The Role of University Education towards Self-Reliant Development and SDGs

- A Case Study of Africa (Engineering and Science) -

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24th FEB 2016

JKUAT is ISO 9001:2008 certified

**********JKUAT Vision**********

To be a University of Global Excellence in Training, Research and Innovation for Development

**********JKUAT Mission**********

To offer Accessible Quality University Education, Training, Research and Innovation in order to Produce Leaders In the Fields of Agriculture, Engineering, Technology, Enterprise Development, Health and other Applied Sciences to Suit the Needs of a Dynamic World

**********JKUAT Slogan(Motto)**********

Setting Trends in Higher Education, Research and Innovation

Overview of JKCAT, JKUCAT and JKUAT

1977: Start of the Plan

1981 — **Middle Level College (JKCAT)**
First Intake of Students (Agriculture: Diploma Technology: Technician)

1988 — **University College (JKUCAT)**
Promoted to University (Degree of KU)

Japan's Cooperation

1994 — **Full Fledged University (JKUAT)**
Start of Graduate School (Master, Doctor of JKUAT)

2000

Developed into one of the top-class universities in the fields of Agriculture, Science and Engineering in Kenya

After — **At Present** — **2016**

Support by Japanese Government through JICA

with Deep Appreciation

Campus Infrastructure such as
- Construction of classrooms and offices
- Installation of modern equipment

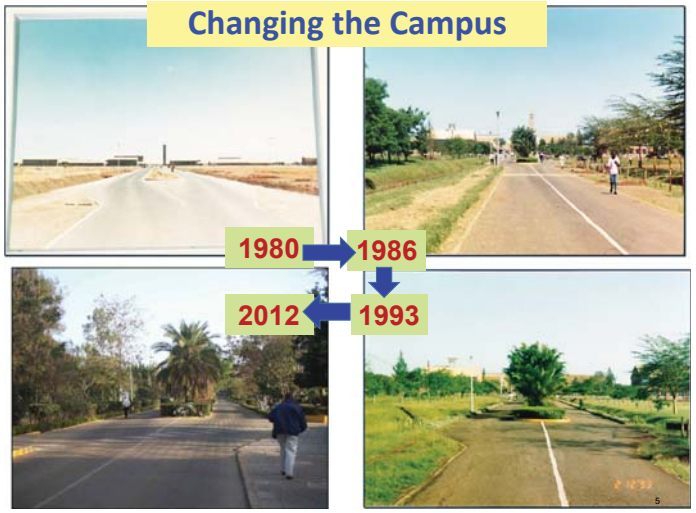
Technical Cooperation such as
- Capacity development of staff
- Joint research activities
- In-country training

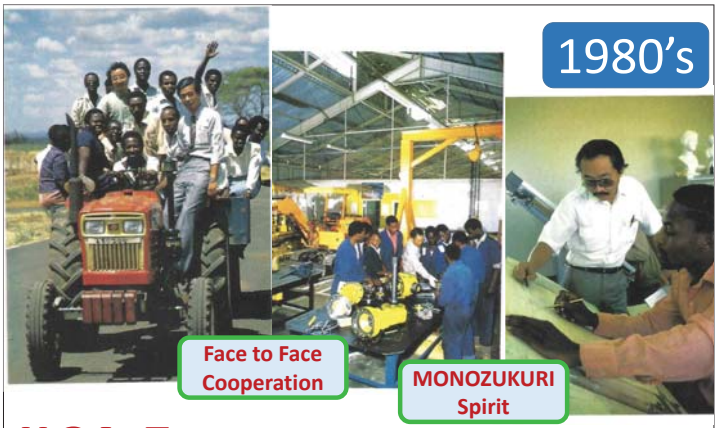
A Variety of Academic Supports such as
- Babaroa awards to excellent students now run by the university
- Networking with Japanese Universities.

JICA (On-going)

- Eritrea Higher Education Support under JKUAT
- Socio-economic Empowerment Trainings for Women
- Renewable Energy (**Bright Project**)
- PAU under JKUAT (**AFRICA-*ai*-JAPAN Project**)
- etc.

