffee in the world. This may be achieved by enabling farmers to improve quality of both product and services and to develop commercial linkages with reliable and rewarding supply chains. Essential in the concept for bringing quality coffee to premium markets in a reliable and consistent way, is for the producer to be certified for one or more of the standards relevant to the coffee sector. In order to fulfill the requirements of most certification standards e.g. Utz Certified and Fairtrade etc, several cooperative societies in Kenya have to undertake environmental audits. Moreover, it is the general policy of the Government of Kenya through its Environmental Management and Coordination Act (EMCA, 1999) and the Environmental Regulations, (2003) that all existing businesses need to undertake routine environmental auditing exercises. The reports from the audits should be filed with the National Environment Management Authority (NEMA) on an annual basis. It is important to note that these reports should demonstrate continuous improvement and efforts with respect to the efficient utilization of resources and the conservation of the environment. This paper seeks to identify the priority issues that these cooperatives need to address if they have to conform to the provisions of EMCA, 1999. This will put them on a path of continuous improvement, hence successful certification. This paper puts together data collected during environmental audits for coffee cooperative societies in Central and Eastern provinces. The research revealed that most cooperatives have put reasonable efforts to conform to the provisions of EMCA, 1999, and other relevant regulations. However, there is need for the cooperative societies to implement the certain measures in order to meet the emerging environmental challenges identified. In addition, these societies should put in place various programs and activities geared towards increasing productivity while also ensuring environmental protection and workplace safety. Finally, the Societies should embrace good manufacturing practices and internalize them in all their operations. Keywords: Coffee, standards, smallholder, cooperative societies.

*Name of Journal/Conference Proceedings/Workshop:* 10th Horticultural Association of Kenya Workshop.

*Year of Publication:* 2011.

## 3.1 DEPARTMENT OF CIVIL ENGINEERING

*Name of Lecturer/Authors:* H. Godana, J. K. Z. Mwatelah and **Z. C. Abiero-Gary.**

*Title of Publication:* Suitability of calcrete as a road construction material for low volume roads in the arid and semi-arid regions: case study North-Eastern Kenya.

*Abstract:* Gravel materials have to meet the minimum Kenya Road Design Manual (KRDM) Part III specification of grading, plasticity and soaked California Bearing Ratio (CBR) requirements for them to be used for road works in Kenya. Calcrete, which is a gravel material that forms exclusively under arid regions and has different material properties due to its different formation process from the temperate climate soils for which the materials specifications were developed, does not meet these specifications mainly due to high plasticity and low soaked CBR. The main objective of this study was to establish the properties of calcrete materials that relate to their suitability as road construction material. Materials from six sites were subjected to carbonate content test so as to establish if they were actually calcrete and the two material samples (from two of the six sites) with the highest carbonate content selected for further testing. The materials from the two sites were subjected to soil index tests, heavy proctor and CBR tests at different moisture contents under-soaked and unsoaked condition so as to establish the properties of the materials and effect of moisture on their strength. The results obtained indicated that plasticity index results were erratic, while linear shrinkage results were consistent. The CBR value increased by between 100% and 200%, between optimum moisture content (OMC) and dry end moisture content. The study concludes that in the case of calcrete materials, the properties that relate to their suitability as road construction material in the arid regions are linear shrinkage and CBR at the likely in-service moisture content and that a higher degree of compaction be specified in the field and CBR test. Key words: Properties of calcrete, suitability as construction, arid and semi-arid region

*Name of Journal/Conference Proceedings/Workshop:* Journal of Agriculture, Science and Technology, Volume 12 (1).

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **A. O. Mayabi.**

*Title of Publication:* The effect of sawdust as a bulking agent on the in-vessel composting of food waste in a manually-turned drum.

*Abstract:* Composting is one approach for recycling organic waste, that mostly consists of kitchen and food residue waste. This can be done at household level by use of in-vessel composters. Sawdust as a bulking agent was used to assess the effect of bulking agent:food waste (BA:FW) ratio on the stabilizing process of food waste in an in-vessel composter drum. The drum was turned manually at hourly interval at 2 rpm in 5 minutes. Three BA:FW v/v ratios were studied; 2:1,3:1, and 4:1 using more or less same food waste composition. Temperature, bulk density, moisture, pH and porosity were monitored over a period of 15 days. Temperature generally rose to above 45oc within the first 5 days in all the ratios and started to fall after 10days except for 2:1 ratio

that remained high even at the 15th day. The moisture content increased during the process with the highest values occurring in the 2:1ratio. There was an semi-logarithmic relationship between the bulk density and porosity across all BA:FW ratios. The pH increased from the initial value of about 4.5 to between 6 and 7.5. Except for less rapid attainment of thermophilic temperature and sustainability, the 4:1 ratio generally achieved the best composting conditions. This study appears to suggest that well rationed BA:FW mixture may be stabilized rapidly in an in-vessel composter enabling a high turn-over to handle the food waste generated in a household. Key words: Bulking agent, in-vessel compositing, waste stabilization

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **M. O. Nyadawa** and J. K. Mwangi.
*Title of Publication:* Geomorphologic characteriticsof Nzoia River Basin.
*Abstract:* Relationships between geomorphologic characteristics are important in understanding runoff response of many drainage basins and other related flow driven basin phenomena like erosion potential. In Kenya, geomorphologic studies are few and therefore inadequate. Nzoia basin in which this study is based is no exception. Nzoia Riverbasin is the largest sub-basin in the Lake Victoria North basin of Kenya. However, geomorphology as a component of the basin's general physical characteristics hasnot been studied and its linkage to flooding established. This study aimed at findinga geomorphologic explanation for the run-off response in the Nzoia River basin. Themethodology involved is characterizing the basin using indices like: relief ratios, stream orders, bifurcation ratios, drainage density and form factor. The study concluded that there is no consistent relationship between relief ratioand basin orders in this basin due to high variance in relief on the divide line. However, high relief ratios of above 0.03 are observed as characteristics of upland subbasins andlow value of about 0.01 for subbasins at the lowlands. This change has explained the flooding phenomena at the lowlands. Bifurcation ratios ranged from 2.8 and 3.3 whichare within Strahler's range but average value of 3.1 is closer to the lower bound valueof 2. On the basis of bifurcation ratio, Nzoia basin flows may experience delayed timeto peak and this is a good property for planning flood response strategies. Analysis ofdrainage density distribution has shown uniform conveyance efficiency with a meanvalue of 0.24-km, however, theoretically, the value lacks control values to base judgment. Overall form factor has classified the basin as fern-shaped with possibility of delayedhighpeakedhydrographs which is also important for flood evacuation planning. Key words: Stream order, bifurcation ratio, form factor, drainage density 1.0.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **M. O. Nyadawa**, A. O. Mayabi and M. Kimathi
*Title of Publication:* The effect of surface albedo and grain size distribution on evaporation losses in sand dams.

*Abstract:* Sand dams are very useful in arid and semi arid lands (ASALs) as facilities for water storage and conservation. Soils in ASALs are mainly sandy and major water loss is by evaporation and infiltration. This study investigated the effect of sand media characteristics, specifically surface albedo, grain size and stratification on water table recession using experimental model. Tanks of 220 litres capacity and 0.9 m depth were set as evaporation media at the JKUAT weather station in Kenya. Experimental media investigated were; fine ballast, fine sand, coarse sand, in-situ sand and stratified combination. Surface albedo were varied by painting top sand media with colours such as white, grey and natural brown sand colour as a control. Albedo was indexed using luminance factor. The study concluded that evaporation losses are inversely proportional to the albedo of the evaporating surface measured in terms of luminance factor. The relation between water table recession in porous medium and pan evaporation is an exponential decay curve. The study showed that stratification of media has significant influence on water loss particularly, if the overlyingMmaterial is courser than the underlying layers. Key words: Sand dams, evaporation, surface albedo, ASAL, water conservation

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **J.K. Mwangi**, G.T. Thiong'o, and J. M. Gathenya.
*Title of Publication:* Assessment of the water quality status of Sasumua watershed, Kenya.

*Abstract:* Economic and demographic growth in agricultural watersheds often leads to intensive land use and increased generation of point and non-point source pollutants. These pollutants which include pathogens, nutrients, toxic contaminants, and sediments are then transported by runoff to water bodies. The study focuses on Sasumua watershed (107km2) of the Upper Tana basin and source to 20% of Nairobi's water supply where intensification of human activity has resulted in increased pollutional load to Sasumua reservoir with implications on water treatment costs for Nairobi Water and Sewerage Company. The objective of the study was to determine the physico-chemical and bacteriological characteristics of the water entering Sasumua reservoir and to assess the relative importance of the various sources of contamination. Water samples were collected at distinct land use boundaries, at reservoir entry/exit points, and at the surface of the reservoir during both dry and wet seasons. These were analysed to determine total suspended solids, total dissolved solids, turbidity, dissolved oxygen, faecal coliforms, nutrients, heavy metals and pesticides. Analysis was done as per the standard method of analysis and evaluation based on World Health Organisation (WHO) standards. For both dry and wet seasons most parameters were within WHO standards except Ming'utio River which showed exaggerated levels of potassium,

iron, lead, manganese, pH and turbidity. For the wet season both turbidity and pH values were above WHO standards for most samples analysed. No pesticides were detected but samples showed signs of contamination with human waste indicating unsuitability for domestic use without treatment. Turbidity and pH were the major issues of concern because of their bearing on water treatment costs. The study contributes towards understanding the water quality status of the contributing rivers and reservoir and can be used by planners to devise ecologically-sound watershed management plans, or by policy makers to evaluate alternative land management options that can abate pollution of water bodies. Key words: Pollutants, Sasumua, water quality, watershed, WHO.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

### 3.2 DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

*Name of Lecturer/Authors:* **T. O. Mbuya,** B. O. Odera, S. P. Ng'ang'a and F. M. Oduori.

*Title of Publication:* Effective recycling of cast aluminum alloys for small foundries.

*Abstract:* A method of effective recycling of aluminium castings suitable for small foundries was investigated. Automotive cast aluminium scrap obtained from various scrap vendors was sorted into groups of similar components, namely; pistons, cylinder heads and housings (gearbox and rear-axle housings). This sorting method was adopted with the hypothesis that the resulting alloys could be closely equivalent to the commercial alloys that were originally used to make the components. The remainder of the scrap was grouped as miscellaneous scrap and contained various parts such as alternator covers, exhaust manifolds, oil sumps and other assorted scrap. As hypothesised, the chemistry of the resulting alloys was found to be consistently equivalent to the commercial alloys commonly used to cast the various components that were melted. For example, the alloy chemistry of secondary alloys from piston scrap was consistently equivalent to commercial piston alloys such as AC8B and LM26. Furthermore, alloys from cylinder head scrap were equivalent to commercial alloys such as 319, LM27 and AC2B. On the other hand, the alloy chemistry from unsorted scrap was not found to be consistent nor equivalent to a specific group of commercial alloys except for the 319 and 380.0 workhorse alloys. These results are discussed against the possibility of reusing the alloys in casting components similar to those that they were recycled from, in addition to other possible applications. Key words: Cast aluminium, aluminium recycling, Al-Si alloys

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Christiaan A. Adenya** and John M. Kihiu.
*Title of Publication:* Stress concentration factors in thick walled cylinders with elliptical cross-bores.
*Abstract:* Computer simulations were conducted to determine the elastic stress concentration factors in the vicinity of an elliptical cross-bore in a closed ended thick walled cylinder. The orientation of the elliptical cross-bore with respect to the meridional plane was varied. Various cross-bore to cylinder bore radius ratios and various geometries of the elliptical cross-bore were investigated. A three-dimensional finite element method (FEM) computer programme in FORTRAN code was developed and used to carry out the investigations. The displacement formulation was used. Cylinder geometries of thickness ratios k = 2.0, 2.25 and 2.5 were considered. Cylinder length was taken to be 9 times the wall thickness to avoid the end effects. The maximum stress concentration factor was experienced when the major axis of the elliptical cross-bore lay in the meridional plane. The minimum stress concentration factor was experienced when the major axis of the elliptical cross-bore lay in the transverse plane. For an elliptical cross-bore of cross-sectional area equivalent to that of a circular cross-bore of cross-bore to cylinder bore radius ratio of d = 0.15, the stress concentration factor (SCF) was a constant at 2.1 for angle of rotation (AOR) of 74.5°. For an elliptical cross-bore of cross-sectional area equivalent to that of a circular cross-bore of d = 0.20, the SCF was a constant at 2.1 for AOR = 73°. For an elliptical cross-bore of cross-sectional area equivalent to that of a circular cross-bore of d = 0.25, the SCF was a constant at 2.1 for AOR = 72.5°. When the elliptical cross-bore had its major axis perpendicular to the cylinder axis the SCF was a minimum, i.e., 2.0 and below. The SCF for a circular cross-bore was 3.0. Therefore an elliptical cross-bore offered the lowest SCF when compared to a circular cross-bore. The information on SCF constants obtained will enable quick design of thick walled cylinders with elliptical cross-bore. Keywords – Thick walled cylinder, elliptical cross-bore, stress concentration factor, finite element method.
*Name of Journal/Conference Proceedings/Workshop:* 5th JKUAT Scientific, Technological and Industrialization Conference 2010.
*Year of Publication:* 2010.

## 3.3 DEPARTMENT OF MECHATRONIC ENGINEERING

*Name of Lecturer/Authors:* **Ikua B. W.**
*Title of Publication:* Status of Research in Nanoscience and Nanotechnology.
*Abstract:* In the last few years, the demand for miniaturized and functional components has rapidly grown. This trend has given rise to the need to develop new materials and has consequently triggered an increase of engineering and scientific activity in the field of nanoscience and technology. The change of focus towards nanoscience and materials research has been due to the good

prospects of bulk materials to dramatically change their physical properties when reduced to nano scale. Nanotechnology is set to dominate or influence technological developments in the next few decades and it has already shown great potential as a tool for engineers and scientists to solve pressing problems in diverse fields including medicine, energy, agriculture and environmental management. Nano-based technologies are likely to be incorporated in virtually all aspects of technology that affect our lives. This paper explores the current status of research and development in synthesis and characterization of nano materials. Special focus is paid on properties and application of nano materials in various scientific fields. Areas of concern that call for further research and development in nanoscience are also discussed. It is expected that the paper will expose the challenging issues of nanoscience and technology and stimulate research interests in this area.

*Name of Journal/Conference Proceedings/Workshop:* 2010 Mechanical Engineering Annual conference on sustainable research and innovation.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Njiri J. G.**, Ikua B. W., Nyakoe N.

*Title of Publication:* Modelling of cutting forces in ball-end milling of Spherical surfaces.

*Abstract:* A geometrical model for the prediction of cutting forces in ball end milling of spherical surfaces is presented in this paper. The cutting tool is decomposed into a series of elementary cutting edges. At any active tooth element, the chip formation is obtained from an oblique cutting process characterized by local undeformed chip section and local cutting angles. Undeformed chip section is established from geometries of the workpiece and tool, cross-feed, feed rate and nominal depth. Cutting forces are evaluated as a function of chip thickness and properties of the workpiece and tool materials. The orthogonal cutting parameters are transformed to oblique milling edge geometry using the classical oblique transformation method, where the chip flow angle is assumed to be equal to the local helix angle. Experiments are conducted to verify the prediction of the model. The predicted and the measured values of forces show a fairly

*Name of Journal/Conference Proceedings/Workshop:* 2010 Mechanical Engineering Annual conference on sustainable research and innovation.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Njiri J. G.**, Ikua B. W., Nyakoe N.

*Title of Publication:* Cutting force control for ball end milling of sculptured surfaces using fuzzy logic controller.

*Abstract:* Productivity and precision in machining is normally limited by the forces emanating from the cutting process. Due to the inherent varying nature of the workpiece in terms of geometry and material composition, the peak cutting forces vary from point to point during machining process. In order to increase productivity without compromising on machining accuracy, it is important to control these cutting forces. In this paper a

fuzzy logic control algorithm is developed that can be used to limit maximum peak forces in milling of spherical surfaces using ball end mills. The controller can adaptively maximize the feedrate subject to allowable cutting force on the tool, which is very beneficial for a time consuming complex shape machining. This control algorithm is implemented in computer numerical control (CNC) machine. It has been demonstrated that the controller developed can provide stable machining and improve the performance of the CNC milling process by varying feedrate in real-time.

*Name of Journal/Conference Proceedings/Workshop:* 5th JKUAT Scientific, Technological and Industrialization conference 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Ndeda R.,** Keraita J.N., Kioni P. N.

*Title of Publication:* Modeling of Bulge Formation in Polymer during Laser Machining.

*Abstract:* Laser micromachining has been widely applied in the fabrication, production and manufacturing of Micro Electro Mechanical Systems (MEMS). It uses photo thermal melting or ablation to fabricate a microstructure. The use of heat as a means of material removal has various negative effects on different materials. Distortion of the material is one of the negative effects. Polymers are often used in medical devices, microelectronic and sensor industries where high precision and high quality is required. During laser cutting of polymers, bulges are formed mainly due to resolidification of molten material in the working zone and temperature difference between the heat affected zone and the heat unaffected zone. A mathematical model will be developed using finite element analysis to model polymer material behavior during laser cutting. The model will be run on both FEMLAB and MATLAB software. The effect of cutting parameters on bulge formation will then be analyzed and the results compared to theoretical structures.

*Name of Journal/Conference Proceedings/Workshop:* 2010 Mechanical Engineering Annual conference on sustainable research and innovation.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Kibini S. K.**, Ikua B. W., Nyakoe G. N.

*Title of Publication:* Modeling of Chatter Vibration in Cylindrical Plunge Grinding Process.

*Abstract:* In modern competitive manufacturing industry, machining processes are expected to deliver products with high accuracy and good surface integrity. This is expected to be achieved, while at the same time maintaining shorter production cycle times, reduced operator intervention and increased flexibility. To meet such demands, the trend is towards increased use of various control methods to control the machining processes. Most conventional control methods employ a process model which predicts the behavior of the process. Cylindrical plunge grinding process which is normally employed as a final stage in line production is no exception. The occurrence of chatter

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| | vibrations in cylindrical plunge grinding limits the ability of the grinding process to achieve the desired surface finish. At the same time, chatter vibration leads to high costs of production due to machine breakages and maintenance costs. In this paper, a theoretical model for the prediction of chatter vibration is developed. The model is used to predict the vibrations resulting from the grinding process. The model is based on the geometric and dynamic interaction of the workpiece and the grinding wheel. It is seen that, varying speeds of grinding wheel or workpiece has an influence in occurrence of chatter. |
| *Name of Journal/Conference Proceedings/Workshop:* | Moi University 6th Annual International Conference 2010. |
| *Year of Publication:* | 2010. |
| *Name of Lecturer/Authors:* | **Wairimu G.** Ikua B. W., Kioni P.N. |
| *Title of Publication:* | Effect of CO2 laser on microstructure of underlying material in paint stripping. |
| *Abstract:* | In this paper, we investigate the effect of lasers on microstructures in CO2 laser paint removal process in mild steel. First, etched mild steel specimens are spray painted and dried. A continuous wave (cw) CO2 laser beam with an estimated power of 35 Watts is then focused on the painted specimens for a wide range of exposure times. The specimens are then checked for any microstructural changes and compared with the unprocessed specimens. It was observed that exposure of the material to the beam had effects on the microstructure of the material even with as little exposure time as 30 seconds. |
| *Name of Journal/Conference Proceedings/Workshop:* | Moi University 6th Annual International Conference |
| *Year of Publication:* | 2010. |
| *Name of Lecturer/Authors:* | **Wairimu G.** Ikua B. W., Kioni P.N. |
| *Title of Publication:* | Effect of laser-material interaction time on cut quality parameters using a CO2 laser. |
| *Abstract:* | In this paper, we investigate the effect of machining parameters on the cut quality during CO2 laser drilling of various materials. Only drilling process as one of the many machining techniques has been discussed. A presentation of how machining time affects kerf widths, HAZ, depth and aspect ratio in glass, wood and perspex using a home-built CO2 laser system has been done. During these experiments, the machining velocity and material thickness were kept constant. |
| *Name of Journal/Conference Proceedings/Workshop:* | 2010 Mechanical Engineering Annual conference on sustainable research and innovation. |
| *Year of Publication:* | 2010. |

## 3.4 DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

*Name of Lecturer/Authors:* Njoroge R K, **Kaberere K K**, Akumu A O.
*Title of Publication:* Determination of reactive power compensation and transmission line power transfer capability improvement of the Kenyan power system.
*Abstract:* It is important to carry out regular power system analysis in the expanding power utilities in order to assess and plan for adequate reactive power. In this paper we look at why it is important to carry out reactive power compensation in a transmission network. A case of an emergency diesel plant that was first installed in a system during drought but could not be retired when the hydrology became favourable due to ensuing low bus voltages because of lack of adequate reactive power has been presented. The software package PSS/E has been used to simulate scenarios presented in this paper.
*Name of Journal/Conference Proceedings/Workshop:* KSEEE-JSAEM International Conference.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* N. W. Gichuhi, A. N. Gitau, J. M. Mutua, **K. K. Kaberere**, M. K. Mangoli.
*Title of Publication:* Distributed Generation of Green Electricity for Sustainable Rural Electrification in Kenya.
*Abstract:* The electricity industry has an important role in developing a sustainable energy system, both regarding the use of electricity to improve environmental performance in society thus contributing to a better living standard and social life and to reduce the environmental impacts from the electricity industry own activities. The industry contributes significantly to the worlds total green house gas emissions and has a significant impact on other environmental aspects, such as exploitation of fuel resources, emissions to air, generation of waste and use of landscape. Approximately 80% of the Kenyan population lives in rural areas where electricity access rate is merely 4%, mainly due to the slow rate of installation caused by the high costs of extending the existing grid to rural areas. It is therefore imperative that a comparative study be carried out to establish the optimum power system to supply the rural areas in Kenya given the financial constraints within many rural households while considering the environmental external costs due to each method. The following scenarios are considered for this study: (i) Mini grid powered by Green Distributed Generation Technologies, (ii) Mini grid power by fossil fuels, (iii) Extension of the existing grid.
*Name of Journal/Conference Proceedings/Workshop:* ICASTOR Journal of Engineering, Vol. 4, No. 1.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Kanai .M Michael**, John .N Nderu and Peterson K. Hinga.
*Title of Publication:* Adaptive PID DC Motor Speed Controller with Parameters Optimized with Hybrid Optimization Strategy.

