

CHUKA



UNIVERSITY

Knowledge is Wealth/Akili ni Mali (Sapientia divitia est)

Proceedings of the 3rd International Research Conference

Theme: Harnessing Research, Innovation and Technology to Realise the Sustainable Development Goals

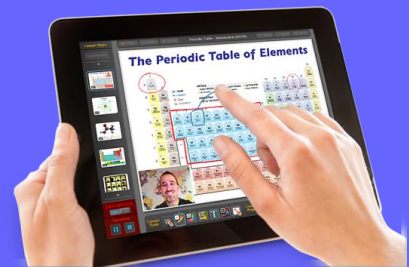
26th to 28th October, 2016



Revitalisation of agriculture and food security for sustainable development



Enhancement of education and health for sustainable development



The role of science, engineering and technology in sustainable development



The role of arts, humanities and social sciences in sustainable development

Collaborators



Conservation of biodiversity, energy and water for sustainable development



The role of arts, humanities and social sciences in sustainable development



Harnessing affirmative action and gender equity for sustainable development



Conservation of biodiversity, energy and water for sustainable development

Chuka University is ISO 9001:2008 Certified



Inspiring Environmental Sustainability for Better Life

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Knowledge is Wealth (*Sapientia divitia est*) Akili ni Mali

**Proceedings of the 3rd Chuka University International
Research Conference held in the Main Campus
from 26th – 28th October, 2016**

**Theme:
“Harnessing Research, Innovation and Technology to
Realise the Sustainable Development Goals”**

Published 2017

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CHUKA UNIVERSITY FUNDAMENTAL STATEMENTS

Motto

Knowledge is Wealth/Akili ni Mali (*Sapientia divitia est*)

Slogan

Inspiring Environmental Sustainability for Better Life

Philosophy

Quality education, training, research, extension, environmental sustainability, and entrepreneurship lead to social cohesion, human integrity, and economic development

Vision

A Premier University for the provision of quality education, training and research for sustainable national and global development

Mission

To provide access, generate, preserve and share knowledge for quality, effective and ethical leadership in higher education, training, research and outreach through nurturing an intellectual culture that integrates theory with practice, innovation and entrepreneurship.

Corporate Colours

Red	
Blue	
Green	
Grey	

The Chuka University corporate colours derived from the University's registered Logo are Red, Blue, Green and Grey, interspersed with White.

(1) Red: Signifies a torch and symbolises education is the light of the world; provision of higher education is the core mandate of Chuka University.

(2) Blue: Signifies calming, soothing water and sky associated with heavenly, untouchable powers, and symbolises honesty, stability and patriotism, which are virtues of Chuka University.

(3) Green: Signifies environmental conservation and renewable energy, designated to describe the academic character of Chuka University.

(4) Grey: Signifies fertility of the Mt. Kenya region land and depicts creation of wealth through utilisation of knowledge – a phrase used to coin the motto of Chuka University.

(5) **White:** Signifies the snow on the peak of Mt. Kenya and represents integrity and social fairness, which are some of the core values of Chuka University.

Core Values

(1) **Customer Value and Focus:** Enhancing customer satisfaction levels by providing products and services that meet or exceed customer expectations.

(2) **Diversity and Social Fairness:** Appreciation of varied cultures and commitment to ensure balanced distribution of resources and opportunities while instituting affirmative action to cater for marginalised sections of the society.

(3) **Environmental Consciousness:** Considering the impact of all activities and programmes to be implemented and taking measures that ensure zero tolerance to environmental damage.

(4) **Fidelity to the Law:** Dutiful adherence to the Constitution and other legal, statutory and regulatory requirements.

(5) **Innovation:** Creativity in undertaking programmes and activities earmarked to contribute novel, effective and efficient ways of advancing humanity.

(6) **Integrity:** Upholding honesty, transparency, accountability and strong moral principles and values in all decisions and actions taken.

(7) **Passion for Excellence:** Being outstanding in all services, activities and programmes undertaken by the University.

(8) **Peaceful Co-Existence:** Living harmoniously with neighbours and the environment and promoting the ideals of cohesion, integration and unity.

(9) **Professionalism and Confidentiality:** Professionalism is the skill, good judgment and polite behaviour exhibited by an expert when discharging responsibilities and delivering services, while confidentiality means commitment to not disclose classified information to unauthorized parties.

