

**CHUKA**



**UNIVERSITY**

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

## Proceedings of the 2<sup>nd</sup> International Research Conference

Theme: Mainstreaming Research Commercialization for Sustainable Development

28<sup>th</sup> to 30<sup>th</sup> October, 2015



Our highly esteemed collaborators



Agricultural revolution for development



Environmental conservation for development



Technology commercialisation for development



Digital transformation for development



Engineering science for development



Education of humanity for development



Mainstreaming social sciences for development



Mainstreaming gender and disability for development

Chuka University is ISO 9001:2008 Certified



Inspiring Environmental Sustainability for Better Life

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**Proceedings of the 2<sup>nd</sup> Chuka University International  
Research Conference held at the Main Campus  
from 28<sup>th</sup> – 30<sup>th</sup> October, 2015**

**Theme:  
‘Mainstreaming Research Commercialization for  
Sustainable Development’**

**Published 2016**

# 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

<p>(1) <b>Customer Value and Focus:</b> Enhancing customer satisfaction levels by providing products and services that meet or exceed customer expectations.</p>
<p>(2) <b>Diversity and Social Fairness:</b> 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.</p>
<p>(3) <b>Environmental Consciousness:</b> Considering the impact of all activities and programmes to be implemented and taking measures that ensure zero tolerance to environmental damage.</p>
<p>(4) <b>Fidelity to the Law:</b> Dutiful adherence to the Constitution and other legal, statutory and regulatory requirements.</p>
<p>(5) <b>Innovation:</b> Creativity in undertaking programmes and activities earmarked to contribute novel, effective and efficient ways of advancing humanity.</p>
<p>(6) <b>Integrity:</b> Upholding honesty, transparency, accountability and strong moral principles and values in all decisions and actions taken.</p>
<p>(7) <b>Passion for Excellence:</b> Being outstanding in all services, activities and programmes undertaken by the University.</p>
<p>(8) <b>Peaceful Co-Existence:</b> Living harmoniously with neighbours and the environment and promoting the ideals of cohesion, integration and unity.</p>
<p>(9) <b>Professionalism and Confidentiality:</b> 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.</p>
<p>(10) <b>Prudent Utilisation of Resources:</b> Utilising resources without wastage and misappropriation by ensuring maximum value and complying with various planned arrangements, internal controls and government regulations.</p>
<p>(11) <b>Teamwork:</b> Adopting a participatory and inclusive approach in undertaking operations and functions of the University.</p>
<p>(12) <b>Timeliness and Devotion to Duty:</b> 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.</p>

## FOREWORD

It is my pleasure to welcome participants to the 2<sup>nd</sup> Chuka University International Research Conference being held on 28<sup>th</sup> to 30<sup>th</sup> October, 2015. Chuka University is fast becoming a hub of quality research. Chuka University has purposed to become a centre for research and the destination for renowned scientists. This Conference brings together multidisciplinary experts to discuss various topics that affect our lives. The Kenyan government recognizes that research, education and training of its citizens is fundamental in the growth of the country's economy. Research advances should provide a paradigm shift in the lives of the people of this country. We must make a complete transformation of the way we have always done things. This turnaround will be driven by research that will lead to better technologies and innovations. The research conducted in universities and research institutions should provide answers to the myriad problems that bedevil developing countries, Kenya being one of them.

Agriculture remains the mainstay of Kenya's economy, yet, poor land use and lack of good policies continue to bedevil the sector resulting in perennial food shortages. It is my belief that massive irrigation and improved propagation techniques can help mitigate against these food shortages. In Kenya, FAO lists 164 sub-basins that have perennial rivers and 35 others with seasonal river systems. These are in addition to a massive aquifer estimated to have some 250 billion cubic metres of water in Turkana County. With these water reserves, irrigation should not be an issue. Besides, we can harvest and store the rain water that drains into the Indian Ocean whenever it rains. We should develop affordable rainwater harvesting techniques, irrigation and natural resource management to turn our drylands into food baskets. Our research should focus on how to harness these natural resources with the aim of increasing Kenya's food self-sufficiency. Research can help in ending perennial hunger by increasing yields of food crops by developing high yielding crops and improved livestock. This calls for innovative production methods. Extension programmes should, for instance, use trained farmers to update fellow farmers by transferring knowledge and skills.