*Abstract:* In this paper, an intelligent controller of DC Motor drive is designed using hybrid method of optimization (Genetic Algorithm and Pattern Search Algorithm) for the optimal tuning of proportional-integral-derivative (PID) controller parameters. A proportional–integral–derivative controller (PID controller) is a generic control loop feedback mechanism controller widely used in industrial control system. The parameters of motor, which vary with the operating conditions of the system, are adapted in order to maintain deadbeat response for motor speed. A Hybrid optimization algorithm is employed in order to obtain the controller parameters assuring deadbeat response at each selected load. The DC-Motor PID-HYBRID controller is modeled in MATLAB environment. The response of the developed controllers is compared to that of the controllers whose parameters are tuned using the well-known Ziegler-Nichols method. The developed methodology is more proficient in improving the controller loop response stability, the steady state error, the rising time and overshoot and hence the disturbances do not affect the performances of DC-motor.

*Name of Journal/Conference Proceedings/Workshop:* The Second International Conference on Advances in Engineering Technology in conjunction with Makerere University to be held on 31st January-1st February 2011.

*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Kanai M. Michael**, John .N Nderu and Peterson .K. Hinga.

*Title of Publication:* Neural Fuzzy Based DC-DC Converter Controller Optimized with Particle Swarm Optimization.

*Abstract:* This paper presents an application of Adaptive Neuro-Fuzzy Inference System (ANFIS) control for DC-DC converter optimized with swarm collective intelligence. First, the controller is designed according to Fuzzy rules such that the systems are fundamentally robust. Secondly, an adaptive Neuro-Fuzzy controller of the DC-DC converter is then designed and simulated; the ANFIS has the advantage of expert knowledge of the Fuzzy inference system and the learning capability of neural networks. Finally, the ANFIS is optimized by Swarm Intelligence. Digital simulation results demonstrate that the designed ANFIS-Swarm voltage regulator controller realize a good dynamic behavior of the DC-DC converter, a perfect voltage tracking with no overshoot, give better performance and high robustness than those obtained by the ANFIS alone.

*Name of Journal/Conference Proceedings/Workshop:* Kenya Society of Electrical and Electronics Engineers (KSEEE) and Japan Society of Applied Electromagnetic and Mechanics (JSAEM) 2010 International Conference held on 5th-6th August 2010 at Multimedia University College, Nairobi.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Kanai .M Michael**, John .N Nderu and Peterson .K. Hinga.

*Title of Publication:* Optimizing LQR to Control Buck Converter by Mesh Adaptive Search Algorithm.

*Abstract:* Power supplies normally provide a constant output voltage. In most of the applications a DC-DC converter is controlled by a

voltage mode or a current mode controller. In this regard, optimal exploitation of DC transforms by classical controllers has been a controversial issue in reputable journals. Due to their switching property included in their structure, DC-DC converters have a non-linear behavior and their controlling design is accompanied with complexities. But by employing the average method it is possible to approximate the system by linear system and exploiting linear control methods. In this paper, control method to control Buck converters by Linear Quadratic Regulator (LQR) controllers is employed. Systems with conventional LQR controllers present good stability properties and are optimal with respect to a certain performance index. However, LQR control does not assure robust stability when the system is highly uncertain. In this paper, a convex model of converter dynamics is obtained taking into account uncertainty of parameters. In order to apply the LQR control in the uncertain converter case, the performance index is optimized by using Mesh Adaptive Search (MADS). As a consequence, a new robust control method for dc–dc converters is derived. This LQR-MADS control is compared with normal LQR design. All the analysis and simulations on the above converter is by MATLAB software. The simulation results show the improvement in voltage output response.

*Name of Journal/Conference Proceedings/Workshop:* The fifth JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Kanai .M Michael**, John .N Nderu and Peterson .K. Hinga.

*Title of Publication:* The AC-DC PID Converter Controller Optimized with Pattern Search Algorithm.

*Abstract:* The paper presents a tuning methodology for the parameters of a PID controller in a three phase Pulse Width Modulation (PWM) Three-Level AC-DC converter system, often referred as Improved Power Quality Converters (IPQC). A PID Controller is a generic control loop feedback echanism controller widely used in industrial control systems. A PID controller calculates an "error" value as the difference between a measured process variable and a desired point. Three-phase Three-level AC-DC converters have been developed to a matured level with improved power quality in terms of power-factor correction, reduced total harmonic distortion at input ac mains, and regulated dc output. However, for best performance, the PID parameters used in the calculation must be tuned according to the nature of the system – while the design is generic, the parameters depend on the specific system. The parameters of converter, which vary with the operating conditions of the system, are adapted in order to maintain desirable response for output voltage and power factor. A Pattern Search Optimization (PSO) algorithm is employed in order to obtain the controller parameters assuring improved response at selected load. The Three-level AC-DC converter PID-PSO controller is modeled in MATLAB environment. The response of the developed controllers is compared to that of the controller whose parameters are tuned using the well-known Ziegler-

Nichols method. The developed method is more proficient in improving the controller loop settling time, the rising time and overshoot and hence the disturbances do not affect the performances of Three-Level AC-DC converter.

*Name of Journal/Conference Proceedings/Workshop:* Egerton University Annual Research Week and International Conference held at Egerton University on 22nd-24th September 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Mureu Ephraim W.**, Stephen Musyoki and Peter Kihato.

*Title of Publication:* Performance analysis of mobile ad hoc network routing protocols.

*Abstract:* Mobile Ad Hoc network (MANET) is an autonomous system of mobile nodes connected by wireless links. Each node operates not only as an end system, but also as a router to forward packets. The nodes are free to move about and organize themselves into a network. They are characterized by multi-hop wireless connectivity, frequently changing network topology and the need for efficient dynamic routing protocols. We compare the performance of four mobile ad hoc network routing protocols: Dynamic Source Routing (DSR) , Ad Hoc On-Demand Distance Vector Routing (AODV), Location Aided Routing (LAR1) and Wireless Routing protocol (WRP). We demonstrate that AODV is more adaptable of the four to highly dynamic networks .The performance metrics are analyzed using varying network load, mobility, and network size. Based on the observations, recommendations can be made about how the performance of these protocols can be improved.

*Name of Journal/Conference Proceedings/Workshop:* Department of Mechanical Engineering, JKUAT, Annual Conference held at AICAD, JKUAT on 8th - 9th April 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Mureu Ephraim W.**, Stephen Musyoki and Peter Kihato.

*Title of Publication:* Automating selection of mobile ad hoc network routing protocols using fuzzy logic.

*Abstract:* The Mobile Ad hoc Networks (MANETs) are wireless networks which have no central bridge, and where each node acts as a destination as well as a router. There are many protocols that have been developed to aid in routing in these types of networks. To achieve effective routing, there are many interdependent parameters that a routing protocol algorithm has to contend with, but which have a great impact on the general performance of the protocol. The various protocols try to optimize more, on some parameters than in others. This means there is a tendency of one protocol performing better in a given scenario while it performs poorly in another. Hence, it is found appropriate to have a suite of protocols from which the application could choose the one to use, depending on the scenario at hand, in order to enhance the routing. In this work, performance evaluation of four MANET protocols is done, the results of which are used to implement an automated protocol selection mechanism. The parameters used to define a network scenario are the node mobility speeds, node

density levels and nodes' traffic load. All these are described in an imprecise manner thus making fuzzy logic the best tool to use in the implementation of the automation process. The four protocols under study are Bellman-Ford, AODV, DSR and WRP. The network simulator used is GlomoSim and MATLAB 7.0.1 is used to implement the fuzzy logic. The results obtained shows that using a protocol suite enhance routing in MANETs.

*Name of Journal/Conference Proceedings/Workshop:* 1st Engineering Conference held on 9th -11th June, 2010 at Masinde Muliro University of Science and Technology, Kakamega.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Mureu Ephraim W.**, Stephen Musyoki and Peter Kihato.

*Title of Publication:* Evaluating performance of WRP and AODV MANETs routing protocols under mobility.

*Abstract:* The Mobile Ad hoc Networks (MANETs) are wireless networks which have no central bridge, and where each node acts as a destination as well as a router. There are many protocols that have been developed to aid in routing in these types of networks. To achieve effective routing, there are many interdependent parameters that a routing protocol algorithm has to contend with, but which have a great impact on the general performance of the protocol. The Routing protocols designed for MANETs are generally classified as either proactive or reactive. We have simulated WRP (proactive) and AODV (reactive) protocols to study their performance characteristics in face of varying nodes' mobility levels. Performance evaluation is based upon different metrics namely- throughput, packet delivery ratio, end to end delay, messaging overhead and energy consumption. The network simulator used is GloMoSim. Our results demonstrate that the AODV which is a reactive protocol outperforms WRP in many of the measured metrics. The AODV is thus a better for choice MA NETs

*Name of Journal/Conference Proceedings/Workshop:* Kenya Society of Electrical and Electronics Engineers (KSEEE) and Japan Society of Applied Electromagnetic and Mechanics (JSAEM) 2010 International Conference held on 5th-6th August 2010 at Multimedia University College, Nairobi.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Muiga Rugara,** D. O. Konditi, S. Musyoki.

*Title of Publication:* Impact of Spartial Diversity Techniques in Combating Interference and Multipath Fading in Wireless Communication Systems.

*Abstract:* The NEXT-generation wireless systems are required to have high voice quality, high bit rate data services, and better coverage and be more power and bandwidth efficient. The fundamental phenomenon which makes reliable wireless transmission difficult is time-varying multipath fading. Increasing the quality or reducing the effective error rate in a multipath environment is extremely difficult and challenging. It is therefore crucial to effectively combat or reduce the effects of multipath fading at both the remote units and/or the base stations by use of diversity

techniques. The use of multiple antennas and radio frequency (RF) chains at the receiver makes the remote units larger and more expensive. As a result, diversity techniques are almost exclusively applied to base stations to improve the reception quality. The technique proposed in this paper is a diversity scheme which improves the signal quality at the receiver on one side of the link by simple processing across transmit antennas on the opposite side. The proposed diversity scheme will improve the error performance, data rate, and the capacity of wireless communications systems. This decreased sensitivity to fading may allow the use of higher level modulation schemes to increase the effective data rate, or smaller reuse factor in a multicell environment to increase system capacity. In other words, the new scheme may be a cost effective way to address the market demands for quality and efficiency without complete redesign of the existing systems and therefore a candidate for the next generation wireless communication systems.

*Name of Journal/Conference Proceedings/Workshop:* 1st Engineering, Science and Technology Conference, Masinde Muliro University of Science and Technology, MMUST.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Muiga Rugara,** D. O. Konditi, S. Musyoki.

*Title of Publication:* Multi-antenna Systems for Mitigation of Multipath Fading in Wireless Communication Systems.

*Abstract:*

Wireless communication channels are generally band-limited and behave like narrow pipes that cannot accommodate rapid flow of data. At the same time unlike Gaussian channel, the wireless channel suffers from attenuation due to destructive addition of multipaths in the propagation media and interference from other users. Severe attenuation makes it impossible for the receiver to determine the transmitted signal unless some less-attenuated replica of the transmitted signal is provided to the receiver. Deploying multiple transmit and receive antennas improves the spectral efficiency and the performance of a wireless systems by increasing the amount of diversity. This paper proposes the use of multiple transmit and receive antennas (multiple-input multiple-output (MIMO) channel) which improve the signal quality at the receiver by use of multiple antennas at the transmitter and/or the receiver. The final analysis proposes a diversity matrix which can be used to optimize wireless communication systems design that achieve high spectral efficiency, low bit error rate, and higher throughput. This must also go with transmit/receive units that have acceptable physical size, reasonable cost and low current drain. These configurations will enable designers to compare the opportunity cost between redesigning the existing systems and adding antenna elements to the most convenient of the transmits and/or receive systems in any network. In other words, the new scheme may be a cost effective way to address the market demands for quality and efficiency without complete redesign of the existing systems and therefore a candidate for the next generation wireless communication systems.

*Name of Journal/Conference Proceedings/Workshop:* KSEEE-JSAEM 2010 International Engineering Conference,

held at Multi-Media University College of Kenya.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Muiga Rugara,** D. O. Konditi, S. Musyoki.

*Title of Publication:* Closed-Loop Transmit Diversity for Mitigation of Interference and Multipath Fading in Wireless Communication Systems.

*Abstract:* The thermal noise often modeled as Additive White Gaussian Noise (AWGN), the path loss in power as the radio signal propagates, the shadowing due to the presence of fixed obstacles in the radio path, and the fading which combines the effects of multiple propagation paths and the rapid movement of mobile units reflectors. In closed-loop transmit diversity scheme, the transmitter has the knowledge of the channel as there is a feedback path from the receiver to communicate the channel seen by the receiver to the transmitter. The channel experienced by the antenna is randomly varying in time. When closed-loop transmit diversity is applied, the symbol from each transmit antenna is multiplied with a complex number corresponding to the inverse of the phase of the channel so as to ensure that the signals add constructively at the receiver. Sending the same information on multiple transmit antenna does not always provide diversity gain. Intuitively, this is due to the fact that the effective channel $h_1 + h_2 h_1 + h_2$in a two transmit antenna case is again a Rayleigh channel; hence the bit error rate performance is identical to a single input single output Rayleigh channel case. However if the transmitted symbols are multiplied by a complex phase to ensure that the phases align at the receiver, there is diversity gain though the bit error rate performance seems to be slightly poorer than the maximal ratio combining case.

*Name of Journal/Conference Proceedings/Workshop:* 5th Annual Research Week and International Conference, held at Egerton University

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Muiga Rugara,** D. O. Konditi, S. Musyoki.

*Title of Publication:* Closed-Loop Transmit Diversity for Mitigation of Interference and Multipath Fading in Wireless Communication Systems.

*Abstract:* The wireless communication Channel suffers from many such as the thermal noise often modeled as Additive White Gaussian Noise (AWGN), the path loss in power as the radio signal propagates, the shadowing due to the presence of fixed obstacles in the radio path, and the fading which combines the effects of multiple propagation paths and the rapid movement of mobile units reflectors. In closed-loop transmit diversity scheme, the transmitter has the knowledge of the channel as there is a feedback path from the receiver to communicate the channel seen by the receiver to the transmitter. The channel experienced by the antenna is randomly varying in time. When closed-loop transmit diversity is applied, the symbol from each transmit antenna is multiplied with a complex number corresponding to the inverse of the phase of the channel so as to ensure that the signals add constructively at the receiver. Sending the same information on multiple transmit antenna does not always provide diversity gain. Intuitively, this is due to the fact that the

effective channel $h_1 + h_2 h_1 + h_2$in a two transmit antenna case is again a Rayleigh channel; hence the bit error rate performance is identical to a single input single output Rayleigh channel case. However if the transmitted symbols are multiplied by a complex phase to ensure that the phases align at the receiver, there is diversity gain though the bit error rate performance seems to be slightly poorer than the maximal ratio combining case.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Agriculture, Science and Technology (JAST); accepted for publication, 2011.

*Year of Publication:* 2011

*Name of Lecturer/Authors:* **Muiga Rugara,** D. O. Konditi, S. Musyoki.

*Title of Publication:* Multi-antenna Systems for Mitigation of Multipath Fading in Wireless Communication Systems.

*Abstract:* Wireless communication channels are generally band-limited and behave like narrow pipes that cannot accommodate rapid flow of data. At the same time unlike Gaussian channel, the wireless channel suffers from attenuation due to destructive addition of multipaths in the propagation media and interference from other users. Severe attenuation makes it impossible for the receiver to determine the transmitted signal unless some less-attenuated replica of the transmitted signal is provided to the receiver. Deploying multiple transmit and receive antennas improves the spectral efficiency and the performance of a wireless systems by increasing the amount of diversity. This paper proposes the use of multiple transmit and receive antennas (multiple-input multiple-output (MIMO) channel) which improve the signal quality at the receiver by use of multiple antennas at the transmitter and/ or the receiver. The final analysis proposes a diversity matrix which can be used to optimize wireless communication systems design that achieve high spectral efficiency, low bit error rate, and higher throughput. This must also go with transmit/receive units that have acceptable physical size, reasonable cost and low current drain. These configurations will enable designers to compare the opportunity cost between redesigning the existing systems and adding antenna elements to the most convenient of the transmit and/or receive systems in any network. In other words, the new scheme may be a cost effective way to address the market demands for quality and efficiency without complete redesign of the existing systems and therefore a candidate for the next generation wireless communication systems

*Name of Journal/Conference Proceedings/Workshop:* Journal of Agriculture, Science and Technology (JAST); accepted for publication, 2011.

*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Denis Ombati** and E N Ndung'u.

*Title of Publication:* Optimization of Underdetermined Blind Speech De-noising for Enhanced Teleconferencing by Interpolated Fastica_25.

*Abstract:* This paper proposes a new method for optimization of blind source separation for enhanced teleconferencing. Independent component analysis ICA and sparse representation SR are the

main tools employed to obtain source signals from observed data containing both original signals and white Gaussian noise. This is called "cocktail-party problem". The aim of this research is to separate source signals and de-noising them thereof, using optimal FastICA. The method will take the advantages of statistical independence and non-Gaussianity of signal components. The signals considered here are instantaneous in nature. Several sparse algorithms have been proposed so far in literature though with different complexities to realize its objectives. The proposed methodology for this research will follow the following procedure. A model room environment in a microphone array and exploit underdetermined blind sources separation. An algorithm that will exploit spatial diversity in time domain to optimize decomposition to obtain independent speech subset. The research looks maximizing SNR and eventually low signal distortion. Our results simulated in MATLAB software based algorithm will be developed to realize optimal modelled blind source separation for separation and de-noising, to mimic real world. Any further direction on this research will be outlined to facilitate future realization of effective separation of many kinds of signals, such as speech or biomedical data, teleconferencing.

*Name of Journal/Conference Proceedings/Workshop:* Kenya Society of Electrical and Electronic Engineering KSEE and Japan Society of Applied Electromagnetic and Mechanics JSAEM 2010 International Conference held on 5th -6th August 2010 at Multimedia University College, Nairobi.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **C. M. Muriithi,** L. M. Ngoo, G. N. Nyakoe, and K. K. Kaberere.

*Title of Publication:* Investigation of Static Voltage Stability Using a Modified Load Flow Algorithm and Counter Propagative Artificial Neural Networks.

*Abstract:* In conventional load flow studies, the active and reactive powers of all load buses are generally specified. Thus, by assuming a constant power load characteristic, the impact of the load in the system is over-emphasized and the theoretical transfer capability is reduced despite increased security margins, which leads to system under utilization. This paper proposes load flow solution with neuro-fuzzy induction motor model which updates the active and reactive powers consumed by the induction motor load during each iteration. Counter-Propagative Artificial Neural Networks (CPANN) are used to classify the weak buses. The stability margin of the weakest buses is investigated using different induction motor load models. The results indicate that the actual situation with induction motor load corresponds to less heavily loaded conditions and a higher voltage was predicted by the power flow.

*Name of Journal/Conference Proceedings/Workshop:* 8th International Conference on Power System Operation and Planning.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **C. M. Muriithi,** L. M. Ngoo, G. N. Nyakoe, and S.N. Njoroge.

*Title of Publication:* Continuation Load Flow With A Neuro Fuzzy Model Of An

Induction Motor For Voltage Stability Analysis.

*Abstract:* This paper uses the concept of the continuation power flow analysis used in voltage stability analysis for control the power in large systems. It uses the *P-V* curves to find the knee point of a certain bus. A neuro-fuzzy model of an induction motor load is used to represent an industrial load. In the subsequent predictor-corrector stages, the induction motors are increased to depict increment in loading. Different motor ratings are used in the investigations. The process starts at some base values of the system and leading to the critical point. Further the reduced Jacobian is used to determine the optimum location for capacitor to affect maximum voltage improvement in total over a range of operating points. In case study, illustrative examples with the IEEE 30 bus system are shown.

*Name of Journal/Conference Proceedings/Workshop:* Third IASTED African Conference, Gaberone, Botswana September, 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **C. M. Muriithi,** L. M. Ngoo, G. N. Nyakoe, and S.N. Njoroge.

*Title of Publication:* Investigating the Impact of A Fuzzy Logic Power System Stabilizer In A Multi Machine System With An Induction Motor Load.

*Abstract:* Current trends indicate that modern power systems are continuously working under stressed conditions. Power demand is rising constantly while several generators are connected to work synchronously to meet the demand. Occasionally, faults within a system occur, which induce electromechanical oscillations of the electrical generators. These oscillations, also called power swings, must be effectively damped to maintain the system stability. Additionally, due to these faults, bus voltages are reduced. The high reactive power demand by the induction motor load during fault condition due to reduced bus voltages causes the generator to behave like a voltage source behind the synchronous reactance and its terminal voltage reduces leading to the possibility of a voltage collapse scenario. For reliability of these systems, and in an attempt to reduce system oscillations, Power System Stabilizers (PSS) have used to add damping by controlling the excitation system. Studies have shown that a well-tuned PSS using a Fuzzy Logic Controller can effectively improve power system dynamic stability. This paper investigates the impact of the FLPSS in maintaining voltage stability. A large induction motor is introduced as a load in a multi machine system, and the impact of the FLPSS are investigated by introducing a temporary three phase fault. For comparison the FLPSS is compared to other PSS found in literature. Results indicate that the FLPSS may lead the generator to lose its capability to maintain constant voltage and hence lead to the stalling of the induction motor load soon after the fault is cleared.