(10) **Prudent Utilisation of Resources:** Utilising resources without wastage and misappropriation by ensuring maximum value and complying with various planned arrangements, internal controls and government regulations.

(11) **Teamwork:** Adopting a participatory and inclusive approach in undertaking operations and functions of the University.

(12) **Timeliness and Devotion to Duty:** Timeliness refers to being time-conscious in undertaking activities, assignments and programmes, while devotion to duty is selfless commitment to undertake activities, assignments and programmes for the good and advancement of humanity.

FOREWORD

Ladies and gentlemen. I welcome you to this International Research Conference which is starting today. This is the third such Conference to be held in Chuka University in as many years. We intend to make these Conferences annual so as to provide scholars with an opportunity to disseminate their research findings, exhibit their innovative ideas and network. Chuka University is fast becoming a Centre of Excellence in the relentless search of new knowledge through research. As a University we are focused on the pursuit of continual improvement in service delivery and the results that we achieve. Our Quality Management System is based on the ISO 9001:2008 Standard, having attained it in 2013 and got recertified this year. By achieving this Standard, we aim to continue providing improved services to our customers at all times. This means that the teaching and research done in this University must be of high quality in tandem with international standards that we have chosen to benchmark with. Some of this University's strategic goals lay emphasis on generation and dissemination of research findings, patenting and commercializing of findings and innovations. In doing this, the University will continue to strengthen the capacity for Science, Technology and Innovation through development of appropriate infrastructure, recruitment and support for further training of Science, Technology and Innovation specialists through forums such as this one.

As an institution of higher learning, Chuka University is expected to play a significant role in the implementation of the social pillar envisaged in Kenya's Vision 2030 by providing "globally competitive quality education, training and research for sustainable development". To benefit and solve problems in the society, Chuka University will increase the quantity, quality and relevance of research output with a view to creating innovations and inventions that will enable Kenya to effectively transform into a knowledge-based economy. The University will continue to provide incentives for research and increase the research fund so as to benefit more staff and students. Furthermore, the University will continue to develop appropriate research infrastructure, including construction of laboratories, as well as acquisition of modern research equipment. The University will also transfer knowledge and disseminate research findings to users through publications. In this regard, I am happy to note that the research proceedings of the two previous Conference events held here have already been published and circulated.

Ladies and gentlemen, a cursory glance of the programme shows that this Conference focuses on the broad thematic areas of agriculture and food security, quality education and health, science, engineering and technology, the arts, humanities and social sciences, gender equity, biodiversity, energy and water. These are some of the areas that the global Sustainable Development Goals aim to tackle. They are, therefore, relevant and important priority areas that Kenya as a country should focus on to address the many challenges that face our nation and humanity.

As part of the international community, our research should focus on areas of social, economic and environmental importance to Kenya by identifying specific areas and priorities that will benefit humanity. This requires that we embrace Information Communication Technologies (ICT) in our endeavours. ICT is critical in the success of any innovation. Innovative systems require the smooth flow of technology and information among the innovators and all actors in the innovative process. The interaction between the actors is necessary because the innovator's idea has to be turned into a process, a product or a service to the public. Our research can never be complete if it ignores the social and economic aspects of development. I am happy to note that a number of papers to be presented in this conference are in these areas. It is a globally accepted fact that Science, Technology and Innovation (ST&I) is a major driver towards the achievement of the sustainable development. The research that we conduct should also integrate national and regional policies on

ST&I to achieve the much needed technological and industrial development of our country in particular and the world at large.

The main objective of this Conference is to provide innovators, scientists, students, industrialists, academicians, policy makers, and the general public with a platform to disseminate and share knowledge. It will also provide an opportunity to Kenyans to harness science, stimulate and inspire current and potential researchers. The University plays an important role as a reservoir of knowledge generated through research. This knowledge and industrially relevant technology are the ingredients with which to build our modern knowledge-based economies. Due to this recognition, the Government of Kenya has launched some initiatives to link universities to industrial innovation. Among the three models of academia-industry linkage are: Knowledge Transfer Partnership (KTP), The Triple Helix Relationship, and Africa Knowledge Transfer Partnership (AKTP). Kindly embrace them too.