Universities and research institutions like KALRO should work in partnership to develop drought resistant and disease resistant crop varieties for our marginal districts. The same is also possible for our livestock. For example, research has produced the live thermostable avirulent 1-2 ND which is able to protect poultry against Newcastle Disease, one of the many diseases that kill poultry. Research should also be used to protect the quality and productivity of our soils and environment. A good example of scientific research that has made an impact on the environment is the making of briquettes or charcoal from waste agricultural products such as coffee and rice husks. This can help save our forests from destruction and increase Kenya's forest cover. The ripple effect of improved forest cover is improved rainfall and its attendant benefits. Another area where science can be used sustainably is to make biogas from cow dung. Scientific and technological research and innovation should be applied to impact a wider population and improve the standards of living of citizens.

The developed technologies should be simple enough for adoption. Vertical gardens and mini-greenhouses, for example, can help feed large populations if they are introduced in places with scarce farming land such as in slum areas. What farmers need is technical assistance to propagate the crops. Today, most arable land in Kenya has been fragmented into economically unviable

pieces of land. For example, 89% of the households in Kenya occupy less than three hectares, while 47% of households live on farms that are less than 0.6 hectares. Only 10% of the farms or 570,000 households live in pieces of land that are above 3 hectares. The only way to make these small pieces economically viable is by practicing intensive agriculture and innovative methods in vertical gardens and mini-greenhouses. Research should provide the farmers with technical information on how to manage these facilities, and how to conserve arable land so that it continues to be productive. Research in biotechnology is another means to promote food security. This is possible through protection of local germplasm and exploring traditional dimensions of genetically modified organisms. Other bioethical dimensions such as life sciences and health care should also be explored.

Kenya's Agricultural Sector Development Programme (ASDP) gives specific mandates to the Kenya Agricultural Livestock and Research Organization (KALRO), Kenya Forestry Research Institute (KEFRI), Kenya Marine and Fisheries Research Institute (KEMFRI), Kenya Forestry Research Institute (KEFRI) and the Kenya Industrial and Research Institute (KIRDI) parastatals established under the Science and Technology (Amendment) Act of 1979. Other state corporations registered under the Companies Act (Cap 468) are the Coffee Research Institute (CRI), the Tea Research Institute (TRI), the Kenya Sugar Research Institute (KESRI), the Kenya Seed Company (KSC) and the National Irrigation Board (NIB). These are public and private agricultural research institutions mandated to spearhead Kenya's agricultural system. These institutions should work in partnership with universities established under charters to carry out agricultural research. I am glad to note that research is already taking place through such forums and other collaborative arrangements. This innovation system comprising research centres, universities, private enterprises and community based organisations will create, disseminate and utilize available knowledge and technologies to move Kenya's economy forward.

Kenya has achieved a middle level economy status. Our research should be geared towards sustaining steady economic growth, which will eventually see this country realize industrial take off. An improved economy will mean more income for our populace. Universities and other research institutions will provide the impetus and the missing link between national development and technological development. They should identify and link economic, social and political policies that will spur growth, expand markets and alleviate poverty. The research done by all these institutional should be coordinated by the National Council for Science and Technology to avoid duplication of effort. The National Commission for Science, Technology and Innovation (NaCoSTI) has continued to do a commendable job since 1977 when it was first established through an act of Parliament. Mr. Director General, we appreciate the many research projects and activities that you have continued to fund for they have made an impact on in this country.

Ladies and gentlemen, the Kenya Constitution 2010 has embraced devolution, thus decentralizing planning and other socio-economic development projects from the central government to the counties. Our research and development agenda should now focus on these devolved units since each of them has unique potential and resources. Let us examine the strength of each county and help them to exploit their potential through research. Let us decentralize industries by establishing them in the counties rather than concentrating them in cities. In this regard, I am happy to note that earlier this month Chuka University hosted a very successful summit dubbed: **“The First Eastern and Central Counties Agribusiness Investment Summit”** on 7<sup>th</sup> - 9<sup>th</sup> October, 2015. During the

summit, regional counties came together to showcase their entrepreneurial prowesses. This is the kind of partnership that will turn our small-scale farmers into industrialists by helping them to add value to their raw materials, thus earning more from their toil. Researchers have a role to play in this endeavour.