*Name of Journal/Conference Proceedings/Workshop:* Mechanical Engineering Conference, AICAD.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Kiptoo A.K., **Muriithi C. M.**

*Title of Publication:* A Proposal To Introduce Virtual Laboratory Into Jkuat Electrical Engineering Syllabi: Dynamic Power System Modelling.

*Abstract:* Power system panels are some of the most educative systems as far as power system analysis is concerned. Along the electrical engineering career in the developing nations the learners are forced to imagine some of the colossal facts in the field. This is because of lack of equipment which is too expensive rendering them lame in practical aspects of the studies. This is contrary to many other courses where the specimens are easily available and the dangers involved are manageable such as working with plant specimens. It is therefore a milestone to introduce a unit that will equip students with the actual world through virtualization of the complicated systems in order to demystify the internal detailed operation of the system and subsystems. This Study explores the academic significance behind introduction of virtual laboratories in developing countries with emphasis on power systems. The study will take into account a simple three bus system modeled using MATLAB, SimPowerSystem toolbox. For the case study a contingency is introduced into the system and then cleared after preset time then the results are then captured before, during and after the fault. Further information on the relevancy of the course from the students currently studying power system is gathered using questionnaires and analyzed using Microsoft excel. In conclusion it is important to introduce Virtual laboratory in the Kenyan higher education system to package the current highly theoretically oriented system.

*Name of Journal/Conference Proceedings/Workshop:* Jkuat Conference, AICAD.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Mureithi C. M**, Ngoo L. M, Nyakoe G. N.

*Title of Publication:* Analysys Of A Fuzzy Logic Power System Stabilizer For Stability Enhancement.

*Abstract:* Modern power systems consist of several generators working synchronously to meet the power demand. For reliability of these systems, stability must be ensured incase of faults within the system. Power System Stabilizers are used to add damping to the rotor oscillations of the synchronous machine by controlling its excitation. The disturbances occurring in a power system induce electromechanical oscillations of the electrical generators due to faults within the system. These oscillations, also called power swings, must be effectively damped to maintain the system stability. To ensure a robust damping, the PSS should provide a moderate phase advance at frequencies of interest in order to compensate for the inherent lag between the field excitation and the electrical torque induced by the PSS action. Studies have shown that a well-tuned PSS can effectively improve power system dynamic stability. The objective of this paper is to show robust damping of the PSS may be improved by using a Fuzzy Logic Controller based on Mamdani. The powerful properties like invariance to uncertainties, robustness and ease of design of fuzzy logic controllers are used to enhance stability of the machine. The fuzzy decision is carried out to determine the

input into the PSS. The output of the PSS is then conveyed to the excitation system of the generator. The paper demonstrates the impact of the Fuzzy Logic Controller on the overall stability of a power system. Simulations have been carried out on 16 bus test system found in literature. A comparison is carried out on a generator without a PSS, with a PSS and with a PSS plus a Fuzzy Logic Controller. The results indicate that the inclusion of a Fuzzy Logic Controller improves the overall stability of the system by enhancing the damping of the electromechanical oscillations introduced by a three phase fault in the system.

*Name of Journal/Conference Proceedings/Workshop:* JKUAT Conference, AICAD.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **C. M. Muriithi,** L. M. Ngoo, G. N. Nyakoe, and S.N. Njoroge
*Title of Publication:* A Neuro Fuzzy Model Of An Induction Motor For Voltage Stability Analysis Using Continuation Load Flow.

*Abstract:* This paper uses the concept of the continuation power flow analysis used in voltage stability analysis. It uses the continuation load flow to plot the PV curves of an induction motor load. A neuro-fuzzy model of an induction motor load is used to represent an industrial load. In the subsequent predictor-corrector stages, the induction motors are increased to depict increment in loading. Different motor ratings are used in the investigations. The process starts at some base values of the system and leading to the critical point. Further the reduced Jacobian is used to strategically locate the capacitor banks in the power system so as to effect maximum voltage improvement. In case study, illustrative examples with the IEEE 30 bus system are shown.

*Name of Journal/Conference Proceedings/Workshop:* Journal of Electrical and Electronics Engineering Research, Vol. 3(4), pp. 42-51, ISSN – 2141 – 2367, Academic Journals.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **J.K. Muriuki,** C. M. Muriithi, D.K. Murage.
*Title of Publication:* Induction Motor Load Flow Simulation with Digsilent Powerfactory.

*Abstract:* Currently there is a growing interest in load modeling. This has gained momentum globally as an area of research by power industry engineers and academic researchers. The interests have been in the simulation of voltage stability and planning by utilizing static loads to represent the relationship between power and voltage. As, most load of the power systems are dynamic, there is need to diversify the study to capture dynamic load characteristics from the measured voltage disturbance. It is a reality that, load representation that contributes significantly to voltage instability of the power system has received relatively less attention and continues to be an area of greater ambiguity. Therefore, there is a need for studies in power system load modeling and analyze their characteristics both under steady state and dynamic performance. The paper proposes to solve the load flow equations of a power system with DigSilent induction motor (IM) models whose active and reactive power

are estimated at each iteration. Simulations were carried out to demonstrate the effects of small and large faults in the system on the induction motor loads. In addition, the dynamic behavior of the IM with reference to various parameters was investigated. The results include system responses to sudden load changes and 3-phase faults. The simulation results indicate that the effect of the load model and their aggregation on system performance is reasonable and practical. It was also found that, representing the system loads by a single dynamic equivalent load reflects the actual stability of the power system. However, representing these loads by constant impedance load gives false indication of the system stability under dynamic behavior.

*Name of Journal/Conference Proceedings/Workshop:* JKUAT Conference, AICAD.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **J.K. Muriuki,** C. M. Muriithi, D.K. Murage.
*Title of Publication:* Powerfactory Load Flow Sensitivity Analysis Of A Composite Load Model.

*Abstract:* PowerFacotry Load flow sensitivity is a method used to obtain certain relationship between dependent and independent variables using differential relationship among physical measure in systems. Voltage sensitivity analysis is based on the linearization of the system around the operational point resulting from a load flow calculation. Inappropriate load representation has been a major setback causing inaccurate simulation results of the dynamic load. Further, induction motor loads comprise of 60% power system loads whose understanding under various dynamics is crucial for system stability. Static loads are known to be imprecise in dynamic load simulation and therefore yield false information on the system stability. This paper presents a composite load model whose parameters are varied to investigate their effects on both active and reactive load dynamics. Load modelling using field measurement data from power quality meter of an industrial consumer are analyzed to assess their effects on sensitivity of the system stability. Load flow sensitivity is analyzed to perform a voltage sensitivity analysis based on the linearization of the system around the operational point that results from a load flow calculation. The efficiency of the system is estimated using the IEEE 9 bus system. The result indicates that load model parameters have different sensitivity values under voltage disturbance. The results acquired are thus acceptable and rational.

*Name of Journal/Conference Proceedings/Workshop:* Eldoret Polytechnique on Advanced Technology Conference.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **G.G. Kidegho**, M.S. Mbogho, A.O. Akumu.
*Title of Publication:* Enhancement of Electrical Power Supply Using Grid Connected Urban Solar Photovoltaic Electricity.

*Abstract:* The electrical energy shortfall in Kenya, coupled with the ever increasing electricity demand, necessitates the need to involve other existing energy sources to supplement the existing forms of power generation. Kenya has an advantage by being located

at the equator where solar cycles are accurately predicted. This paper endeavors to demonstrate that urban solar PV electricity generation could make a major contribution in meeting electricity demand in Kenya. The study uses load and solar insolation data from Embakasi Nyayo estate to design a typical solar PV electricity generation system. The study proposes to use HOMER design software to implement the design. Preliminary results obtained from this study, show that a single solar system of 2.5kWp tied to the grid would be adequate for the case study. When the study is fully realized, the site has a potential to generate 11MW of electrical power. Further, findings this study support the argument that urban solar PV electricity generation has a big potential to augment power generation in the country. This study therefore recommends widespread adoption of solar PV electricity generation. To optimize the use of this resource in electricity generation for the benefit of consumers, properly negotiated feed-in tariffs are recommended.

*Name of Journal/Conference Proceedings/Workshop:* First Engineering, Science and Technology Conference, held at the Masinde Muliro University of Science and Technology Kakamega from 9th to 11th June 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **G.G. Kidegho**, M.S. Mbogho, A.O. Akumu.

*Title of Publication:* A Study of the Effects of Urban Domestic Electrical Burden On The Electricity Generation Industry Of Kenya.

*Abstract:* Electrical energy in Kenya is the largest prime mover of the economy. Despite this fact, this energy source is in short supply. To satisfy the demand for electrical energy countrywide, available resources have been exploited. Currently electrical power generation is by; hydro, geothermal, petroleum fuels, wind and some solar PV in the rural areas. This paper investigates the effects of the urban domestic electrical burden on the power generation industry. The study uses Microsoft Excel to analyze the electrical burden. Further, the study would extrapolate the domestic burden to observe its effects nationally. Preliminary results did reveal a substantial national electrical burden of 319.98MWp occurring between 8PM and 9PM. These findings support the urgent need to address the electrical burden. Management of the urban electrical burden will relieve the generation industry of a large electrical burden in addition to reducing substantial losses in the transmission network

*Name of Journal/Conference Proceedings/Workshop:* 2010 KSEEE & JSAEM, International Engineering Conference held at the Multimedia University College, from 5th to 6th August 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **G.G. Kidegho**, M.S. Mbogho, C. M. Muriithi.

*Title of Publication:* A Study of an Urban Domestic Composite Load Model Suitable For Solar PV and Grid Hybrid System.

*Abstract:* In every power supply system, the load is a major component to the system voltage stability. For this reason, load modeling is

done to predict the behavior of the load. The load behavior in a power system directly affects the voltage profile of the system. In most generation systems in a country, the urban domestic load consumes up to 30% of the total generated power. It is with this fact in mind that this paper carried out an urban domestic load modeling to study the effects of disturbances and perturbations caused by the load to a power generation system. In the study, a solar PV and grid hybrid system is used. An equivalent circuit of an induction motor is used as a dynamic load together with the static domestic load to form the load model. The study uses both quantitative and qualitative analysis methods and also explores the use of trajectory sensitivity concepts. Using load analysis software; Excel and MATLAB the load was modeled. The domestic load used in the study is drawn from a study case suburb; Embakasi Nyayo Estate. Preliminary results obtained indicate accurate predictions for the hybrid solar PV and grid system. The investigations further indicate that load voltage dynamics can significantly influence the damping of modal oscillations. Further, as the system becomes more stressed, sensitivity to parameter variations increase significantly and this can be used to predict marginal stable behavior.

*Name of Journal/Conference Proceedings/Workshop:* 2010 JKUAT Scientific, Technology and Industrialization Conference held at the Jomo Kenyatta University of Agriculture and Technology from 17th to 19th November 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **C. M. Mwangi,** S.M. Kang'ethe, G.N. Nyakoe.

*Title of Publication:* Design and simulation of a fuzzy logic traffic signal controller for a signalized intersection.

*Abstract:* Traffic control and management poses a major problem in many cities, especially in rapidly growing and motorizing cities like Nairobi, Kenya. Currently, fixed-cycle controllers are being used in all signalized intersections in Nairobi. This has culminated in most intersections within the city almost grinding to a halt during peak hours. The efficiency of traffic flow through an intersection depends on the phases, sequence and the timing of the traffic signals installed. This paper proposes a fuzzy logic system to control traffic signals on a signalized intersection. The Fuzzy Logic Controller (FLC) dynamically controls the traffic light timings and phase sequence to ensure smooth flow of traffic, decrease traffic delays and thus increase the intersection capacity. In the design, vehicle detectors are placed strategically upstream and downstream to determine traffic density and the delay on each approach. This traffic data is then used by the FLC to determine whether to extend or to terminate the current green phase and to select the appropriate phase sequence. A fuzzy logic traffic control simulation model is developed and tested using MATLAB/ SIMULINK software. The performance of the Fuzzy Logic traffic controller is then compared to that of the fixed-cycle controller. The performance of FLC is found to be similar to that of the fixed controller in normal traffic conditions. However, in heavy traffic conditions, FLC results shows 25% decrease on average delay of cars waiting at the intersection and 6%

improvement on total number of cars served at the intersection over the same simulation period compared to the fixed cycle controller. The results show that there is a huge improvement that can be realized by using FLC in controlling traffic flow at intersections. Keywords: Traffic control, Traffic flow, Signalized intersection and Fuzzy logic controller.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Gideon G. Kidegho**, Marangi S. Mbogho and Maina C. Muriithi.

*Title of Publication:* A study of an urban domestic composite load model suitable for solar PV and grid hybrid system.

*Abstract:* In every power supply system, the load is a major component to the system voltage stability. For this reason, load modeling is done to predict the behavior of the load. The load behavior in a power system directly affects the voltage profile of the system. In most generation systems in a country, the urban domestic load consumes up to 30% of the total generated power. It is with this fact in mind that this paper carried out an urban domestic load modeling to study the effects of disturbances and perturbations caused by the load to a power generation system. In the study, a solar PV and grid hybrid system is used. An equivalent circuit of an induction motor is used as a dynamic load together with the static domestic load to form the load model. The study uses both quantitative and qualitative analysis methods and also explores the use of trajectory sensitivity concepts. Using load analysis software; Excel and MATLAB the load was modeled. The domestic load used in the study is drawn from a study case suburb; Embakasi Nyayo Estate. Preliminary results obtained indicate accurate predictions for the hybrid solar PV and grid system. The investigations further indicate that load voltage dynamics can significantly influence the damping of modal oscillations. Further, as the system becomes more stressed, sensitivity to parameter variations increase significantly and this can be used to predict marginal stable behavior. Key words: load modeling, distribution system, voltage profile, urban domestic load.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **M.M Kanai**, J.N Nderu, P.K Hinga.

*Title of Publication:* Optimizing LQR to control buck converter by mesh adaptive search algorithm.

*Abstract:* Power supplies normally provide a constant output voltage. In most of the applications a DC-DC converter is controlled by a voltage mode or a current mode controller. In this regard, optimal exploitation of DC transforms by classical controllers has been a

controversial issue in reputable journals. Due to their switching property included in their structure, DC-DC converters have a non-linear behavior and their controlling design is accompanied with complexities. But by employing the average method it is possible to approximate the system by linear system and exploiting linear control methods. In this paper, control method to control Buck converters by Linear Quadratic Regulator (LQR) controllers is employed. Systems with conventional LQR controllers present good stability properties and are optimal with respect to a certain performance index. However, LQR control does not assure robust stability when the system is highly uncertain. In this paper, a convex model of converter dynamics is obtained taking into account uncertainty of parameters. In order to apply the LQR control in the uncertain converter case, the performance index is optimized by using Mesh Adaptive Search (MADS). As a consequence, a new robust control method for dc–dc converters is derived. This LQR-MADS control is compared with normal LQR design. All the analysis and simulations on the above converter is by MATLAB software. The simulation results show the improvement in voltage output response. Keywords; Linear Quadratic Regulator (LQR), Mesh Adaptive Search (MADS), DC-DC converter, Voltage Control.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

## 3.5 DEPARTMENT OF GEOSPATIAL INFORMATION SYSTEMS

*Name of Lecturer/Authors:* **D. Kuria**, E. Mutange, D. Musiega and C. Muriuki.

*Title of Publication:* Multi-temporal land cover mapping of the kakamega forest utilising landsat imagery and GIS.

*Abstract:* Forest resources contribute significantly to the Kenyan economy. However, due to pressures exerted by the growing population, this scarce resource is seriously endangered. In particular, the Kakamega Forest has experienced serious degradation in the past, though some restoration efforts have also been put in place. In this research, we utilise time series Landsat imagery to characterise the changes and capture the trends in land cover changes. Three epochs are utilised, namely, 1986, 1995 and 2005. Pre-processing involved georeferencing and radiometric corrections. As a first step the time series imageries were evaluated via a threshold analysis distinguishing between 'forest' and 'non-forest'. Subsequently, a supervised multispectral classification was performed distinguishing various land cover classes. Ground truthing for the historical imagery was done using aerial photographs, topographic maps and site visits. Actual land cover verification was based on amateur photographs taken in 1999 from an aircraft, and ground observations in 2008. For classification the maximumlikelihood decision rule was applied

considering bands 3, 4, 5, 7 plus 7/2 for thematic mapper (TM)/enhanced thematic mapper plus (ETM+) imagery and 1, 2, 3 and 4 for Multi-spectral scanner (MSS) data, respectively. The classification results form a solid basis for a consistent and detailed evaluation of forest history between 1986 and 2005. Analysis results presented include graphs and pie charts of change in land cover class areas over time as well as such allowing for true change detection with transitions between the different classes. In this study, maximum likelihood supervised classification change detection techniques were applied to Landsat images acquired in 1986, 1995 and 2005 respectively. To map land cover changes in kakamega forest, a supervised classification was carried out on the six reflective bands for the three images individually with the aid of ground truthing data. Changes among different land cover classes were assessed. During the study period, a very severe land cover change had taken place as a result of agricultural and settlement. These changes in land cover led to vegetation degradation. The effects of restoration efforts are also captured in the research findings. Key words: Land-cover mapping, image classification, change detection

*Name of Journal/Conference Proceedings/Workshop:* Journal of Science and Technology, Volume 12 (1).
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* K. W. Mubea, T. G. Ngigi and **C. N. Mundia.**
*Title of Publication:* Assessing application of markov chain analysis in predicting land cover change: a case study of Nakuru Municipality.

*Abstract:* Land use/cover change is a major global environmental change issue and projecting these changes is essential for the assessment of environmental impacts. In this study, a combined use of satellite remote sensing, geographic information systems (GIS), and markov chains stochastic modelling techniques were employed in analysing and projecting land use/cover changes. The results indicate that there has been a notable and uneven urban growth and substantial loss in forest land, and that the land use/ cover change process has not stabilized. The study demonstrates that the integration of satellite remote sensing and GIS can be an effective approach for analyzing the spatial-temporal patterns of land use/cover change. Further integration of these two techniques with Markov modelling was found to be beneficial in describing, analysing and projecting land use/cover change process. The projected land use/ cover for 2015 show substantial increase in urban and agricultural land uses. Key words: GIS, land cover, Markov modelling, Nakuru municipality, satellite remote sensing.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.

# 4. SCHOOL OF ARCHTECTURE AND BUILDING SCIENCES (SABS)

## 4.0 DEPARTMENT OF CONSTRUCTION MANAGEMENT

*The Vice Chancellor Prof. Mabel Imbuga inspecting capital projects*

*Name of Lecturer/Authors:* **G. Munala** and B. O. Moirongo.
*Title of Publication:* The need for an integrated solid waste management in Kisumu, Kenya.

*Abstract:* The composition and amount of solid waste being generated in Kisumu has been on the increase. This can partly be attributed to changing urban lifestyles, resource consumption patterns, improving income levels and other socio-economic and cultural issues. Thus, new approaches in handling these wastes need to be introduced to cope with their increase. This study has triangulated its findings through various literature reviews, interviews and field survey observations. It provides documentary evidence on the level of conditions and level of practice in solid waste management in Kisumu. The findings indicate that only about 20 % of the 400 tonnes of solid waste generated in Kisumu is collected and transported to the dumpsite. Residents do not separate waste at household level and burning is a common mode of disposal. The findings affirm to the need for a change in management regimes to become more commercially viable, adaptive and inclusive. There is also need for a sociocultural attitude change among the residents at household level. Key words: Kisumu, minimisation, recovery, recycling, solid waste management

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011
*Year of Publication:* 2011.

# 5. INSTITUTE OF BIOTECHNOLOGICAL RESEARCH (IBR)

*Experiment being conducted on tissue culture banana seedlings from Institute of Biotechnology Research*

*Name of Lecturer/Authors:* Wambua J.M., Makobe M.N, Njue E.M. and **Nyende A.B.**

*Title of Publication:* Hydroponic screening of Sorghum cultivars for salinity tolerance.