The government can increase productivity by tapping the knowledge, technology and skills available from institutions of higher learning. Innovations in the Jua Kali Sector can lead to national development through industrialization by reverse engineering and informal production systems. This can best be done through the efforts of public private partnerships as witnessed during this Conference. In this regard, I wish to thank the National Commission for Science, Technology and Innovation (NaCoSTI), Safaricom, the National Environment Management Authority (NEMA), the Kenya Wildlife Service (KWS) and the Government of Kenya for continued financially and material support to this Conference. They have continued to partner with us by providing the much needed research grants to our researchers. These grants are not in vain for they support scientific research and technological innovation for national development, technological advancement and acquisition of education.

Ladies and gentlemen, for the knowledge generated by researchers to be useful, it must be packaged and published and disseminated to the end users. This is best done through mass media and through organised extension services. We should, therefore, encourage a bottom-up rather than a centre-periphery approach or top-down approach in developing our policies and plans. This is the best way to realize the true benefits of devolution and ownership of discoveries.

Finally, ladies and gentlemen, I wish you a happy stay in Chuka University and fruitful deliberations at the end of which we expect to churn out a number of innovations. Indeed I have been challenging my staff that this University must produce a Nobel Prize winner by the year 2026. I believe it is possible and I know it can be done.

With these few remarks, I now declare the Third Chuka University International Research Conference officially opened.

Thank you all.

Prof. Erastus N. Njoka, Ph.D.
Vice-Chancellor
and
Professor of Animal Science

PREFACE

Chuka University became the 2nd Chartered and 9th Full-Fledged Public University in Kenya in 2013. It is located in Chuka Town in Tharaka-Nithi County at approximately 186 km from Nairobi City along the Nairobi-Meru Highway. Chuka University has triple core Missions of Education, Research and Extension. Great strides have been made in delivery of higher education. Impressive strides have been made in pursuit of research and delivery of extension services in the region. The University desires to strengthen and sustain these noble strides by hosting the 3rd International Research Conference. The theme of this Conference was **Harnessing Research, Innovation and Technology to Realise the Sustainable Development Goals**. The subthemes were:

- Revitalisation of agriculture and food security for sustainable development
- Enhancement of quality education and health for sustainable development
- The role of science, engineering and technology in sustainable development
- The role of arts, humanities and social sciences in sustainable development
- Harnessing affirmative action and gender equity for sustainable development
- Conservation of biodiversity, energy and water for sustainable development

The objectives of the Conference are:

- To disseminate and share current knowledge, innovations and technologies to spur sustainable development.
- To bring students, researchers, scholars, professionals and policy makers together to interact and network.
- To facilitate interested parties and stakeholders to acquire and exhibit the new knowledge, technologies and capacities.
- To provide a forum for students, researchers and industrialists to commercialise their creations and innovations.

The theme is anchored on the 17 Sustainable Development Goals (SDGs) that the UN member states will be expected to use to frame their agendas and political policies until 2030. The SDGs offer good coverage and balance of socially, economically and environmentally sustainable development. Research, Innovation and Technology (RIT) play important roles in sustainable development by facilitating formulation of evidence-based ideas, targets and indicators, and assessing progress, testing solutions and identifying emerging risks and opportunities. The SDGs framework contains a number of conceptual as well as implementation challenges that require enhancing collaboration among scientific communities, policy makers and other collaborators to overcome. This Conference has been coined to exemplify the roles RIT can play in the realisation of Sustainable Development.

Ultimately, we have received nearly 150 abstracts to be deliberated during this Conference. Thus the Conference promises to be educative, enriching, informative, inspiring and memorable. Sincere gratitude goes to all scholars, researchers, authors and stakeholders who have provided their knowledge for sharing. The organisers are grateful to the Vice-Chancellor, Prof. Erastus Njoka, for being at the forefront of championing these kinds of forums and for availing the bulk of the funding for the Conference. Similarly, we acknowledge our esteemed sponsors for subsidizing the Conference's financial support. We sincerely wish all delegates lively interaction and enjoyable visit here with us and look forward to welcoming them again next year.

Arising from the Conference are these Proceedings of which we hope will go along way in transferring and disseminating the knowledge that was shared during the plenary sessions. I wish you informative reading that will culminate in their application to develop our country and the world.

Professor Dorcas K. Isutsa, Ph.D.

Deputy Vice-Chancellor (Academic, Research & Student Affairs)
and
Professor of Horticulture

DISCLAIMER

Views and opinions expressed herein are those of contributing authors and not necessarily those of the publisher, Chuka University. Only papers that were orally presented, consented by authors, and had met overview criteria were published in these proceedings. The publisher reserves the right to typeset the papers to meet the proceedings layout.

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