The theme of this Conference strikes a timely call that aims at training farmers to become agribusiness entrepreneurs with the ultimate aim of sustaining development through commercialization of agriculture and research findings. The kind of sustainable development we seek cannot be realized unless we embrace Information Technology (IT). IT will link the devolved units and the other regional countries in what is referred to as the information superhighway. This will enhance our business opportunities in the region and help to improve trade ties. For our research to reach the intended audience, universities and other research institutions must shed the ivory tower mentality and reach out to the grassroots. This will be possible if our findings are packaged and disseminated to the end users. This as I said earlier calls for a revival and support of our extension services.

Finally, ladies and gentlemen, I wish you informative reading of the proceedings that have been compiled from the papers you submitted and presented in this Conference. Thank you very much for generously sharing your research findings. We look forward to hosting you here again in our future conferences.

Prof. Erastus N. Njoka, Ph.D.

**Vice-Chancellor and Professor of Animal Science**

## PREFACE

Chuka University became the 2<sup>nd</sup> Chartered and 9<sup>th</sup> full-fledged public university in Kenya on 8<sup>th</sup> January, 2013. It is also ISO 9001:2008 Certified. The University is located in Meru South Subcounty, Tharaka-Nithi County at 186 km from Nairobi City along the Nairobi-Meru Highway, and next to the snow-capped Mt. Kenya. The area's cool climate, with temperatures ranging from 16°C to 24°C and annual rainfall averaging 1,000 mm, provide a serene environment for learning, as it is devoid of the mundane hassle and bustle activities found in big cities. The University is designated as a centre of excellence in Environmental and Renewable Energy Studies and offers diverse academic programmes. It has triple core Mission 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 extension services in the region. The University is strengthening and sustaining these achievements through Conferences.

The Conference was held from 28<sup>th</sup> to 30<sup>th</sup> October 2015 to provided a forum for sharing findings of the various researches conducted over past years. The theme was: "Mainstreaming Research Commercialization for Sustainable Development". The sub-themes were:

1. Agricultural Revolution for Development
2. Environmental Conservation for Development
3. Technology Commercialisation for Development
4. Digital Transformation for Development
5. Engineering Science for Development
6. Education of Humanity for Development
7. Mainstreaming Social Sciences for Development
8. Mainstreaming Gender and Disability for Development

Subsequently, four lead papers by expert scholars and over 150 session papers and posters received were presented. The Conference had a rich collection of papers in line with the subthemes. The conference therefore was educative, enriching, informative, inspiring and memorable. It was held for three days, from 28<sup>th</sup> October, 2015 (Wednesday) to 30<sup>th</sup> October, 2015 (Friday). The Chief Guest was Dr. Moses Rugut, Director General, National Commission for Science, Technology and Innovation. Prof. Erastus N. Njoka, the Vice-Chancellor, officially opened the conference on 28<sup>th</sup> October, 2015. Thereafter, participants proceeded to parallel breaker sessions organised in three rooms, according to subthemes. Papers of a wide range were presented in the breaker sessions to give participants a chance to update and share their knowledge. Participants were able to view exhibits during break time and adhered to time as scheduled for the smooth running of the conference. On 29<sup>th</sup>, participants attended official closing ceremony and reception dinner. On 30<sup>th</sup> October, 2015, participants went for a tour of the Samburu National Reserve and Olepejeta Conservancy.

We sincerely thank all participants who turned up for the conference and wish them well in their work stations as we look forward to another conference.

Professor Dorcas K. Isutsa (Ph.D.)

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

### **Disclaimer**

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### **Organisers**

Prof. Dorcas K. Isutsa - Deputy Vice-Chancellor (Academic, Research & Student Affairs)  
Prof. Zachary M. Getenga - Director (Research, Extension and Publications)  
Dr. George M. Muthaa - Director (Graduate School)  
Dr. Lemmy M. Muriuki - Faculty of Agriculture & Environmental Studies  
Ms. Christine Atieno Peter - Faculty of Arts & Humanities  
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Dr. Mercy Wanja Njagi - Faculty of Education & Resources Development  
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Dr. Geoffrey K. Gathungu - Faculty of Agriculture & Environmental Studies  
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