*Abstract:* Sorghum *(Sorghum bicolor* L. Moench*)* crop has been considered relatively more salt tolerant than other cereals and has the potential as a grain and fodder crop in saline soils. However, only a few of the cultivars can thrive under relatively high levels of salinity. Genetic improvement of *Sorghum bicolor* for salt tolerance is of importance due to limited arable land and increasing salinity coupled with population pressure. The objective of this study was to evaluate the salinity tolerance of four selected Kenyan sorghum cultivars (Mtama1, El-gadam, Seredo and Serena) obtained from K.A.R.I. Katumani. Seeds of the named cultivars were pregerminated in petri dishes lined with moistened 12.5mm diameter Whatman filter paper in a germination chamber at 27°C for 3 days prior to transfer into the hydroponics system using the Shive and Robbin's nutrient solution for testing of seedling salinity tolerance. The hydroponics was placed at controlled environmental conditions with supplemental lighting of 4750 lux for twelve hours of day and twelve hours of darkness in the biotron. Four salinity levels were established using different NaCl concentrations corresponding to a nutrient solution electrical conductivity (EC) of 5, 10 and

15dSm$^{-1}$ and a control of Shive and Robbin's nutrient solution (0.22dSm$^{-1}$). Shoot length, root length, fresh and dry weights of the seedlings were recorded in order to quantify seedling growth under salinity pressure. The factorial experiment was set up in a CRD. There were significant intercultivar differences in shoot growth ($p \leq 0.01$), where Serena had the highest growth at high NaCl concentrations (10 and 15 dSm$^{-1}$) while Mtama1 had the least shoot growth among the four cultivars. El-gadam and Seredo were significantly different at 10 and 15 dSm$^{-1}$ while at 5 dSm$^{-1}$ shoot growth among the four cultivars was also significantly different ($p \leq 0.05$). Root was inhibited at 10 and 15 dSm$^{-1}$ for both Mtama 1 and El-gadam while Seredo and Serena were less affected. Results further indicated that root development was not significantly different for Mtama 1 and Elgadam but showed enhanced root growth for Serena and Seredo at ($p \leq 0.05$). Even though increment of salinity level, continued to contribute to growth inhibition at an electrical conductivity above 5dSm$^{-1}$ Seredo and Serena showed adaptation to high levels of salinity (10 and 15 dSm$^{-1}$) as compared to Mtama 1 and El-gadam. The sensitivity and tolerance levels in the cultivars suggest that there were two classes of tolerance levels: those that were tolerant and not inhibited in shoot and root growth and those that were sensitive. Based on this study it was concluded that, *Sorghum bicolor* L. Moench cultivars differ in their ability to grow under different levels of salinity during the early seedling growth stages. This is an important characteristic to be taken into account when selecting cultivars that can survive in saline soils. Key words: salt tolerance, seedling nutrient screening, Electrical Conductivity, sorghum cultivars.

*Name of Journal/Conference Proceedings/Workshop:* JAGST, Vo. 12 (2).
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* James Oluoch Nonoh, Wilber Lwande1, Daniel Masiga, Rafi Herrmann, James K. Presnail, Eric Schepers, Matilda Angela Okech, Richard Bagine, Paul Mungai, **Aggrey Bernard Nyende** and Hamadi Iddi Boga.

*Title of Publication:* Isolation and characterization of streptomyces species with antifungal activity from selected national parks in Kenya.

*Abstract:* Microorganisms and their natural products are potentially important for the biological control of crop diseases without detrimental effects to the environment. In this study, acetonitrile-methanol extracts of 361 actinobacterial isolates obtained from Aberdares, Arabuko Sokoke, Lake Bogoria, Mt Kenya, Kakamega, Ruma, Shimba Hills and Imenti forest national parks in Kenya were screened for antagonism against *Fusarium oxysporum*, *Fusarium* spp and *Colletotrichum kahawae*, which are important crop pathogens. Twenty-three isolates showed antagonistic activity to one or all of the test fungi. Five isolates that were antagonistic against all test fungi were investigated further and were also found to have antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*. Morphological and physiological studies show that the isolates belong to streptomycetes. Phylogenetic analysis of amplified actinobacterial 16S rRNA gene confirmed that all the five antagonistic isolates formed close phylogenetic clusters

with known members of *Streptomyces* species with a (97 - 100%) sequence identity. The results suggest that protected areas may be ideal habitats for isolation of antagonistic actinobacterial species which may have the potential for beneficial application in biological control of fungal pathogens. However, further investigation by characterization of the antifungal necessary. Key words: Protected and antibacterial compounds produced will be areas, soil streptomyces, bio-prospecting, antimicrobial, phytopathogens.

*Name of Journal/Conference Proceedings/Workshop:* African journal of Microbiology Research. Vol. 4 (9) pp 856-864.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Mwirigi P.N., Kahangi, E.M., **Nyende A.B**., and Mamati E.G.
*Title of Publication:* In vitro propagation of the Kenyan yam (Dioscorea spp).
*Abstract:*
Yam tuber is used as food where it provides cheap, starch-rich food for the hot humid tropics. In Kenya yam is mainly boiled, fried or roasted although a minority of consumers also process it into flour for use in some baked products. Yams are propagated vegetatively using corms and tuber-sets. In general vegetative propagation is associated with the rapid spread of diseases and is cumbersome. The main objective of this study was to develop an efficient *in vitro* mass propagation protocol for this particular species. The work involved establishment of the best sterilization procedure for the explants that were initially grown in pots in a screenhouse and then exposed to different levels of commercial bleach (3.5% chlorine). This was followed by culturing the nodal cuttings from the explants in MS media supplemented with different levels of growth regulators. The two step-wise sterilization procedure using commercial bleach was found to be the best and hence recommended for future work. There were significant differences among the treatments with the combination of BAP and IAA at levels of 0.5mg/l of BAP + 0.02mg/l of IAA giving the best results for plantlet regeneration. *Invitro* rooting was achieved without the use of hormones and the most vigorously growing plantlets acclimatized in the greenhouse. In conclusion, the study found that it is possible to propagate yams *in vitro* and with the adoption of this protocol for micro-shoot growth, increased rates of multiplication can be achieved. This technique can then be exploited to generate clean, disease-free material both for mass propagation and experimental work. Key words: *Dioscorea* spp., *In vitro*, Propagation, Protocol

*Name of Journal/Conference Proceedings/Workshop:* African journal of Horticultural Science. 3: 112-122.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Asudi G., E.M. Ateka, **A.B. Nyende**, F. Wanzala.
*Title of Publication:* Morphological diversity of Kenyan Papaya Germplasm.
*Abstract:*
Papaya is one of the major fruit crops of the tropical regions of the world. It shows considerable phenotypic variation in morphological and horticultural traits that can be utilized in its genetic improvement. In Kenya, wide range of papaya germplasm exists and has not been characterized. Therefore, there is difficulty in differentiating the papaya accessions in the different regions

of Kenya. Characterization of papaya germplasm is normally accomplished by use of morphological descriptors, hence as a first step, a germplasm collection from within Kenya was gathered and its morphological diversity was assessed. The papaya germplasm was collected from Coast, Nyanza, Western, Rift Valley, Eastern and Central provinces of Kenya and characterized in the field using morphological descriptorsbased on fruit, flower, stem and leaf characteristics. The morphological characters were recorded and morphological data from sixty accessions were submitted to principal component and Neighbor-joining cluster analysis. Accessions from Coastal, Western, Rift Valley and Nyanza provinces showed the widest morphological diversity with those from Eastern and Central provinces showing the least diversity. Fruit shape, fruit diameter, tree habit, leaf size and flower color showed the greatest variation in principal component analysis. The high diversity observed within the accessions points to ample possibilities of obtaining desirable trait combinations in specific cultivars. Key words: Kenya, papaya, germplasm, morphological characterization.

*Name of Journal/Conference Proceedings/Workshop:* African Journal of Biotechnology. 9 (51) 8754-8762
*Year of Publication:* 2010

*Name of Lecturer/Authors:* Tsoka O., P. Demo, **A.B. Nyende**, K. Ngamau.
*Title of Publication:* Potato seed tuber production from invitro and rooted apical stem cuttings under aeroponic systems.*Abstract:*

*Abstract:*

Potato productivity is generally low in Malawi due to lack of quality seed tuber coupled by absence of a potato seed certification programme leading to farmers achieving less than 7t $ha^{-1}$ against achievable yield of 40t $ha^{-1}$. With regards to this, an assessment of potato (*Solanum tuberosum* L) seed tuber production under aeroponics in Malawi was conducted in order to assess aeroponics as an alternative system of producing minitubers. *In vitro* plantlets and rooted apical stem cuttings of three clones (CIP381381.13, CIP381381.20 and CIP395016.6) were used as source material for the aeroponic study in the greenhouse. A two factor factorial experiment arranged in a Completely Randomised Design (CRD) with four replicates was laid out. Data collected included the following: percentage plants survival to harvest, root length, plant height, number of minitubers per plant, date from transplanting to 1$^{st}$ tuberisation, number of harvests and tuber weights. Days to 1$^{st}$ tuberisation from both material sources was observed 28d after transplanting. The results showed that the i*n vitro* plant material source significantly yielded better seed potato tuber numbers per plant (24.3) than rooted apical stem cuttings (3.4) ($p<0.05$). Amongst the *in vitro* clones, CIP 381381.13 gave significantly higher tuber numbers (30.0) per plant compared to the other clones. This indicates that, *in vitro* plantlets have potential to give a viable material for seed potato tuber production under aeroponics and can offer an alternative method for seed tuber production. Key Words:Seed potato, aeroponics, rooted apical stem cuttings, i*n vitro* plantlets, *Solanum tuberosum,* Malawi.

*Name of Journal/Conference*

*Proceedings/Workshop:* AJB
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Doris W. Ndegwa**, Nancy L.M. Budambula, Samuel Kariuki and John N. Kiiru.

*Title of Publication:* Aminoglycoside modifying enzymes detected in strains of escherichia, klebsiella, pseudomonas and acinetobacter implicated in invasive infections in Nairobi, Kenya.

*Abstract:* Aminoglycoside resistance through the production of aminoglycoside modifying enzymes (AMEs) is common and thus of clinical importance. The presence of AMEs genes in gram negative bacteria on plasmids, transposons and integrons facilitates the rapid acquisition of antibiotic resistance. This study aimed to characterize AMEs in antibiotic resistant strains of Escherichia, Klebsiella, Pseudomonas and Acinetobacter implicated in invasive infections in Nairobi, Kenya. The experimental design was a two point cross-sectional design comparing 54 clinical isolates obtained from the KEMRI laboratory collected in 2001 to 2006 and 54 clinical isolates from Aga Khan University Hospital collected in 2007 to 2008. The isolates were identified, tested for antimicrobial susceptibility to seven aminoglycosides then the AMEs were detected phenotypically and genotypically. The most prevalent AME gene detected was acc(6)-Ib-cr (45.9%) followed by acc(3)-II (25.9%, aac(6)-I(22.2%) and aac(3)-I (16.3%). Phenotypic studies showed that multidrug resistant Pseudomonas aeruginosa harboured numerous AMEs and 81% of the resistance was conferred by impermeability. Increase in aminoglycoside resistance by both naturally derived and semi synthetic antibiotics is alarming. Methods for monitoring their effectiveness should be instituted at the different healthcare system in Kenya. Key words: Aminoglycoside, antibiotic resistance, aminoglycoside –modifying enzymes (AMEs).

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **R.Ntabo**, H. Boga, A. Muigai and R. Mwirichia.

*Title of Publication:* Isolation and Characterization of Bacteria Isolates from Soil feeding termites and Soil from Juja and kakamega forest in Kenya.

*Abstract:* In the last several years information on the gut ecosystem of termites has continued to be gathered. Most studies have been focused on wood feeding termites but studies on soil feeders remain sparse owing to their difficulty of establishing permanent laboratory cultures. The aim of this study was to isolate, characterize and identify bacteria resident in the soil feeding termite gut, mound and parent soil of Cubitermes species with the potential to produce antibiotics and enzymes for industrialization. The samples were collected from kakamega forest from two sites Kalunya Glade and Lirhanda Hill. The study was also extended to the soils found in Juja. Hundred and thirty seven (137) isolates were cultivated and isolated using dilute nutrient agar media and screened for their antagonistic effects on various test organisms. Fifty one percent of the isolates were antagonist to Escherichia coli. Fifty seven percent of the isolates

were antagonists to Bacillus subtilis while 55% of the isolates were antagonist to Candida albicans. Enzymatic activities of the isolates showed that 65% of the total isolates were starch degraders, 54% were casein degraders and 68% of the isolates were able to liquefy gelatin. Eleven percent of the isolates were cellulose degraders the majority of which were obtained from termite gut and mound. Isolates from Juja soil had the highest number of non degraders as compared to Kakamega Forest soils. The isolates were characterized using morphological, biochemical and molecular methods. Phylogenetic analysis of amplified 16S rRNA gene sequence revealed majority of the isolates were closely related to Bacillus and Brachybacterium species and had showed invitro antagonistic effects. Gram negative bacterial isolates obtained were closely related to Pseudomonas species. In conclusion, the isolates were potential antibiotic producers with varying ability to degrade gelatin, casein, and cellulose an indication of the role they play in their habitat. Key words DNBA· Colony forming unit· Mound· Gut· Surrounding soil· Kalunya· Lirhanda hill· Juja.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **W.O. Nyakundi**, G. Magoma, J. Ochora and A.B. Nyende.

*Title of Publication:* A survey of pesticide use and application patterns among farmers: a case study from selected horticultural farms in rift valley and central provinces, Kenya.

*Abstract:* About 25-35% loss in agricultural produce is caused by pests and diseases which can be controlled by use of pesticides. These pesticides kill or deter the destructive activity of the target organism and they posses' inherent toxicities that endanger the health of the farmers, consumer and the environment. This leads to a need to study or assess pesticide usage patterns and applications on horticultural farms. To this effect a survey was carried out in Rift Valley and Central provinces of Kenya between October 2009 and January 2010 on horticultural farms producing either kales french beans, cabbage, eryngium, morbydick and arabicum. Results indicated that pesticides are readily available and widely used in farms and the main herbicides in use were identified as linurex 50 wp and diurex 80wp while insecticides included diazol 60EC and methomex 90S, fungicides included folicur EW and dithane M45. Sixty (60%) of the respondents were Male and 40% female between the age of 20-60 years with an average age of 45 and a standard deviation of 13.3 years. Eighty (80%) of the respondents agreed to use hats, gloves for protection but they were not in good condition thus exposing them to pesticides. The pesticides affected the environment by citation of death of fish in nearby rivers. The most frequently mentioned source of information was from commercial media (37.6%), government agricultural extension officers (26.4%), village leaders (25%) and finally the opinions of other community leaders. Educational interventions are essential for promoting

safety during all phases of pesticide handling. Public policies should be developed to encourage farmers to change their pest management methods from chemical based to methods that are healthier and more environmentally friendly. Key words: Pesticides, horticultural farms and pesticide application.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **W.O. Nyakundi**, G. Magoma, J. Ochora and A.B. Nyende.

*Title of Publication:* Biodegradation of Diazinon and Methomyl pesticides by white rot fungi from selected horticultural farms in rift valley and central provinces, Kenya.

*Abstract:* White rot fungi are robust organisms and are generally more tolerant to high concentrations of polluting chemicals than bacteria, they therefore present a powerful prospective tool in bioremediation. In this study, the potential for biodegradation of methomyl and diazinon by white rot fungi through enrichment and isolation of methomyl and diazinon biodegraders from horticultural soils was done. Five white rot fungal isolates WR1, WR2, WR4, WR9 and WR15 were cultured in a medium containing methomyl and diazinon as the only carbon source and incubated at 280C and monitored for biodegradation at intervals of 10 days for a period of 100 days. Using Gilson HPLC system with acetonitrile (75% sample: 25% acetonitrile) as the mobile phases. The biodegradation of methomyl and diazinon overtime using fungal isolate mixtures, took 59 days while for individual isolates, it took a maximum of 100 days to biodegrade the pesticides. These proofs that fungal mixtures in soil fasten the rate of biodegradation of pollutants compared to individual isolates. The pesticide methomyl was eluted at 4.9 minutes while the methomyl metabolite was eluted at 4.1 minutes. Diazinon was eluted at 11 minutes while the diazinon metabolites; diazoxon and oxypyrimidine were eluted at 2.3 and 2.6 minutes. The HPLC method used enabled the separation and quantification of the pesticides in a HPLC runtime of 15 min. Results indicated that after 100 days all the isolates managed to biodegrade the respective pesticides. The rate of mineralization or disappearance of a pesticide was proportional to the concentration of the pesticide. White rot fungi are advantageous over bacterial systems since these fungi can grow rapidly when supply of nutrients is low/limited. Key words: White rot fungi, Methomyl, Diazinon, Metabolite and biodegradation.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

# 6. INSTITUTE OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY (ICSIT)

## 6.0 DEPARTMENT OF COMPUTING

*Name of Lecturer/Authors:* **R. W. Mwangi,** C. Mwathi, R. M. Waweru and L. Nyaga
*Title of Publication:* Integrating ICT with education: using computer games to enhance learning mathematics at undergraduate level.

*Abstract:* Integration of ICT in the education sector is a desired trend globally. Where it has been adopted, it contributes significantly to increased access to education for all (EFA). This research seeks to look into ways in which computer games as ICT tools can be used to enhance and promote quality teaching and learning; particularly in creating and sustaining interest in the teaching and learning of Functions, a topic taught in mathematics courses such as Discrete Mathematics, Real Analysis and Calculus, among others. At Jomo Kenyatta University of Agriculture and Technology (JKUAT) in Kenya, the topic is introduced to students of Mathematics and those of Computer Science in first year Discrete Mathematics. A computer game was developed using Full Professional Adobe Acrobat 9 Pro. The game is designed in five levels in line with the progression of functions subject content. A minimum score of 60% for each level was built in the game to ensure the player has a good grip of the content for a certain level before moving on to the next level, thus contributing to guided revision of the level with fun. After game development, it was availed to ten first year Bachelor of Science in Mathematics students taking discreet Mathematics course at the Taita Taveta Campus of JKUAT. The students were in their second semester academic year 2009/2010. Analysis of end of the semester examinations results show that students who played the game had better performance than their counterparts who had not. Recommendations for further work as advancement of this research is development of a more advanced game in terms of adaptation of the game for use in teaching and learning other Mathematics topics considered to be boring, or difficulty or both and ultimately for purposes of promoting universal quality of university teaching. Key words: ICT, educational computer games, discrete mathematics

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **P. T. Ndung'u**, R. W. Mwangi and S. M. Kang'ethe.
*Title of Publication:* Fulltime biometric mouse design for continuous authentication.

*Abstract:* As we embrace the information and communication technology in our everyday activities and day-to-day transactions, security concerns have increasingly come to light, especially in some of the critical areas of our society today such as education, health and commerce, where such security concerns are even higher. The need for complete and clear authentication and authorisation is of paramount importance. This paper explores and presents the

optimal use of full-time biometric mouse (FBM) for continuous authentication, which would not only enable authentication during log in and start of an application, but will enable continuous authentication throughout a transaction. We formulate a full-time biometric mouse (FBM) design that would ensure thumb positioning and its ergonomics while ensuring comfort and maximum contact with the scanner to enable continuous authentication of the user in a speedy, easy and non-strenuous way. The mouse employs a simple algorithm that ensures quick operation to cut on possible delays and yet maintain the accuracy of the system.Key words: Biometrics, continuous authentication, identification, verification, authentication, minutiae.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* T. Catarci, A. Dix, **S. Kimani** and G. Santucci.
*Title of Publication:* User-Centered Data Management.
*Abstract:* This lecture covers several core issues in user-centered data management, including how to design usable interfaces that suitably support database tasks, and relevant approaches to visual querying, information visualization, and visual data mining. Novel interaction paradigms, e.g., mobile and interfaces that go beyond the visual dimension, are also discussed.

*Name of Journal/Conference Proceedings/Workshop:* Publishers: Morgan & Claypool Publishers, 2010. ISBN: 9781608452811.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* S. Berkovsky, M. Coombe, J. Freyne, D. Bhandari, N. Baghaei and **S. Kimani.**
*Title of Publication:* Exercise and Play: Earn in the Physical, Spend in the Virtual.
*Abstract:* Contemporary lifestyle is becoming increasingly inactive: a little physical (sport, exercising) and much sedentary (TV, computers) activity. The nature of sedentary activity is often self-reinforcing, such that increasing physical and decreasing sedentary activity is difficult. We present a novel approach aimed at combating this problem in computer gaming. Rather than explicitly changing the amount of physical and sedentary activity a person sets out to do, we propose a new game design that leverages engagement with games in order to motivate players to perform physical activity as part of a traditional sedentary game playing. This work presents the design and evaluates its application to an open source game, Neverball. We altered Neverball by reducing the time allocated for the game tasks and motivated players to perform physical activity by offering time based rewards. A study involving 180 young players showed that the players performed more physical activity, decreased their sedentary playing time, and did not report a decrease in perceived enjoyment of playing the active version of Neverball. A survey conducted amongst 103 parents revealed their positive attitude towards the activity motivating game design. The obtained results position the activity motivating game design as an approach that can potentially change the way players interact with computer games and lead to a healthier lifestyle.

*Name of Journal/Conference Proceedings/Workshop:* Cognitive Technology Journal 14(2), 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **S. Kimani**, N. Baghaei, J. Freyne, S. Berkovsky, D. Bhandari and G. Smith.
*Title of Publication:* Gender and Role Differences in Family-Based Healthy Living Networks.
*Abstract:* We have recently witnessed a tremendous increase in popularity and growth of online social networks. Social support and family involvement can play an important supportive role in health management. An increasing number of family members are establishing online social networking relationships with their families. This trend poses new research questions on effectively accommodating family members in online social networks. Family members themselves often have very different requirements based on their gender and family role. There is little research on the design of family-oriented social networking applications. In order to fill this research gap and investigate the impact of social and family relationships in online social networks, we are developing a healthy living online social application to support families in adopting healthy lifestyles. This paper reports the findings of a user study aimed at understanding gender- and role-based characteristics and differences in family-based healthy living social networks. The study shows that female users play a major role in leading the usage of the social technology; parents remain conscious of and concerned about their family's health as they interact with the social technology; and the social technology should support fun, especially for children.

*Name of Journal/Conference Proceedings/Workshop:* International Conference on Human Factors in Computing Systems (CHI 2010), 2010. Published by: ACM New York, NY, USA, Pages: 4219-4224.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **S. Kimani**, S. Berkovsky, G. Smith, J. Freyne, N. Baghaei and D. Bhandari.
*Title of Publication:* Activity Awareness in Family-Based Healthy Living Online Social Networks.
*Abstract:* Social relationships and family involvement play an important role in health management, whereas activity awareness is useful in decision-making and stimulating motivation and action. In this paper, we propose a novel activity awareness user interface for family-oriented healthy living social networks. It is intended to increase family members' interaction with healthy living social networks. A user study showed that the activity awareness interface can add value to specific aspects of interaction with family-based healthy living social applications. The interface increased interaction with the underlying healthy living content and led to higher level of learning about healthy living and impact on specific healthy living activities. There was also significant appreciation of and interaction with the activity awareness user interface elements.

*Name of Journal/Conference Proceedings/Workshop:* International conference on Intelligent User Interfaces (IUI 2010), 2010. Publishers: ACM New York, NY, USA; Pages: 337-340. ISBN: 978-1-60558-515-4.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Kiula, B. M**. and Wafula, J. M.

*Title of Publication:* ICT penetration and utilization in local authorities in Kenya: the status and implications.

*Abstract:* Effective penetration and utilization of ICT in the public service for high-end value-adding operations in local government is crucial to enhance effective and efficient services that satisfy the citizens and other stakeholders. ICT penetration and utilization in the local government has not reached the levels necessary to reap the benefits of ICT in service delivery. This study sought to find out the status of ICT penetration and utilization and what the observed status implies. Three councils were purposively selected for this study. Stratified random sampling was employed to obtain respondents within the councils. Eighty respondents were obtained with a ratio of proportional allocation being used to allocate proportionate samples to the councils and their departments based on the respective staff populations. An ICT penetration and utilization index was developed based on a custom-made weighting. Pearson Moment of Correlation Coefficient and test of statistical significance were used to compare the strength of linear relationship between the index and ICT resources with descriptive statistics being used to analyze the results. ICT penetration and utilization was found to have a significant linear relationship with ICT resources, the level of education, age, length of service and the job scale of staff. Great investment in ICT resources and better educated staff was recommended towards improved ICT penetration and utilization in local authorities. Key words ICT - Information and Communication Technology (technologies, including computers, telecommunication and audio-visual systems, that enable the collection, processing, transportation and delivery of information and communication services to users as per the Kenya ICT Sector Policy Guidelines) ICT Penetration and Utilization- This refers to the presence of, access and use of ICT or the extent of ICT infrastructure, its access, use and value addition to the organization.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **C. Wamuti**, E. Mochoge and Dr. Waweru.

*Title of Publication:* Autonomous intelligent Computer Based Training – Robotics.

*Abstract:* This paper seeks shows how to extend Computer Based training - C.B.T by building independent components with intelligence. It explains the methodologies that could be employed given the new programming frameworks. Historically, CBTs growth has been hampered by enormous resources required: human resources to create a CBT program, and hardware resources needed to run it. However, the increases in PC computing power and especially the growing prevalence of computers equipped with CD-ROMs is making CBTs a viable

option for corporations and individuals alike. Many PC application come with a modest form of CBT, often called a tutorial (Webopedia 2009). A common example of a CBT is Microsoft's Encarta. Despite this goodness of a CBT, they suffer a really big problem, that is, they are only accessible on a mainframe, not from a remote site. This makes such systems not offer the goodness foretold by e-learning systems. But then, there must be a solution for this. The answer is yes. The answer is: "... several distinct physical components working together as a single system." (Barnaby T., 2002). Following Barnaby's approach, it is natural to think about a central controlled system managing intelligent agent that teaches in class rooms. Keywords: Artificial Intelligence, agents, eLearning, robots, Computer Based Training.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Geoffrey Wekesa Chemwa.**

*Title of Publication:* Security Issues Faced by Mobile Cash Transfer Applications in Kenya on GSM and 3G Networks.

*Abstract:*

The advent of mobile cash transfer and mobile banking applications in Kenya has given rise to unprecedented mobile transaction security issues. These applications run on Global System for Mobile (GSM) communications networks and the Universal Mobiles Telecommunications Systems (UMTS). GSM networks were standardized by the European Telecommunications and Standards Institute (ETSI) in 1990 and moved from second generation standard (2G) to 2.5G in 1997 with the introduction of the General Packet Radio Service (GPRS). On the other hand, UMTS was standardized by the Third Generation Partnership Project (3GPP) into a 3G network with the introduction of the High-Speed Downlink Packet Access (HSPDA) in 2001 (Aura, 2009). It is a known secret that GSM networks face serious security concerns like false base station attacks, short key lengths, internetwork leaks, intra-network weaknesses and compromised authentication algorithms. These weaknesses pose a great danger to any applications that run on the network. Research shows that attacks such as channel hijacking, message alteration, call interception, phone cloning, and denial of service, malware and fraud could be perpetrated on GSM networks (Gemalto, 2009). The 3G security architecture tries to address these concerns. This paper postulates that since mobile cash transfer and banking applications security architectures were developed in obscurity, they could easily be cracked when they lose their obscurity. The paper investigates the security loopholes present on 3G networks and their likely impact on the security of cash transfer and banking applications. The study also looks at the security of the applications themselves and how biometric authentication can be used to improve security through multimodal authentication. Keywords: Mobile banking, 3G, mobile applications, security, convergence, mobile cash transfer.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Gichuru J.N.**, Dr. Waweru Mwangi and Dr. M. Kanyaru.

*Title of Publication:* A Fuzzy Model Based on Software Quality Metrics which Estimates Software Maintainability.

*Abstract:* Software maintainability continues to be of great essence in software development. Low maintainability in software leads to rigorous maintenance activities that scale up the overall cost of development as well as reducing the functional duration of an application. In order to continually improve software applications, a means to quantitatively measure software maintainability is necessary. This paper proposes a prediction model built on fuzzy logic technology to estimate the maintainability of a software product. This research is guided by two objectives: First is to establish the factors that determine software maintainability at source-code level and the metrics that capture these factors. Second is to establish a means of combining these metrics and weigh them against each other. The outcomes of these objectives are presented as well as a discussion of knowledge modeling using fuzzy logic. The development of this model is based on the fact that maintainability like other software quality facets can be described in terms of a hierarchy. This hierarchy consists of factors, attributes and metrics. The model captures factors that determine maintainability at source-code level as articulated by various attributes. Three metrics which quantify these attributes are then considered as input parameters to the model. These metrics are average Cyclomatic complexity, average number of live variables and the average life span of variables. Fuzzy logic is then used to weigh the metrics against each other and combine them into one output value which is the estimated software maintainability. This work is a contribution to the on-going research aimed at establishing a means to quantify maintainability of software. It is also an improvement to the much criticized Maintainability Index (MI), the identified measure so far. Keywords: Software maintainability, fuzzy logic, average Cyclomatic complexity, average live variables and average variable span.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Muliaro J. Wafula**; Albert Kibe; Kiula, Boniface Mwirigi; Caroline Wambugu.

*Title of Publication:* Computer usage in institutions of higher learning: case of JKUAT.

*Abstract:* Universities worldwide are impressing adoption of computers in their operation and delivery of services. Enterprise Resource Planning systems (ERP) are among Management Information Systems (MIS) preferred for adoption. The adoption ensures optimization of ICT resources. JKUAT has implemented Sage

ACCPAC ERP and in the process learnt lessons that can be shared. Through a survey conducted across the University, this paper sought to examine the effectiveness and correctness of computer usage at JKUAT. The findings of the survey pointed to the need of formulating a computer usage policy (CUP). The paper outlines the implications of operating without a computer usage policy. Key words: Enterprise Resource Planning, Information and Communication Technology, Computer Usage Policy, Management Information System.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Mokua Richard**, Dr.Waweru Mwangi, Dr. John Mathenge Kanyaru.

*Title of Publication:* Design and implementation of an object oriented programing language.

*Abstract:* This paper presents work done to address two issues of interest to both Programming Language (PL) theory and software development: 1) The inadequacies of mainstream Object Oriented Programming Languages used in the software industry such as Java, C# and C++ and 2) The design and implementation of a statically typed Object Oriented Programming Language that addresses some of the issues identified above. Research was conducted through critical analysis of existing Object Oriented Programming Languages (OOPL) as well as a literature review of journal and conference publications in that area. The aim was to elicit evidence of PL constructs that had been found through previous experience to lead to poor Software Engineering practices such as increased amount of bugs, poor maintainability, late (i.e. runtime) detection of errors, poor usability and low programmer productivity. This work has produced key benefits that include a deeper understanding of PLs specifically OOPLs, and an improved comprehension and appreciation of the nuances of PL design. The findings have the potential to benefit PL researchers and designers in various ways. We consider that the contributions of this work are that a list of the language constructs (e.g., Static Variables, Lack of Object Level Encapsulation, Presence of Primitive Types) that seem to lead to poor Software Engineering practices with current OOPL have been identified. A further significant contribution is the production of a new OOPL designed to act as proof of concept to illustrate how these issues can be addressed. Keywords: Object Oriented Programming Language, Compilers, Software Engineering, Type Systems, Compiler Design and Construction

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

# 7. INSTITUTE OF ENERGY AND ENIVIRONMENTAL TECHNOLOGY (IEET)

*Name of Lecturer/Authors:* **P. M. Njogu**, J. M. Keriko, R. N. Wanjau and J. J. Kitetu.
*Title of Publication:* Distribution of heavy metals in various lake matrices; water, soil, fish and sediments: A Case study of the Lake Naivasha Basin, Kenya.

*Abstract:* Water, sediments, soil and fish, common carp (Cuprinus carpio), largemouth blackbass (Micropterus salmoides), tilapia (Oreochromis leucostictus) and mirror carp (Cyprinus spectacularlus) from the Lake Naivasha basin were analysed for lead (Pb), cadmium (Cd), zinc (Zn), copper (Cu) and nickel (Ni). Samples were collected from the Main Lake, Lake Oloidien, Crescent Lake, River Malewa, Naivasha Municipal Council Sewer entry point, flower farm discharge canals and the Kenya Wildlife Services (KWS) Sanctuary (Joan Roots farm). Fish samples were bought from fishermen while still alive and identified by the Kenya Marine and Fisheries Research Institute (KEMFRI) staff. The heavy metal concentrations were determined using flame atomic absorption spectrophotometry (AAS). The mean sediment concentrations (in µg/g dry weight) were 62.5 ± 26.5 for Ni, 42.39 ± 17.95 for Zn, 32.71 ± 16.94 for Pb, 1.52 ± 0.87 for Cu and 1.65 ± 0.96 for Cd respectively, whereas those in soil (in µg/g dry weight) were 25.69 ± 10.62 for Pb, 2.56 ± 1.40 for Cd, 53.28 ± 19.41 for Zn, 52.05 ± 22.64 for Ni and 1.02 ± 0.57 for Cu respectively. The mean heavy metal contents in fish (in µg/g wet weight) were 1.7 ± 0.91 for Pb, 0.33 ± 0.30 for Cd, 8.03 ± 2.7 for Zn, 14.34 ± 4.4 for Ni and 0.3 ± 0.11 for Cu, whereas those in the water column (total content) were 16.56 ± 9.55 µg/L for Pb, 12.69 ± 9.54 µg/L for Cd, 1.34 ± 0.48 mg/l for Zn, 0.18 ± 0.13 mg/l for Ni and 5.68 ± 3.71 µg/L for Cu respectively. The study shows that the most important sources of heavy metals pollution in the Lake Naivasha basin are River Malewa, geochemical processes, flower farms and the Naivasha Municipal Council. Key words: Lake Naivasha, pollution, heavy metals, sediments, soil, fish, Oloidien.

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 13(1) 2011.
*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Francis Xavier Ochieng.**
*Title of Publication:* EAC Capacity Assessment / Capacity building of EAC secretariat to implement the Regional Strategy on scaling up access to modern Energy services.

*Abstract:* The East African Community (EAC) Secretariat is currently implementing the Regional Strategy on Scaling up access to modern energy services. The strategy seeks to achieve implementation of four main targets: access to modern energy cooking services; access to electricity for peri-urban and urban areas; access to electricity for communities, health centers and schools; and lastly access to mechanical energy for productive use. In a bid to implement this strategy the EAC undertook a Capacity assessment to understand aspects that need strengthening in

order for it to implement the strategy.
The main "quick-win" results of this Energy based CA/CD study indicated that EAC secretariat needs to:

a. Strengthen the national focal points at each of the partner states to enable them implement the strategy
b. Develop a data base of best practices and lessons learnt of energy activities and projects undertaken in the EAC partner states. A strategy for implementation should also be included.
c. Harmonization of EAC partner states policies & strategies with that of the regional strategy
d. Development of the policy and administrative systems to enable EAC utilize the climate negotiation funds for funding the strategy related energy activities
e. EAC secretariat to liaise with the Inter-University Council of East Africa (IUCEA) to enable them integrates energy issues in their activities.

*Name of Journal/Conference Proceedings/Workshop:* 2nd Stakeholder's workshop on CA/CD for the EAC secretariat to implement the Regional strategy on scaling up access to modern energy services held on 11th – 12th May 2011 in Kigali, Rwanda

*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Francis Xavier Ochieng.**

*Title of Publication:* Final evaluation of the Somalia Energy and Livelihoods Programme (SELP).

*Abstract:* Somaliland and Puntland represent some of the set of post-conflict states rebuilding their infrastructure. As a key driver, the provision of energy in a country where 95% of the population rely on traditional unsustainable biomass provides a special challenge. The study assessed an energy up scaling model where cross-sectoral approaches involving provision of renewable energy technologies to schools, health centers and community centers ; developing of community cooperatives to fabricate and sell improved cook stoves; training of technicians to install and maintain solar products including solar pumps; and lastly fabricated and disseminated a mechanical wind pump. The utilization of cross-sectoral applicative approaches in energy ensured the wide application of renewable energy technologies to communities in post-conflict states of Puntland and Somaliland. It also led to the development of an improved stove and mechanical wind pump fabrication industries. The latter is especially remarkable since this is the first time that mechanical wind pumps have been fabricated by another organization apart from Bob Harries Limited (BHEL) outside Kenya. This achievement was due to the knowledge and technical transfer agreements between Xareed Company in Somaliland which was supported by ADRA in Somalia.

*Name of Journal/Conference Proceedings/Workshop:* Presentation of the Final project Evaluation of the Somaliland Energy and Livelihood Project at ADRA-Somalia office in March, 2011.

*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **Francis Xavier Ochieng.**

*Title of Publication:* A field Assessment of Plastic Tubular biogas digesters in Kenya.

*Abstract:* Previous studies have indicated that Plastic Tubular digesters (PTD) normally have a high failure rates. In a bid to understand this, the study undertook to assess a sample of 32 PTDs in 5 counties (Kisumu, Kajiado, Kiambu, Nairobi and Eastern) in Kenya out of the potential installed 300 PTD's installed country wide. Results indicate that the main reasons for failure of PTD's has mainly to do with the material used in making them and the end-user management of the PTD's. The use of higher quality plastic material that is flexible as applied in the fourth generation PTD's has enabled a drastic reduction of the failure rates of PTD's in the counties studied.

Further the proper training of the end user accounts for almost 90% of the failure of PTD's in Kenya. In the assessed sample's 3 out of 10 PTD's have failed due to poor management by the end user. In most cases this takes the form of either over-feeding or under-feeding of the digester, stepping on or puncturing the digester bag by animals or children and lastly the poor quality of the feed stock leading to scum formation and subsequent failure of the digester.

*Name of Journal/Conference Proceedings/Workshop:* Submitted for peer review before self publishing.
*Year of Publication:* 2011.

# 8. INSTITUTE OF TROPICAL MEDICINE AND INFECTIOUS DISEASES (INTROMID)

## 8. 0 DEPARTMENT OF MEDICAL LABORATORY SCIENCES

*Name of Lecturer/Authors:* G.A. Murilla, **Jesca O. Wesongah**, Terence Fodey, Steven Crooks, A. N. Guantai, W. M. Karanja and T. E.Maitho.

*Title of Publication:* Validation of a competitive chloramphenicol enzyme linked immunosorbent assay for determination of residues in Ovine tissues.

*Abstract:* Chloramphenicol (CAP) is a broad-spectrum antibiotic, which has been used in animal production. However, in humans it leads to hematotoxic side effects, in particular CAP induced aplastic anaemia for which a dosage-effect relationship has not yet been established. The objective of this study was to validate a locally developed CAP enzyme linked immunosorbent assay (CAP ELISA) for determination of CAP residues in ovine tissues. Two groups (n=5) of sheep were treated with CAP sodium succinate at 25-mg/kg bodyweight and slaughtered one and four weeks post treatment. Overall the mean percentage recoveries in muscle, liver and kidney were 92 %, 70% and 78% respectively. The limit of detection (LOD) and detection capability (CCβ) for muscle, kidney, liver, were 1.2ng/g, 0.6ng/g and 0.8ng/g and □2.5 ng/g, □1ng/g and □1ng/g respectively, allowing the CAP ELISA to be used effectively as a screening tool for CAP residues in livestock products (liver, muscle and kidney).

*Name of Journal/Conference Proceedings/Workshop:* The East and Central African Journal of Pharmaceutical Sciences, Vol. 13 No. 1, pg 12 -18: ISSN 1026-552X.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* S. K. Emmanuel, **J. R. Ongus** and J. Oundo.

*Title of Publication:* Syphilis among Pregnant Women in Juba, Southern Sudan.

*Abstract:* *Background:* Syphilis is a chronic infectious disease caused by the spirochaete *Treponema pallidum* subspecies *pallidum*. It has significant long-term morbidity for mothers and can seriously make several complications in pregnancy, which may result in; spontaneous abortion, stillbirth and other negative outcomes including congenital syphilis. There is currently, no data on the burden of syphilis in pregnant women in Juba. But surveillance conducted in 2007 revealed that the prevalence range from 12% to 21% in some areas in southern Sudan.

*Methods:* A cross-sectional study was carried out in three antenatal clinics in Juba to determine the prevalence and associated factors for syphilis in pregnant women. 231 Pregnant women who consented were recruited using a standard questionnaire and 5mililitres of blood was collected and plasma was obtained. Samples were tested for syphilis using both RPR and TPHA tests.

*Results:* Out of the 231 samples 51 (22.1%) tested positive for active syphilis. significant risk factors identified in this study

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|---|---|
| | were; being a housewife (OR 2.808; 95% CI 1.259-6.262; P= 0.0116), History of abortion (OR 2.654; 95%CI 1.244-5.664; P= 0.0116) and history of partner travel (OR 2.149; 95%CI 1.088-4.263; P= 0.028), while attending antenatal clinic for previous pregnancy was a protective factor (OR 0.281;95%CI 0.143-0.564; P= 0.0004). Other factors which were not significantly associated with syphilis were polygamous married (p= 0.355); given birth before (p= 0.386) and duration of stay with partner (p= 0.161). The prevalence of syphilis is 22.1% in pregnant women in Juba which is still high as compared to other studies; being a housewife, history of abortion and history of partner travelling were identified risk factors while attending antenatal clinic for previous pregnancy was a protective factor.<br>*Conclusions:* Screening and treating mothers for syphilis in their first visit to antenatal clinic can reduce the prevalence and outcomes of syphilis in pregnancy. Regular health education is also necessary for expectant mothers to create more awareness about the disease. |
| *Name of Journal/Conference Proceedings/Workshop:* | East African Medical Journal. Vol. 87 No. 5 May 2010. |
| *Year of Publication:* | 2010 |

# 9. SCHOOL OF HUMAN RESOURCE DEVELOPMENT

## 9.0 DEPARTMENT OF COMMERCE AND ECONOMIC STUDIES

*Name of Lecturer/Authors:* **Margaret Oloko.**
*Title of Publication:* Influence of power distance on employee empowerment and multinational corporation performance in Kenya.

*Abstract:* Most scholars in this area of study state that performance of organizations is highly dependent on the influence of power distance which refers to the extent to which members of an organization expect and accept that power is distributed unequally amongst themselves within the hierarchy in terms of either high or low power distance in a host country. Employee empowerment is of utmost importance in terms of its contribution to the multinational corporation performance (MNC) today. The overall objective for the study is to establish the influence of power distance on the relationship between employee empowerment and organization performance. The specific objectives were to establish the influence of power distance on the strength of the relationship between employee empowerment and organization performance and to establish whether there is a direct relationship between employee empowerment and organization performance. Data for the study was collected using a questionnaire which contained measurements of power distance, employee empowerment and non-financial measures of performance of organizations. A pilot study was conducted to pre-test the questionnaire using a sample of 10 respondents. The questionnaire consisted of a Likert type scale ranging from 5 – very great extent to 1 – not at all. A census study of 60 multinational corporations operating in Kenya was conducted. The response rate was 65%. That is, 39 firms were interviewed. These results confirmed that the strength of the relationship between employee empowerment and MNC performance in a host country is influenced by power distance. The result ($r = 0.608, < 0.01$) showed a moderate relationship between employee empowerment and MNC performance. The magnitude of the correlation coefficient implies a moderate relationship ($r = 0643$, $p < 0.01$) between employee empowerment and organization performance. Key Words: Employee Empowerment, Power Distance and Multinational Corporation Performance (MNC).

*Name of Journal/Conference Proceedings/Workshop:* 5th JKUAT Scientific, Technological and Industrialization Conference 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Joseph A. Misati** and Dishon M. Mngoda.
*Title of Publication:* Re-visioning Kenya's social development agenda for industrialization and sustainable development.

*Abstract:* Kenya aspires to become a globally competitive and prosperous Nation with high quality of life by the year 2030. This quest began soon after independence with the realization the government needed to put in place measures to ensure rapid economic development and social

progress for all citizens. A premier social policy; sessional paper no. 1 of 1965 on African Socialism and its application to planning in Kenya envisaged to spur economic growth by rapid industrialization and development of the productive agricultural sector in rural areas failed to embrace decentralized decision-making and local participation and by 1970's the inadequacies of the economic growth & top down approaches had become apparent. In the subsequent decades, the government formulated and implemented various policies and reform measures aimed at decentralization efforts to enhance equity and faster pro-poor growth. In the education sector, the Gachathi report (1976) and Mackay report (1981) among others sought to emphasize the need for education for practical orientation and self reliance , While in the health sector the government launched its proposal for far reaching changes placing greater emphasis upon decentralized priority setting and equitable allocation of resources alongside the national development plans. In 1983, the District Focus for Rural Development (DFRD) strategy was launched with the sole aim of making the district the locus for project identification and implementation. More recently, the Economic Recovery Strategy for Wealth and Employment Creation (ERSEWC 2003) which outlined interventions and strategies for reducing poverty aimed at enhancing access to the benefits of economic growth by the most disadvantaged members of the society was formulated, culminating in the current blue –print, The Kenya Vision 2030. This paper assesses the reforms and their resultant impacts on social development in Kenya over the decades, with greater emphasis placed on the current programmes. It argues that whereas the strategy's foundation is erected on the economic, social and political pillars, strengthening the on-going institutional and governance reforms will go a long way in raising efficiency in the production and social sectors. Data was obtained mainly from secondary sources including; sessional papers, National development plans and statistical abstracts. Discourse analysis involving a critical review of the existing literature indicates that the implementation of various development policies notwithstanding, poverty and other development related setbacks persisted. It is recommended that constructive civic engagement, cubing brain drain among highly trained technocrats, ensuring sustainable peace and tranquility specially in the neighboring countries and restoring financial discipline including curbing corruption will go a long way in guarding against depleting the much prized gusto necessary for propelling the county towards industrialization by the year 2030. Key Word: Participatory Governance, Vision 2030, Social Development, Decentralization.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

## 9.1 DEPARTMENT OF ENTERPRENEURSHIP AND PROCUREMENT

*Name of Lecturer/Authors:* **E. W. Gakure** and Peter Paul Kithae.

*Title of Publication:* Youth led MSES investment in technology; aiding business growth or a nought?

*Abstract:* Technology has been described as "the systematic application of scientific and other organized knowledge to practical task". When applied to micro and small enterprises, technology has proved to be the engine of economic growth amongst "Asian Tigers". The purpose of technology is to improve productivity of enterprises, and enhance the quality of goods produced by enterprises to help them withstand local and international competition. According to Haan (1999), there is evidence that SMEs in Kenya are continually engaged in adapting Industrial equipment for their own use and self constructing tools and equipment. There is also evidence that other informal sources of information such as friends and simple imitation through observations are common. Coupled with this, the Kenyan government has done a lot in creating enabling environment for youth led MSES to compete favourably with other enterprises. Youths are innovative, enthusiastic, vibrant and optimistic. Given a chance, youths are capable of transferring their acquired technologies into business enterprises and drive Kenya towards achieving its vision 2030. However, most youths are not employed. They are not starting own enterprises to create jobs for themselves and for others. Even their already started MSES are closing up within their first two years after start up. The baseline survey of 1999 estimated that 80% of the MSEs fail within their first three years due to problems related to appropriate technology. This research study aimed at investigating how technologies that youth acquired in various forums and learning institutions affect performance of their enterprises. It used training, purchase of equipment, franchising and sub-contracting (forms of technology) as its independent variables while Improved product quality, increased efficiency, increased output, increased sales, improved sustainability and increased profits & market share (effects on MSE performance) were its dependent variable. Both qualitative and quantitative research designs were used. Quantitative design revealed the direction and strengths of the variables while qualitative design discussed the main themes. The design was descriptive in nature; as Gall and Borg (1989) noted, "Descriptive studies by nature emphasis interpretation". The target population for the study was youth led MSEs in Makueni district who received any form of technology between 2000 and 2007. The total number of all MSES in the district was estimated at 1320. Assuming those led by youths were 30 % (as youths are 30% of total house holds (GOK, 2006)), our target population became 396. The findings of the study were summed up in form of an MSE technology adoption model which showed that dependent variables were a function of investment in technology. Consequently, these variables affect performance of MSE which in turn influences the type of investment in technology that the MSE adopts. At start-ups and early stages of business growth, there is very

minimal investment in technology which results to inappropriate technology adoption forms and consequently to ineffective MSE performance. The study recommended a deliberate action to be taken in form of refresher courses for entrepreneurs and more capital injection to finance all the four forms of investments in technology and assist the MSES to break the vicious circle of poor performance. Once this is done, it was projected that the resulting technology will be able to help youth led MSES to achieve improvement of product and service quality, increased efficiency, increased output and sales volume, and increased profitability and market share. These profits would then be re-invested in technology to further enhance the enterprises' sustainability and global competitiveness and thus empower youth to build a better Kenya.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **K.L.Wanjau**, R.W. Gakure, J. Kahiri.

*Title of Publication:* The role of quality in growth of small and medium enterprises and economic development in Kenya.

*Abstract:* The purpose of this paper was to evaluate the contributions of quality initiatives towards growth and industrialization of manufacturing small and medium enterprises (SMEs) in Kenya. Quality has been recognized as a successful management philosophy in the manufacturing industry. The study adopted an exploratory approach using a descriptive survey. The instruments of the study were a questionnaire, interview schedule (structured) and an observation checklist. In this study, 123 manufacturing SMEs were extensively surveyed, to ascertain contributions made by quality initiatives in the manufacturing sector towards realizing growth and industrialization. The correlations between various quality implementation dimensions and growth have been evaluated and validated by employing various statistical tools. The findings revealed that quality has a positive influence on growth and industrialization of an organization and economic development in general. The overall results indicated that entrepreneurial management (EM), marketing orientation (MO) and capacity enhancement of employees had significant linear relationship with quality. Surprisingly, no statistical evidence was found to confirm the effect of investing in technology and adoption of quality. The study recommended that SMEs must create a culture that is conducive to and supportive of quality implementation. They must align quality implementation with their goals and competitive environment. Government and other organizations supporting entrepreneurship development could assist and train manufacturing SMEs to acquire appropriate technology. This will go a long way in assisting SMEs in initiating quality practices supported by technology. Findings of the present study may assist public policy – makers and entrepreneurs to evaluate the importance of quality in enhancing SME growth,

which serve as the best potential source of job creation and industrialization of the Kenyan economy. Keywords- Quality, SMEs, manufacturing enterprises, ISO, consultant, enterprise growth, economic growth.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Joseph Obwogi** and Romanus Odhiambo Otieno

*Title of Publication:* The effectiveness of quality assurance at Kenyan Universities: A Case of Jomo Kenyatta University of Agriculture And Technology.

*Abstract:* The purpose of this study was to assess the effectiveness of quality assurance in Kenyan Universities with a specific focus on Jomo Kenyatta University of Agriculture and Technology. The research sought to establish the effect of Government of Kenya regulations relationship on university quality assurance; the effectiveness of quality assurance practices on teaching and learning; and the challenges facing quality assurance initiatives. A descriptive study in form of a survey was undertaken on a population of 10,739 students and 1,000 employees, from both gender. Stratified random sampling was used to select respondents consisting of both staff and students. The findings of the study revealed that the university has a policy for quality assurance and also provides for external review of programmes, that quality assurance at the university is effective and quality assurance mechanisms are in place that the university has clear mechanisms for teaching and learning and rules and regulations are consistently applied during student evaluation and the examination processing. The teaching staffs are able to handle assignments and continuous assessment tests as guided by the course objectives; meet the course requirements, and regularly attend class. However, institutional facilities and services such as library, internet connectivity, academic trips, need to be addressed further. The study recommends that the university takes all actions to ensure that quality assurance standards and procedures are adhered to; and that delivered products or services meet performance requirements and standards. Key Word(s): Effectiveness, Quality Assurance, Academic Quality.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Henry M. Bwisa.**

*Title of Publication:* Towards the improvement of entrepreneurship education in Africa.

*Abstract:* Many African universities offer entrepreneurship education aimed at producing self-employable graduates to create employment. Kenya pioneered on the continent in starting a master's degree in entrepreneurship in the 1990s at its Jomo

Kenyatta University of Agriculture and Technology. Many other countries on the continent have introduced entrepreneurship education/training in one form or another at one level of education or another. However not many of entrepreneurship graduates are self-employed. Has this to do with the method of preparing the students? This author conducted research in Kenya to attempt an answer. The research produced findings which can be generalized and replicated on the continent. This paper presents the research findings which are used to give, among others, the following recommendations for Africa:

a. Employ effective entrepreneurship delivery and assessment methods.
b. Develop effective entrepreneurship educators.
c. Integrate entrepreneurs in curricula design and delivery.
d. Establish university business incubators.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology. 2010.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Roselyn W. Gakure** and Wario Guyo Wako.

*Title of Publication:* The role of project management in the success of projects undertaken by entrepreneurs in electrical contracting SME.

*Abstract:* Studies have shown that project management skills are crucial for successful implementation of complex projects. However the impact of such skills in the SME sector in general and in the electrical contracting sub-sector especially in this part of the world is not well known. This study sought to identify the role of project management skills in the success of small electrical contracting projects. The study assessed the most important project management skills necessary for successful implementation, the extent of its use, the factors limiting their use and the relationship between their use and project success. The study was a census of the SME electrical contractors in Thika. Primary data was collected using semi-structured questionnaires. Analysis was done using descriptive statistics and data presented in tables, charts and narratives. Secondary analysis was conducted using Pearson's correlation. The research found out that the project management was a vital component in the success of any project. According to most respondents, project management was all about organizing the resources like time, labour and money in order to enable the work to run smoothly. This shows that they understand project management more than it was expected. The research also identified the factors limiting the use of project management skills and the relationship between the Project Management skills and success of the project. These included unqualified workforce, inadequate funds, and lack of honesty from the employees and clients, unavailable materials, limited time among others. The study made several recommendations which included among other things training of SME electrical contractors, educating the public, improvement in licensing of contractors, and encouraging entrepreneurs to invest in well stocked hardware stores in Thika. Key words: Project management, project success, quality contracting, productivity, project management tool, customer satisfaction

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.
*Year of Publication:* 2010.

## 9.2 DEPARTMENT OF SOCIAL SCIENCES AND HUMANITIES

*Name of Lecturer/Authors:* **Ondieki-Mwaura**, F.N, Okello, J.J., Okello, J.J. and J. M. Bahemuka.
*Title of Publication:* Are there significant welfare outcomes for farmers who participate in global commodity chains? The case of export horticultural farmers in Kirinyaga Region of Kenya.
*Abstract:* The aim of this study was to determine whether farmers participating in export horticulture were better off than farmers who did not. This study is informed by debates on how globalisation and specifically global trade impacts on small farmers in third world countries, with proponents arguing that it has positive impacts and opponents arguing that participation in global commodity systems has little impact or even detrimental effect on small farmers. This study aimed to compare the welfare of participants in export horticulture with those of non-participants using both income and non-income indicators. A survey of 360 farmers was carried out in Kirinyaga to obtain household data with 240 export farmers and 120 non-export farmers being interviewed. Simple mean comparisons combined with p-score were used to determine whether significant differences existed between French bean and non-French bean. Both income and non-income indicators were used to determine welfare outcomes for the two groups of farmers. The study found that there were some differences in welfare indicators between those who participate and those who do not participate in French bean production, specifically in the type of housing, asset endowment and income. However, although export French bean farming had a positive impact on participating farmers its impact is declining as farmers' incomes from it are reducing. Key Words: export farmers, non- export farmers, welfare outcomes, income, non-income indicators, French bean production.
*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* E. Kimani and **K. Mwikamba.**
*Title of Publication:* Gender dynamics in science and technology.
*Abstract:* An understanding of gender dynamics in science and technology is based on the perspective of how social norms, values and attitudes dictate differentials in the participation of male and female in these fields. This in essence calls for a critical consideration of the forces, naturally and socially ascribed, that influence the choices that women and men make, both in education and professional alienation. While gender refers to socially ascribed differences between males and females as

women, men, girls and boys, there are notable natural differences dictated by sex that cannot be ignored. The discussion thus zeroes into what males and females can do, and what they think they can do or are expected to do by the society. The ideal is therefore on the differences between nature and nurture and by extension, sex and gender. The argument is that more than the physiological make up of an individual, the concept of gender is responsible for the female's lack of venture into science and technology, viewing it as a no go zone, hence male dominated in theory and practice. While education as a whole is important in empowering individuals, skills and knowledge in mathematics, science and technology are known to guarantees a place in the related world of work. The existence of glaring gender disparities in the participation in science and technology on the basis of gender is a global concern; hence a need to engage in scaling up strategies to encourage female to intensify their interest and participation in these areas, while ensuring that boys and men stay on. Key words: Gender, sex, participation, disparity, science and technology

*Name of Journal/Conference Proceedings/Workshop:* JAGST Vol. 12(2) 2010.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Ondieki-Mwaura**, F.N, Okello, J.J., Okello, J.J. and J. M. Bahemuka.

*Title of Publication:* Can smallholders continue to effectively participate in global commodity chains? The case of French bean production in Kirinyaga region of Kenya.

*Abstract:* The participation of smallholders in global commodity chains such as export horticulture has often been characterized as problematic given the high transaction costs that these farmers face. The involvement of small holders in Kenya's export sector has therefore been hailed as an exception rather than the rule success story especially given the fact that it has developed largely under the private sector. However, changes in certain standards in export markets such food safety standards have posed a threat to these farmers' participation. For example, there is increasing evidence that exporters of fresh produce prefer to work with larger farmers or even engage in production rather than work with small farmers. If smallholders are going to continue participating in export horticulture value chains, they will have to among other things develop and participate in institutional arrangements that reduce the increasing transaction costs brought about by international food safety standards. This study aims to describe the various institutional arrangements that small farmers use to participate in export horticulture and the challenges and constraints they face within these arrangements. In addition, it will determine factors that affect farmers' choice of alternative institutional arrangements that exist. A survey of 240 farmers was carried out in Kirinyaga to obtain household data and 4 focus group discussions were held in each of the four districts in Kirinyaga. The case study methodology was used to gather in-depth information on the key institutional arrangements used by farmers. The study found that the most

dominant institutional arrangements were selling individually to brokers, followed by selling as part of a group to an exporter. Some farmers were involved in more than one arrangement perhaps as a strategy to overcome the inherent disadvantages found in some arrangements. Key words: smallholders, participation, export horticulture, institutional arrangements.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Maina F. G. and **Sakwa M. M.**

*Title of Publication:* Understanding financial distress among listed firms in Nairobi Stock Exchange: a quantitative approach using the Z-Score multi-discriminant financial analysis model.

*Abstract:* The paper assesses the financial distress among listed firms in Nairobi Stock Exchange in Kenya. The Capital Market Authority (CMA) has a regulatory responsibility to keep surveillance of firms listed in Nairobi Stock Exchange (NSE) with regards to capital, liquidity and other aspects with overall aim of ensuring financial stability of these firms. The expectation is therefore that the firms will be financially prudent and healthy which in turn will attract investors. The recent crisis where a number of NSE listed companies' including stock brokers experienced financial distress is an indication that there is a missing link between surveillance and the management of these firms. If this is not rectified the public can loose interest in investing in Nairobi Stock Exchange. There is therefore a need to critically assess the financial position of the listed firms and suggest ways of improving the performance of NSE. This study utilizes the Z'-score multi-discriminant financial analysis model which provides the framework for gauging the financial performance of the firms. This is in addition to the use of the ANOVA and correlation tests in support the evidences from the Z-score model. The sample constituted selected firms listed in Nairobi Stock Exchange divided into five different sectors. The results clearly indicated that the financial health of the listed companies needed to be improved. In addition a disjoint was noted in the correlation between what is expected of the listed companies in terms of financial performance and the benefits to be accrued from CMA surveillance on them. On the analysis of the financial statements of the listed firms it was be postulated that the financial distress experienced by the firms are emanating from functioning of these firms. On the other hand, the Capital Market and NSE role responsibility needs to be strengthened. The study recommended that the NSE should make financial stability an integral driver of its policy framework. Key words: Financial distress, Governance and management, Capital Market Authority (CMA), Nairobi stock exchange, Z'-score multi-disriminant financial analysis model.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta

University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Muthike S.W. and **Sakwa M. M.**

*Title of Publication:* Can macroeconomic indicators be used as predictors of the stock exchange index trends? (A look at the Nairobi Stock Exchange).

*Abstract:* The factors influencing the investor's decision to invest in the Stock Exchanges are well documented, yet an investor cannot consistently maximize returns and minimize risks. The literature mainly focuses on the individuals as investors and their reactions to statements from the respective firms or experts or the government projections (political or economic). What is not very certain in literature are the potential effects that Macroeconomic Indicators on the stocks exchange index trends. The implication of this is that there are relationships between the stock exchanges index levels and the Macroeconomic Indicators such as inflation rate, money supply among others, that even if they do not directly impact on the index levels of the stock exchanges, they influence individuals to either increase or decrease their portfolios. On this basis, the study investigated the relationships between Nairobi Stock Exchange index trends and the Macroeconomic Indicators in the country. Correlations can either be positive or negative but more importantly when the correlations between the NSE index trends and the Macroeconomic Indicators are either leading, or lagging, they can inform the investors to either increase or decrease their portfolios thus aiding the maximization of returns and the minimization of risks. The data was gathered from Nairobi Stock Exchange (Daily Market Reports), Kenya National Bureau of Statistics (Statistical Abstracts) and the Central Bank of Kenya (Monthly Economic Reports).The coefficients for the logarithms of Treasury Bills, Money Supply, and Real Exchange rates were positive, while the signs of Inflation Rates and Gross Domestic Product were negative. The 91-Day Treasury Bills and the Inflation rate were the only clear Leading Macroeconomic Indicators on the NSE 20-Share Index. The Money Supply and Real Exchange Rates showed that they were both leading and lagging Macroeconomic Indicators on the NSE 20-Share index. Hence they cannot be used to proxy the share prices. The Gross Domestic Product showed the weakest relationship with the NSE 20-Share index. The study concludes that the Kenyan stock market and the formed significant relationships with all Macroeconomic Indicators identified, except the Gross Domestic Product. Key Words: Nairobi Stock Exchange Index Trends, Macroeconomic Indicators.

*Name of Journal/Conference Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

*Name of Lecturer/Authors:* **Udi Kamau** and Dr. Hellen Mberia.

*Title of Publication:* Retention of staff in public universities.

*Abstract:* Retention of employees is arguably a widely discussed subject and an important dilemma many organizations and higher institutions of learning might face in the future, if not facing it already. Universities are institutions that develop the kind of expertise and human resource essential to develop the countries

policies, governance structures, cultural and socio-economic aspects of development. Globalization has brought on dynamic markets and competition, and with that it is not hard to picture that universities are likely to focus and should be focusing on long-term strategies and a greater focus on attracting, developing and retaining its employees, particularly the core workers both academic and non academic to guarantee sustainability of programs and personnel. The purpose of this paper is to reveal through review of literature, the identified causes or determinants of staff turnover that may assist university administration reduce staff turnover in public universities. By comparing local and international research findings the paper highlights existing research gaps and findings that can be evaluated and employed to hire, develop and retain a committed workforce in institutions of higher learning. The review focuses on research published in peer reviewed journals from the year 1990 to 2010. The review focused on articles that addressed these concerns and synthesized those with a defensible research design.

*Name of Journal/Conference Proceedings/Workshop:*

*Proceedings/Workshop:* The 5th JKUAT Scientific, Technological and Industrialization Conference held on 17th-19th November 2010 at Jomo Kenyatta University of Agriculture and Technology.

*Year of Publication:* 2010.

# 10. RESEARCH, PRODUCTION AND EXTENSION

*Prof. E.M. Kahangi (first on the right) leads the Monitoring and Evaluation Committee during 2010/2011 monitoring and evaluation exercise of JKUAT Funded Projects. Looking on is Mr. Richard Wamalwa (third on the right) who was on attachment at RPE Division.*

*Name of Lecturer/Authors:* M.O. Okumu, P. J. A. van Astenc, **E. Kahangi**, S.H. Okech, J. Jefwad, and B. Vanlauwed.

*Title of Publication:* Production gradients in smallholder banana (cv. Giant Cavendish) farms in Central Kenya.

*Abstract:* Banana is an increasingly demanded food and cash crop in sub-Saharan Africa. Reported yields in smallholder farms vary substantially. The importance and spread of yield constraints *have* not been properly quantified. A study was carried out in Central Kenya to (i) quantify the yield levels, the primary yield constraints, and the spatial production gradients in such systems (ii) explore how soil fertility gradients relate to gradients in soil fertility management, and whether this is a function of farmer resource availability. Data was collected on crop management aspects, pests and diseases, and soil and plant tissue samples analyzed for nutrient contents. Bunch yields were higher near homesteads (29.8 t ha−1 yr−1) than at mid-distance (26.8 t ha−1 yr−1), or far away 20.2 t ha−1 yr−1. Yields were much higher than previously reported (11–14 t ha−1 yr−1) in Kenya. Both soil and tissue K levels were higher near and mid-distance, than far from the homestead. Gradients of soil

pH, total N, available P and Organic carbon were found, being higher near the homestead, while Mg and Ca were lowest near the homesteads. K was the most deficient nutrient, with tissue K index ($I_K$) decreasing when moving away from the homesteads. P and Ca deficiencies were also observed. Resource-poor farmers' soils were higher in exchangeable K and Mg, pH, and total N, and supported higher mat densities compared to resource-endowed farmers' farms. Soil quality problems were the biggest yield loss factors and not pests and diseases.

*Name of Journal/Conference Proceedings/Workshop:* Scientia Horticulturae, Volume 127, Issue 4, 10 February 2011, Pages 475-481.

*Year of Publication:* 2011.

*Name of Lecturer/Authors:* **E. Murugi Kahangi**.

*Title of Publication:* The Potential of Tissue Culture Banana (*Musa* spp.) Technology in Africa and the Anticipated Limitations and Constraints.

*Abstract:* The use of tissue culture (TC) technology to propagate banana plants gives growers several advantages over the conventional propagation. This technology is an indispensable tool for the facilitation of quick, and en masse, multiplication of adequate planting material of indigenous and exotic banana (*Musa* spp.) clones and production of disease-free planting material. The technology also rejuvenates the plants resulting in more vigorous growth, higher yields, better quality fruits, earlier fruiting and more uniform crop than those produced by conventional means. Additionally, banana "seed" corms are bulky and expensive to transport and subject to delay for extended periods for phyto-sanitary inspection. TC plants are relatively inexpensive to ship and easier to be certified by plant inspectors since they are packaged in sterile containers. In spite of these advantages, TC technology remains little known or underexploited in Africa due to a number of constraints. Africa has limited TC facilities and personnel to operate TC laboratories and virus indexing services (TC process does not eliminate viruses), especially in commercial production. A durable system is needed to help the continent to engage in crossborder business of TC banana planting material to enable improved and more sustainable banana production. Using best practices and TC laboratories, workable and practical models for the distribution of TC material within and between African countries face significant challenges. In addition, major constraints persist that prevent farmers from adopting TC banana technology. These include lack of credit for farmers to purchase the planting material and the high inputs required to realize optimum yields, while knowledge on the agronomic practices required for dealing with TC plants remains to be disseminated and documented. Reliability of banana markets is catalytic in promoting production and consumption, which in turn would impact on better sales of TC planting material. Most banana markets in Africa remain rudimentary, resulting in high postharvest losses, reducing farmers' incomes and discouraging them from adopting the technology. The future for the TC adoption in Africa is bleak, unless the constraints highlighted in this paper are addressed.

*Name of Journal/Conference Proceedings/Workshop:* Acta Hort. (ISHS) 879:281 – 288.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Peter Mwaura, Thomas Dubois, Turoop Losenge, Daniel Coyne and **Esther Kahangi**.
*Title of Publication:* Effect of endophytic *Fusarium oxysporum* on paralysis and mortality of *Pratylenchus goodeyi.*
*Abstract:* Three bioassays were conducted to investigate the antagonistic effect of secondary metabolites produced by 5 endophytic *Fusarium oxysporum* isolates from banana (*Musa* spp.) plants in Kenya, against *Pratylenchus goodeyi.* Percentage paralyses were recorded 3, 6 and 24 h after exposure to culture filtrates. Percentage mortality was evaluated after 48 h. All isolates caused significantly higher percentage paralysis (17.5 - 25.9%) and percentage mortality (62.3 - 72.8%) of *P. goodeyi* motile stages compared to the control (8.4 - 10.9% and 17.3 - 34.6%, respectively). Percentage paralysis of motile stages of *P. goodeyi* decreased as the length of time exposure to culture filtrates increased, while mortality increased as length of nematodes exposure to culture filtrates increased. Kenyan isolates performed equally as good as the Ugandan isolate (V5W2) in causing paralysis and mortality. Results from this study demonstrated that endophytic *F. oxysporum* antagonizes *P. goodeyi* through production of secondary metabolites. Key words: Banana, endophyte, *Fusarium oxysporum*, mortality, paralysis.
*Name of Journal/Conference Proceedings/Workshop:* African Journal of Biotechnology Vol. 9 (8), pp. 1130-1134, 22 February, 2010. Available online at http://www.academicjournals.org/AJB.ISSN 1684–5315 © 2010 Academic Journals
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* M.N. Muchui, C.K. Njoroge, **E.M. Kahangi** and C.A. Onyango.
*Title of Publication:* Determination of Maturity Indices of Tissue Cultured Bananas (Musa spp.) 'Williams' and 'Grande Naine'.
*Abstract:* Growth patterns of plant crop of banana (Musa spp.) cultivars 'Grande Naine' and 'Williams' (AAA genome), grown in Maragwa, Central Kenya in 2006 and 2007, were determined to establish the best maturity indices to determine harvest time. The banana plants were randomly selected from an already existing orchard where the farmer followed the recommended agronomic practices. The banana bunches were allowed to grow until half, three quarter and full maturity. Data were collected on growth parameters and postharvest quality of bunches. Bunch age and finger diameter were highly positively correlated (r = 0.881 and 0.939 for 'Grande Naine' and 'Williams', respectively). Finger diameter was correlated positively with pulp to peel ratio and total soluble solids (r = 0.941 and 0.997 for 'Grande Naine' and 'Williams', respectively). In 'Williams', finger diameter was positively correlated to pulp to peel ratio (r = 0.949) and total soluble solids (r = 0.991). Fruit growth curves for both cultivars followed the pattern of bananas grown in the tropics. The best maturity indices for determining the harvest time of

'Grande Naine' and 'Williams' may be a combination of bunch age and grade, as these correlate very well with postharvest characteristics such as pulp to peel ratio and total soluble solids.

Keywords: grade, green life, growth parameters, postharvest quality, total soluble solids.

*Name of Journal/Conference Proceedings/Workshop:* Acta Hort. (ISHS) 879:425 – 430.
*Year of Publication:* 2010.

*Name of Lecturer/Authors:* Muchui M.N., Mathooko F.M., Njoroge C.K., **Kahangi E.M.**, Onyango C.A. and Kimani E.M.

*Title of Publication:* Effect of perforated blue polyethylene bunch covers on selected postharvest quality parameters of tissue-cultured bananas (Musa spp.) cv. Williams in Central Kenya.

*Abstract:* Banana farming in Kenya has recently moved from subsistence to commercial farming. There is therefore the need to produce high quality fruits that are visually acceptable, have good postharvest quality attributes and therefore sell well in both local and international markets. Technologies such as pre-harvest bunch covers have been shown to improve postharvest quality of banana fruits. However, earlier reports on the effect of bunch covers on postharvest quality of banana fruits in the tropics have been contradictory. This study therefore aimed at understanding the effect of perforated polyethylene bunch covers on the postharvest quality characteristics of tissue-cultured bananas using banana (Musa spp.) cv. Williams as the test variety. The trial was carried out in Maragwa region in central province of Kenya, in a complete randomized design and was replicated three times. Perforated dull and shiny blue polyethylene covers were placed when the hands had started to turn upwards. Fruits were harvested at full three quarter maturity. Parameters measured were; bunch weight, finger grade and length, starch, total soluble solids (TSS), sugars, total titratable acidity (TTA), pulp/peel ratio, colour, chlorophyll content, firmness, moisture content, weight loss, green life and shelflife. Banana bunches were also evaluated for cleanliness and bruise marks at harvest. Data were subjected to analysis of variance (ANOVA) using the general linear model (GLM) procedure of SAS statistical programme. The means were compared using Student Newman Keuls' test (SNK) and least significant difference (LSD) at significance level of 5%. Results showed that bunch covers did not influence finger grade, length and bunch weight at harvest. Colour, chlorophyll content, firmness, starch content, TSS, TTA, moisture content, weight loss, individual and total sugars and pulp/peel ratio at harvest and during ripening were not influenced by bunch covers. Bunch covers did not influence greenlife and shelflife significantly. Fruits grown under cover were more visually appealing, cleaner and had minimal bruises compared to the unbagged fruits. However, bunch covers had some detrimental effects on postharvest quality characteristics of banana fruits of the covered bunches compared to the fruits from the control, where few fingers of top hands of some bunches suffered sun burn. The study has shown that perforated dull and shiny blue bunch covers may be used in commercial banana orchards in

| | |
|---|---|
| | Kenya to produce high quality fruits especially in the cooler areas. |
| *Name of Journal/Conference Proceedings/Workshop:* | Journal of Stored Products and Postharvest Research Vol. 1(3), pp. 29 – 41, December 2010 ISSN 2141- 6567 © 2010 Academic Journals. |
| *Year of Publication:* | 2010. |

# SECTION D: CONTINUING EDUCATION PROGRAMME CENTRES (CEP)

## 1.0 INTRODUCTION

Jomo Kenyatta University of Agriculture and Technology (JKUAT) has been collaborating with various educational institutions in Kenya for the last ten years through the auspices of the Continuing Education Programme (CEP). There are 28 programmes offered at 35 University-approved centres.

In some of the centres mentioned under 1.2, the programmes have run full cycle and problems with regard to their quality have arisen. Some centres have even sequestered programmes previously offered by the University. In order to guarantee the quality of the programmes in the remaining centres, the Vice Chancellor, in her wisdom, constituted a committee in September, 2007 to investigate the quality of the University programmes offered at these centres.

## 1.1 PROGRAMMES OFFERED AT CEP CENTRES

A total of twenty eight (28) programmes are offered at the CEP centres. These are: Executive MBA, Bachelors degrees in: Information Technology (IT), Computer Technology, Business and Information Technology, Commerce, Commerce and Business Administration, Business and Office Management, Cooperative Business, Analytical Chemistry, and Medical Laboratory Sciences, Diploma programmes in Information Technology, Computer Technology, Management and Information Technology, Business and Information Technology, Purchasing and Supplies Management, Business Administration, Public Relations, Advertising and Sales, Mass Communication, Mechanical Engineering, Electrical Engineering, Clinical Medicine, HIV/AIDS Management, Community Development, Human Resource Management and Microfinance, Certificate courses in IT, Management and Information Technology and HIV/AIDS Management, and Bridging courses in IT, Mathematics, English, Chemistry, Physics and Biology.

## 1.2 LIST OF CEP CENTRES

The names of the 33 CEP centres are: Loreto College Msongari, Nairobi Institute of Business Studies, Kenya College of Accountancy University (Kisumu), Kenya College of Accountancy University (Nairobi), Nairobi Institute of Technology, Regional Centre for Mapping of Resources for Development, Pioneer International College, Kenya School of Professional Studies, Starehe Boys Centre, Shepherd Foundation Education and Research Centre, Holy Rosary College, Zetech College, Embu College, Kirinyaga Technical College, Kenya Institute of Management – South C, Kenya Institute of Management – Nakuru, Kenya Institute of Management – Eldoret, Kenya Institute of Management – Kisumu, Kenya Institute of Management – Mombasa, Graffins College, Kenya Institute of Social Work and Community Development, Valley Business School, Cornerstone Training Institute, Megan College Lake Institute of Tropical Medicine, Cooperative College, Kenya College of Communication Technology, Kenya Institute of Management, Nairobi Institute of Business Studies, Mount Kenya University, Muranga College of Technology, Kimathi University College of Technology, Tracom College (Nakuru), Alphax College (Eldoret) and Jaffrey Institute of Professional Studies (Mombasa).

## 1.3 OBJECTIVES OF AUDITING CEP CENTRES

The objectives of carrying out audit in CEP Centres are:

- To ensure that qualified and experienced resource persons servicing units at the affiliated institutions and approved centres are as per University policy.
- To ensure that academic resources availed to the students are relevant, adequate and meet University requirements.
- To ensure that there is provision of sufficient facilities at the affiliated institutions and approved centres for students' welfare.
- To ensure teaching is conducted in line with the syllabus.

## 1.4 HOW TO CONDUCT AUDIT IN CEP CENTRES

The quality audits are usually conducted according to DAQA "Scheduled Quality Audits of Affiliated Institutions and Approved Centers" procedure. The CEP Centres are expected to be cooperative during the audit in order to make the process successful. Most of the audit aspects are drawn from CHE and IUCEA Guidelines and as a result, CEP Centres are expected to fully adhere to these Guidelines.

## 1.5 QUALITY ASSURANCE VISIT GENERAL FINDINGS

Arrangements were made to visit all centres that offer JKUAT programmes to find out whether quality requirements were adhered to. During the visit, it was established that students' population was reducing across all the centres. The following positive findings and areas for improvements were gathered in most centres.

### 1.5.0 POSITIVE FINDINGS

Students appreciated JKUAT team for visiting centres to check on the quality of teaching and learning.

a. All the students expressed satisfaction with the programmes that they were pursuing.
b. Most centres had laboratories, lecture rooms and libraries for teaching and learning.
c. They also had qualified human resource to serve students.
d. The students were sitting examinations that are set centrally at JKUAT for standardization and quality assurance.

### 1.5.1 AREAS FOR IMPROVEMENT

a. There was need to review programmes that have completed full cycle or are about to.
b. There was need to speed up processing of examinations for centres and issuance of transcripts.
c. Those centres with inadequate resources such as computers, books, space and sporting facilities were advised to acquire more for effective teaching and learning.
d. Centres were also advised to make arrangement for supervision of students on attachment.

# SECTION E: APPENDICES

## 1.0 INTRODUCTION

The production of Quality Assurance Bulletin (QAB) was initiated in 2006/ 2007 academic year to captureon-going and completed research activities; publications and other quality issues within the University. The successful production of this fifth bulletin is a testimony that JKUAT is living up to its vision of being "*An Institution of Excellence in Training, Research, and Innovation for Development*". Although there were so many challenges encountered during the production of the bulletin, all the Faculties, Schools and Institutes were represented. These include: Faculty of Science; Faculty of Agriculture; Faculty of Engineering; (now College of Engineering), School of Human Resource Development; School of Archtecture and Building Sciences; Institute of Tropical Medicine and Infectious Disease; Institute of Biotechnology Research; Instititute of Energy and Enviromental Technonology; Nairobi Campus; and Research, Production and Extension Division.

The Directorate has contionouly endevoured to improve QAB from Volume I to Volume V. For instance, the QAB Volume I to Volume III used to report both the *on-going research activities* and *completed research activities* as *Topic, Researcher(s),* and *Status of the Research*; whereas *Publications* as *Name of the Lecturer/ Author, Title of Puplication, Name of the Journal/ Conference Proceedings/ Workshop*. This was a very simple and a straightforward format of reporting. As a result, the number of *on-going research activities*, *completed research activities* and *publications* were high. Unfortunately, this format did not differentiate the *on-going* and *completed research activities*. Moreover, it also gave scanty information on *completed research* and *publications*.

However, due to a high number of staff, postgraduate students and researchers from outside the University consulting the bulletin, the Directorate saw the need to improve it. The *on-going research activities* retained their initial format of *Topic, Researcher(s), and Status of the Research* while *completed research activities* are now reported as *Title, Researcher(s), Background, Methods, Results and Conclusions*. The *Publications* now have an *Abstract* and is now captured as *Name of the Lecturer/ Author, Title of Publication, Abstract, Name of the Journal/ Conference Proceedings/ Workshop*. The change of reporting format has made the contribution by researchers towards production of the QAB decline from 2009/2010 academic year when it was instituted to 2010/2011 academic year. This is because the format is more detailed to include extra information that were initially not provided. Some other factors that affect production of bulletin is lack of motivation of the researchers, lack of a research database at the departmental level that could be availed on request, chairpersons with a lot of other responsibilities among others.

## 1.2 ON-GOING RESEARCH ACTIVITIES

The *on-going research activities* from 2006/2007 academic year to 2010/2011 academic year have been summarized by Appendix 6 graph on page 206. The graph shows that the *on-going research activities* increased from 255 in 2006/2007 academic year to 278 in 2007/2008 academic year. This was followed by a fall to 251 in 2008/2009 academic year and a sharp rise to 326 in 2009/2010 academic year. In 2010/2011 academic year, it fell to 188.

## 1.3 COMPLETED RESEARCH ACTIVITIES

The format of reporting adversely affected the submission of completed research activities. For instance, there was an increasing trend from 2006/2007 academic year to 2008/2009 academic year i.e. 102 in 2006/2007, 128 in 2007/2008 and 147 in 2008/2009 academic years. With the introduction of new reporting format, it decreases to 64 in 2009/2010 academic year and further decreases to 42 in 2010/2011 academic year. This is well depicted in Appendix 7 graph on page 207.

## 1.4 PUBLICATIONS

The *Publications* submissions have been on the decline since initial production of QAB with the year (2010/2011) when the format was changed recording the least i.e. 113. The academic years 2006/2007, 2007/2008 and 2008/2009 had 303, 290 and 246 respectively (see Appendix 8 on page 208). One of the reasons was that the number of *Publications* which forms a critical part of promotion of academic staff was thought to be violated during interviews. Thus lack of motivation by academic staff to submit their publications and other research activities towards production of the bulletin. However, on a positive note, the number of *Publications* rose from 113 in 2010/2011 academic year to 214 in 2010/2011.

## 1.5 TOTAL RESEARCH ACTIVITIES AND PUBLICATIONS

The total Research Activities (both *on-going and completed*) and *Publications* illustrated by Appendix 9 graph on page 209 were as follows: 660, 696, 644, 503 and 444 for 2006/2007, 2007/2008, 2008/2009, 2009/2010 and 2011/2011 respectively. It showed a declining trend for reasons already indicated in Section 1.0 and 4.0.

## Appendix 1: Table 1: A Total Number of Research Activities and Publications in 2006/2007 Academic Year

| S/N | Faculty/ Institute/ School | Department | On-going Research | Completed Research | Publications | Total Research Activities and Publications |
|---|---|---|---|---|---|---|
| 1. | *Science* | Statistics and Actuarial Sciences | 5 | 8 | 17 | ***30*** |
| | | Pure and Applied Mathematics | 4 | 9 | 15 | ***28*** |
| | | Chemistry | 22 | 4 | 12 | ***38*** |
| | | Biochemistry | 22 | 2 | 10 | ***34*** |
| | | Botany | 19 | 9 | 69 | ***97*** |
| | | Physics | 6 | 3 | 7 | ***16*** |
| | | Zoology | 22 | 23 | 32 | *77* |
| | | | ***100*** | ***58*** | ***162*** | **320** |
| 2. | *Engineering* | Electrical and Electronics | 4 | 1 | 11 | ***16*** |
| | | Mechanical | 9 | 2 | 8 | ***19*** |
| | | Mechatronics | 0 | 0 | 0 | ***0*** |
| | | Telecommuni-cation | 0 | 0 | 0 | ***0*** |
| | | Geomatic | 17 | 0 | 0 | ***17*** |
| | | Civil | 17 | 0 | 20 | ***37*** |
| | | BEED | 21 | 0 | 26 | ***47*** |
| | | | ***68*** | ***3*** | ***65*** | **136** |
| 3. | *Agriculture* | Horticulture | 19 | 6 | 15 | ***40*** |
| | | Food Science | 23 | 14 | 29 | ***66*** |
| | | | ***42*** | ***20*** | ***44*** | ***106*** |
| 4. | *SHRD* | CES | 3 | 0 | 10 | ***13*** |
| | | EPD | 5 | 7 | 1 | ***13*** |
| | | Social Sciences | 8 | 3 | 12 | ***23*** |
| | | | ***16*** | ***10*** | ***23*** | **49** |
| 5. | *ITROMID* | MLS | 0 | 0 | 0 | **0** |
| | | | | | | |
| 6. | *SABS* | Architecture | 2 | 1 | 5 | ***8*** |
| | | Land Architecture | 0 | 0 | 0 | ***0*** |
| | | Construction Management | 6 | 0 | 3 | ***9*** |
| | | | ***8*** | ***1*** | ***8*** | **17** |
| 7. | *ICSIT* | Computing | 14 | 9 | 0 | **23** |
| | | IT | 0 | 1 | 1 | **2** |
| | | | ***14*** | ***10*** | ***1*** | **25** |
| 8. | *IBR* | N/A | 0 | 0 | 0 | ***0*** |
| 9. | *IEET* | IEET | 7 | 0 | 0 | *7* |
| 10. | *Sports and Games* | *N/A* | 0 | 0 | 0 | ***0*** |
| ***Grand Total*** | | | **255** | **102** | **303** | **660** |

## Appendix 2: Table 2: A Total Number of Research Activities and Publications in 2007/2008 Academic Year

| S/N | Faculty/ Institute/ School | Department | On-going Research | Completed Research | Publications | Total Research Activities and Publications |
|---|---|---|---|---|---|---|
| 1. | *Science* | Statistics and Actuarial Sciences | 7 | 7 | 1 | ***15*** |
| | | Pure and Applied Mathematics | 17 | 4 | 17 | ***38*** |
| | | Chemistry | 17 | 3 | 8 | ***28*** |
| | | Biochemistry | 32 | 3 | 4 | ***39*** |
| | | Botany | 29 | 7 | 42 | ***78*** |
| | | Physics | 4 | 8 | 4 | ***16*** |
| | | Zoology | 25 | 14 | 47 | ***86*** |
| | | | ***131*** | ***46*** | ***123*** | **300** |
| 2. | *Engineering* | Electrical and Electronics | 13 | 5 | 11 | ***29*** |
| | | Mechanical | 6 | 5 | 13 | ***24*** |
| | | Mechatronics | 0 | 0 | 0 | ***0*** |
| | | Telecommuni-cation | 0 | 0 | 0 | ***0*** |
| | | Geomatic | 10 | 0 | 7 | ***17*** |
| | | Civil | 17 | 0 | 18 | ***35*** |
| | | BEED | 2 | 33 | 23 | ***58*** |
| | | | ***48*** | ***43*** | ***72*** | **163** |
| 3. | *Agriculture* | Horticulture | 23 | 4 | 4 | ***31*** |
| | | Food Science | 17 | 6 | 15 | ***38*** |
| | | | ***40*** | ***10*** | ***19*** | **69** |
| 4. | *SHRD* | CES | 1 | 8 | 2 | ***11*** |
| | | EPD | 3 | 0 | 26 | ***29*** |
| | | Social Sciences | 6 | 6 | 2 | ***14*** |
| | | | ***10*** | ***14*** | ***30*** | **54** |
| 5. | *ITROMID* | MLS | 4 | 0 | 7 | ***11*** |
| 6. | *SABS* | Architecture | 3 | 0 | 9 | ***12*** |
| | | Land Architecture | 13 | 0 | 0 | ***13*** |
| | | Construction Management | 3 | 2 | 1 | ***6*** |
| | | | ***19*** | ***2*** | ***10*** | **31** |
| 7. | *ICSIT* | Computing | 6 | 2 | 9 | ***17*** |
| | | IT | 0 | 7 | 5 | ***12*** |
| | | | ***6*** | ***9*** | ***14*** | **29** |
| 8. | *IBR* | N/A | 7 | 1 | 0 | **8** |
| 9. | *IEET* | N/A | 17 | 3 | 13 | **33** |
| 10. | *Sports and Games* | *Sports and Games* | 0 | 0 | 9 | **9** |
| *Grand Total* | | | ***278*** | ***128*** | ***290*** | **696** |

## Appendix 3: Table 3: A Total Number of Research Activities and Publications in 2008/2009 Academic Year

| S/N | Faculty/ Institute/ School | Department | On-going Research | Completed Research | Publications | Total Research Activities and Publications |
|---|---|---|---|---|---|---|
| 1. | *Science* | Statistics and Actuarial Sciences | 18 | 34 | 3 | 55 |
| | | Pure and Applied Mathematics | 8 | 8 | 0 | 16 |
| | | Chemistry | 1 | 0 | 1 | 2 |
| | | Biochemistry | 11 | 25 | 4 | 40 |
| | | Botany | 36 | 0 | 32 | 68 |
| | | Physics | 4 | 6 | 5 | 15 |
| | | Zoology | 13 | 6 | 18 | 37 |
| | | | ***91*** | ***79*** | ***63*** | ***233*** |
| 2. | *Engineering* | Electrical and Electronics | 0 | 0 | 0 | 0 |
| | | Mechanical | 4 | 6 | 8 | 18 |
| | | Mechatronics | 9 | 2 | 5 | 16 |
| | | Telecommuni-cation | | | | |
| | | Geomatic | 0 | 0 | 0 | 0 |
| | | Civil | 13 | 0 | 42 | 55 |
| | | BEED | 13 | 1 | 18 | 32 |
| | | | ***39*** | ***9*** | ***73*** | ***121*** |
| 3. | *Agriculture* | Horticulture | 28 | 28 | 30 | 86 |
| | | Food Science | 9 | 19 | 28 | 56 |
| | | | ***37*** | ***47*** | ***58*** | ***142*** |
| 4. | *SHRD* | CES | 51 | 0 | 0 | 51 |
| | | EPD | 2 | 1 | 1 | 4 |
| | | Social Sciences | 6 | 6 | 5 | 17 |
| | | | ***59*** | ***7*** | ***6*** | ***72*** |
| 5. | *ITROMID* | MLS | 0 | 0 | 8 | ***8*** |
| 6. | *SABS* | Architecture | 0 | 0 | 2 | 2 |
| | | Land Architecture | 3 | 2 | 0 | 5 |
| | | Construction Management | 0 | 0 | 0 | 0 |
| | | | ***3*** | ***2*** | ***2*** | ***7*** |
| 7. | *ICSIT* | Computing | 9 | 1 | 0 | ***10*** |
| | | IT | 0 | 0 | 0 | ***0*** |
| | | | ***9*** | ***1*** | ***0*** | **10** |
| 8. | *IBR* | N/A | 3 | 2 | 18 | ***23*** |
| | | | | | | |
| | *Sports and Games* | Sports and Games | 10 | 0 | 2 | ***12*** |
| | *E-Learning* | E-Learning | 0 | 0 | 1 | ***1*** |
| | *RPE* | RPE | 0 | 0 | 15 | ***15*** |
| ***Grand Total*** | | | **251** | **147** | **246** | ***644*** |

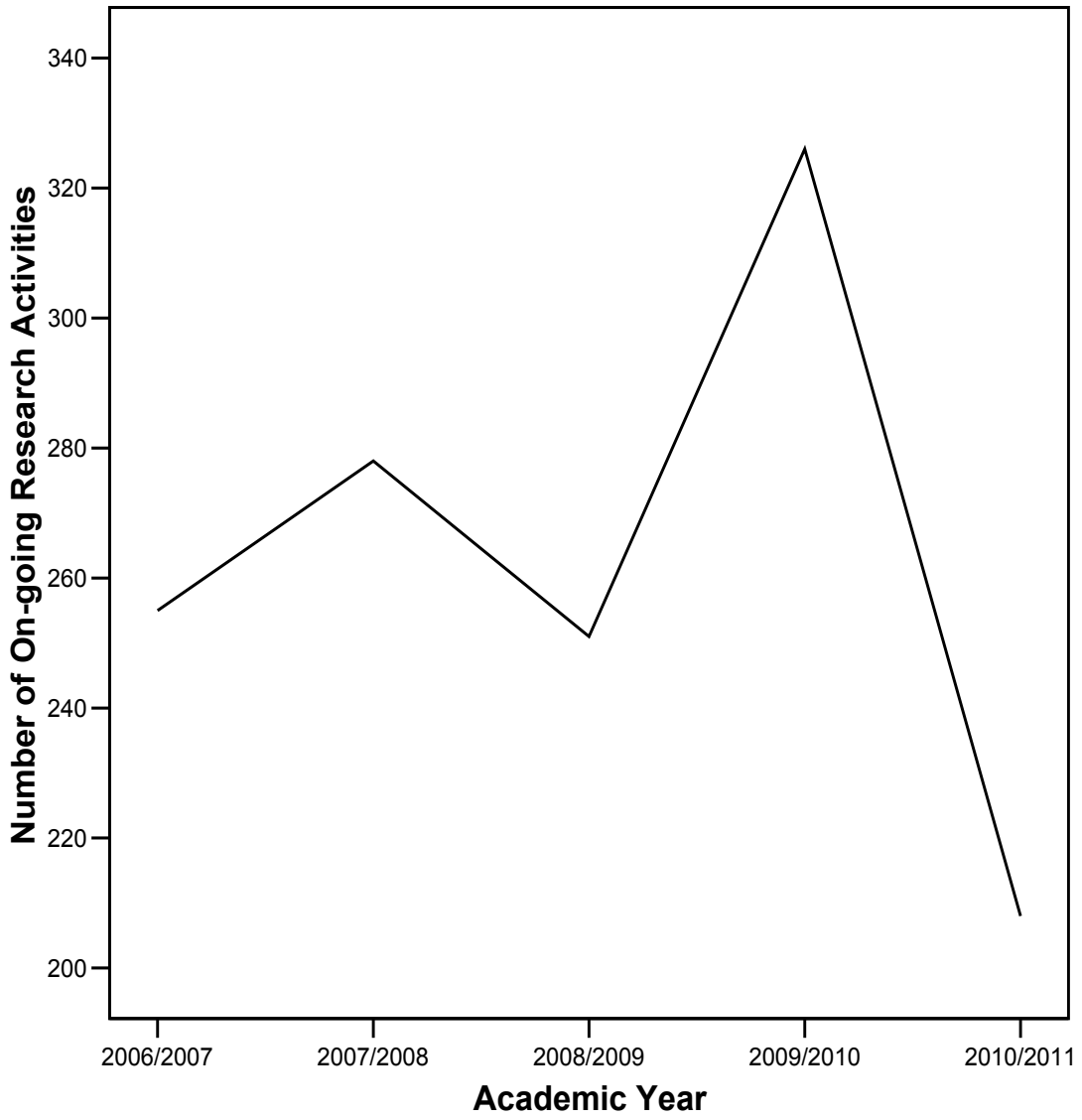
## Appendix 4: Table 4: A Total Number of Research Activities and Publications in 2009/2010 Academic Year

| S/N | Faculty/ Institute/ School | Department | On-going Research | Completed Research | Publications | Total Research Activities and Publications |
|---|---|---|---|---|---|---|
| 1. | *Science* | Statistics and Actuarial Sciences | 13 | 4 | 1 | ***18*** |
| | | Pure and Applied Mathematics | 17 | 0 | 0 | ***17*** |
| | | Chemistry | 1 | 1 | | ***2*** |
| | | Biochemistry | 34 | 0 | 6 | ***40*** |
| | | Botany | 3 | 0 | 10 | ***13*** |
| | | Physics | 6 | 4 | 3 | ***13*** |
| | | Zoology | 25 | 9 | 5 | ***39*** |
| | | | ***99*** | ***18*** | ***25*** | **142** |
| 2. | *Engineering* | Electrical and Electronics | 12 | 0 | 13 | ***25*** |
| | | Mechanical | 0 | 0 | 0 | ***0*** |
| | | Mechatronics | 10 | 2 | 0 | ***12*** |
| | | Telecommuni-cation | 0 | 0 | 0 | ***0*** |
| | | Geomatic | 13 | 4 | 6 | ***23*** |
| | | Civil | 0 | 0 | 0 | ***0*** |
| | | BEED | 16 | 3 | 15 | ***34*** |
| | | | ***51*** | ***9*** | ***34*** | **94** |
| 3. | *Agriculture* | Horticulture | 21 | 5 | 12 | ***38*** |
| | | Food Science | 14 | 7 | 20 | ***41*** |
| | | | ***35*** | ***12*** | ***32*** | **79** |
| 4. | *SHRD* | CES | 70 | 1 | 0 | ***71*** |
| | | EPD | 0 | 0 | 0 | ***0*** |
| | | Social Sciences | 0 | 0 | 1 | ***1*** |
| | | | ***70*** | ***1*** | ***1*** | **72** |
| 5. | *ITROMID* | MLS | ***10*** | ***7*** | ***1*** | **18** |
| 6. | *SABS* | Architecture | 0 | 0 | 0 | ***0*** |
| | | Land Architecture | 0 | 0 | 0 | ***0*** |
| | | Construction Management | 2 | 2 | 0 | ***4*** |
| | | | ***2*** | ***2*** | ***0*** | **4** |
| 7. | *ICSIT* | Computing | 8 | 0 | 0 | ***8*** |
| | | IT | 0 | 0 | 0 | ***0*** |
| | | | ***8*** | ***0*** | ***0*** | **8** |
| 8. | *IBR* | N/A | 14 | 0 | 5 | ***19*** |
| 9. | *IEET* | N/A | 16 | 6 | 2 | ***24*** |
| | *Nairobi Campus* | N/A | 13 | 9 | 10 | ***32*** |
| | *Sports and Games* | N/A | 0 | 0 | 3 | ***3*** |
| | *Taita Taveta* | N/A | 8 | 0 | 0 | ***8*** |
| ***Grand Total*** | | | **326** | **64** | **113** | **503** |

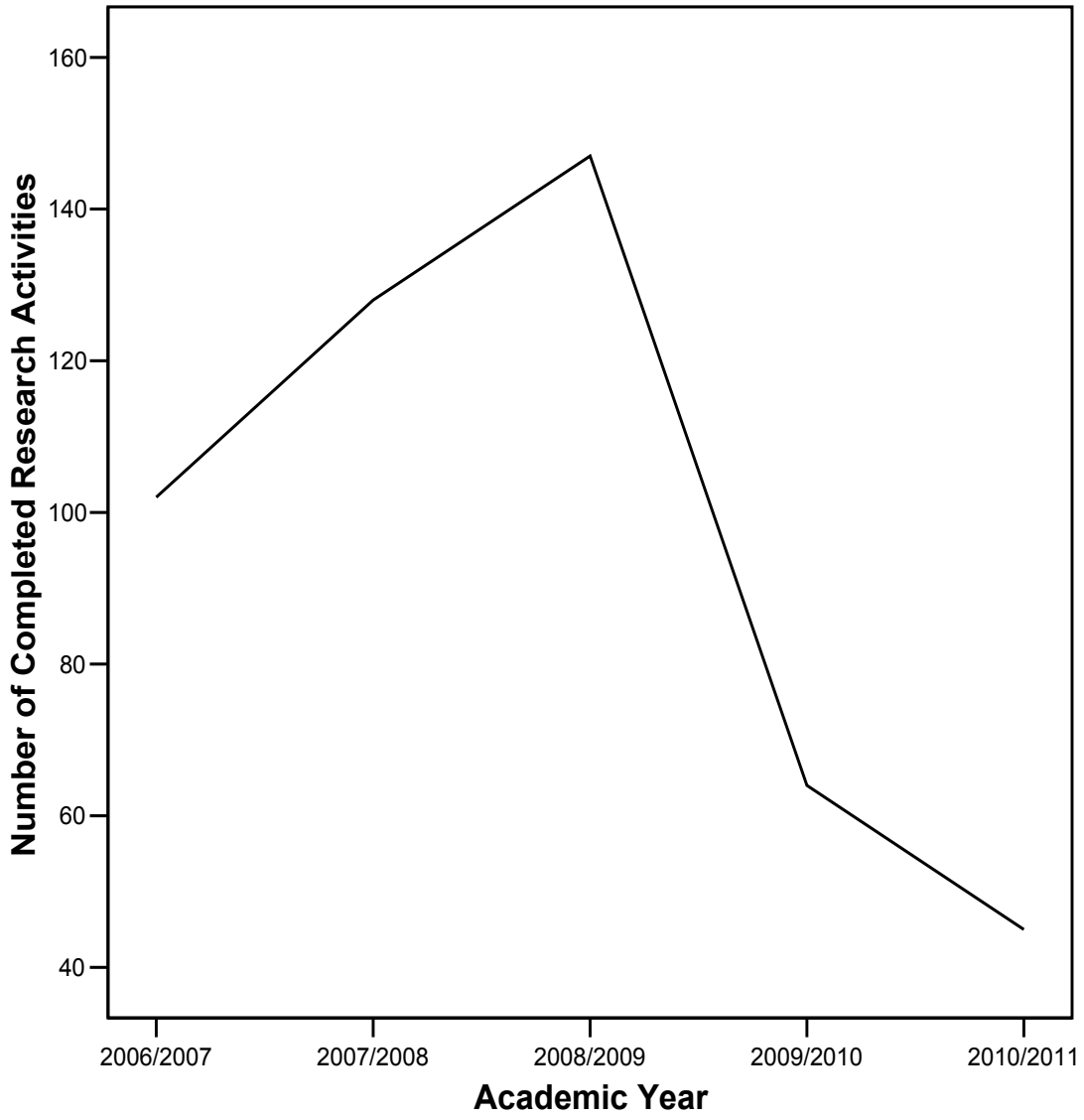
## Appendix 5: Table 5: A Total Number of Research Activities and Publications in 2010/2011 Academic Year

| S/N | Faculty/ Institute/ School | Department | On-going Research | Completed Research | Publications | Total Research Activities and Publications |
|---|---|---|---|---|---|---|
| 1. | *Science* | Statistics and Actuarial Sciences | 3 | 9 | 8 | ***20*** |
| | | Pure and Applied Mathematics | 12 | 0 | 20 | ***32*** |
| | | Chemistry | 11 | 15 | 20 | ***46*** |
| | | Biochemistry | 6 | 0 | 0 | ***6*** |
| | | Botany | 0 | 0 | 9 | ***9*** |
| | | Physics | 20 | 1 | 4 | ***25*** |
| | | Zoology | 9 | 8 | 8 | ***25*** |
| | | | ***61*** | ***33*** | ***69*** | **163** |
| 2. | *Engineering* | Electrical and Electronics | 15 | 0 | 29 | ***44*** |
| | | Mechanical | 0 | 0 | 2 | ***2*** |
| | | Mechatronics | 11 | 2 | 7 | ***20*** |
| | | Telecommuni-cation | 0 | 0 | 0 | ***0*** |
| | | Geomatic | 0 | 0 | 2 | ***2*** |
| | | Civil | 0 | 0 | 5 | ***5*** |
| | | BEED | 8 | 2 | 32 | ***42*** |
| | | | ***34*** | ***4*** | *77* | **115** |
| 3. | *Agriculture* | Horticulture | 32 | 3 | 14 | ***49*** |
| | | Food Science | 8 | 0 | 9 | ***17*** |
| | | | ***40*** | ***3*** | ***23*** | **66** |
| 4. | *SHRD* | CES | 0 | 0 | 5 | ***5*** |
| | | EPD | 0 | 0 | 5 | ***5*** |
| | | Social Sciences | 0 | 0 | 6 | ***6*** |
| | | | ***0*** | ***0*** | ***16*** | **16** |
| 5. | *ITROMID* | MLS | 16 | 2 | 2 | **20** |
| 6. | *SABS* | Architecture | 0 | 0 | 0 | ***0*** |
| | | Land Architecture | 0 | 0 | 0 | ***0*** |
| | | Construction Management | 0 | 0 | 1 | ***1*** |
| | | | ***0*** | ***0*** | ***1*** | **1** |
| 7. | *ICSIT* | Computing | 5 | 0 | 12 | ***17*** |
| | | IT | 0 | 0 | 0 | ***0*** |
| | | | ***5*** | ***0*** | ***12*** | **17** |
| 8. | *IBR* | N/A | 19 | 0 | 9 | **28** |
| 9. | *IEET* | N/A | 20 | 3 | 4 | **27** |
| 10. | *Nairobi Campus* | N/A | 13 | 0 | 0 | **13** |
| 11. | *Sports and Games* | *Sports and Games* | 0 | 0 | 0 | **0** |
| 12. | *RPE* | N/A | 0 | 0 | 5 | **5** |
| ***Grand Total*** | | | ***208*** | ***45*** | ***218*** | **471** |

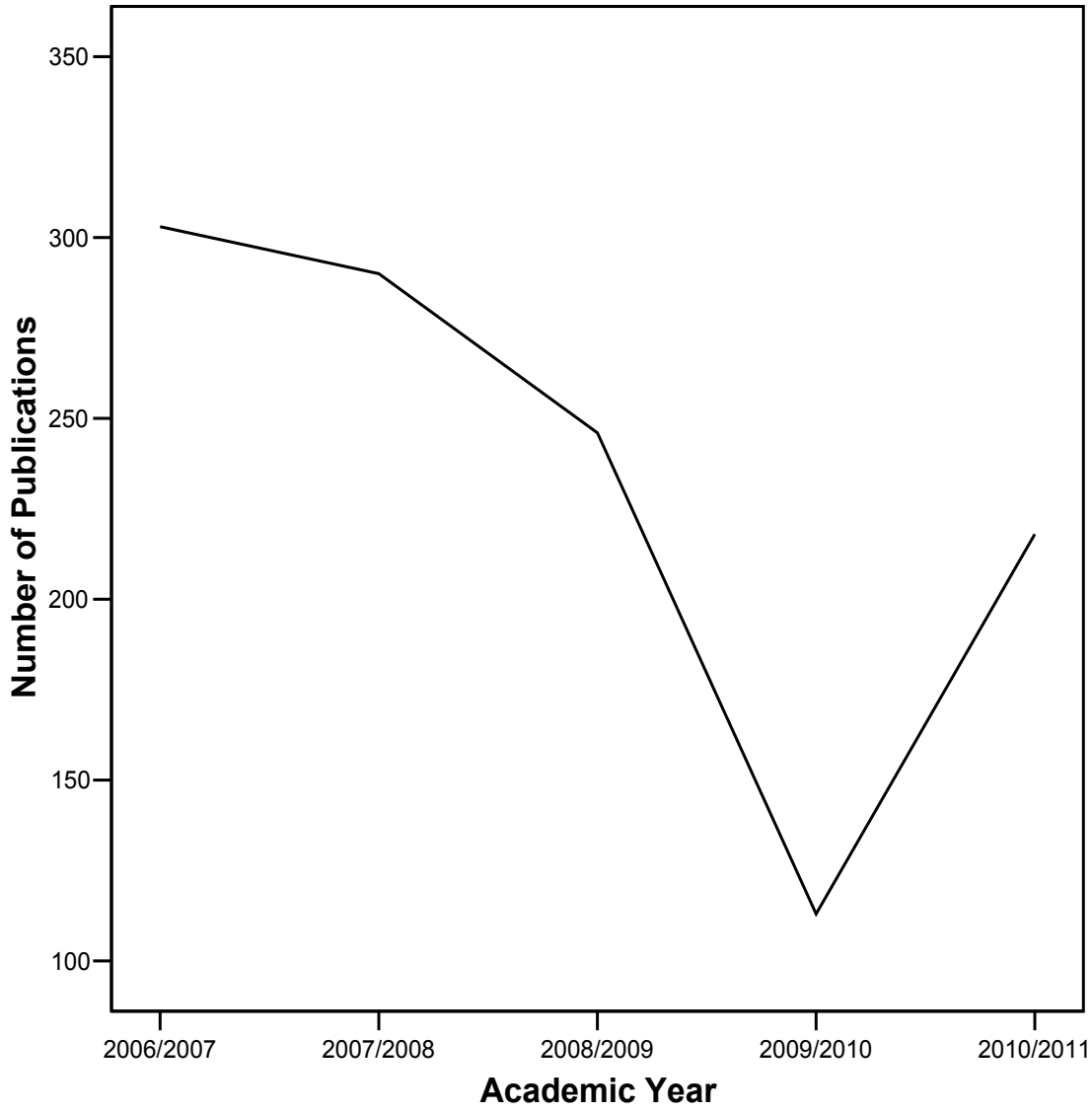
**Appendix 6: A Graph Showing Number of On-Going Research from 2006/2007 to 2010/2011 Academic Year**



**Appendix 7: A Graph Showing Number of Completed Research from 2006/2007 to 2010/2011 Academic Year**



**Appendix 8: A Graph Showing Number of Publications from 2006/2007 to 2010/2011 Academic Year**



**Appendix 9: A Graph Showing Total Number of Research Activities and Publications from 2006/2007 to 2010/2011 Academic Year**