Changing the Campus





JICA Experts at JKCAT

Experts dispatched by the Government of Japan

A Motto of JKUAT

<an example of JKUAT STUDENT PRACTICE-1 (B.Sc.)>

MONOZUKURI based on Creative Design/Drawing

A Japanese word (2 in one) meaning

Monozukuri

"products" — "process of making or creation"

- Requires **creative minds** and often related to **craftsmanship** evolved through **apprenticeship** rather than structured curricula
- Represents the **Japanese Philosophy;**
  "How to Make Things"

In the ability to;
- ✓ make things,
- ✓ good things,
- ✓ very well

Japanese MONOZUKURI, Design Thinking, Fab.Lab. 5S-KAIZEN,TQM・・・

An Overview of JKUAT (as of Dec.2015)

JKUAT Constituent Colleges (C.C.)

1) Taita Taveta,University College
2) Muranga University college
3) Kirinyaga University College
4) Co-operative University College

Full fledged universities from JKUAT C.C.

1) Mombasa Polytechnic University College
2) Meru University College of Technology (MUCT)
3) The Kenya Multimedia University College.
4) Kimathi University College of Technology (KUCT) in Nyeri.

Campuses outside main campus

1) Karen Campus
2) Westlands Campus
3) Nairobi Central Business District(CBD) Campus
4) Mombasa CBD Campus
5) Nakuru CBD Campus
6) Kitale CBD Campus
7) Kakamega CBD Campus
8) Kisii CBD Campus
9) Kisumu CBD Campus
10) Keiyan Campus
11) Arusha Centre (Tanzania)
12) Kigali Campus (Rwanda)

Colleges/Faculties/ Schools

1) **College**
   - Engineering
   - Pure and Applied Science
   - Human Resource Development
   - Health Sciences
2) **Faculties:**
   - Agriculture
3) **Schools:**
   - Architecture and Building Science (SABS)
   - Law
4) **Academic Institutes**
   - Computer and Information Technology (ICSIT)
   - Institute of Tropical Medicine and Infectious Diseases (ITROMID)

Juja
-Main campus-

Research Institutes and Outreach

1) Institute for Biotechnology Research (IBR)
2) Institute for Energy and Environmental Technology (IEET)
3) Sustainable Materials Research & Technology Centre (SMARTEC)
4) Institute of tropical medicine and infectious disease (ITROMID)
5) Water Research and Resources Center (WARREC)

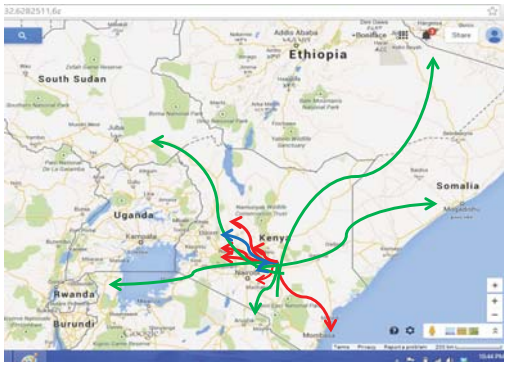
Production and Innovation Centers

1) Food Technology Center (FOTEC)
2) Chemistry Production Center (CPC)
3) Engineering workshops
4) Farm
5) Biotechnology labs

Summary about growth of JKUAT

- The student population growth from inception was slow reaching 2068 in 1994. The growth improved attaining the 3061 mark in the year 2000 and eventually to 40,200 in the year 2015.
- The main disciplines of Agriculture, Engineering, Architecture and Science has grown from 2068 in the year 1994 to 3021 in the year 2000 and eventually to 14,951 in the year 2015.
- This tremendous growth has overstretched the facilities such as lecture halls, workshops, laboratories, the water capacity and waste treatment.
- Quality of Education was implemented by Lab.Based Education through Face to Face Cooperation/Collaboration between Japanese and Kenyan Staff.

Reaching Out Across Kenya and Africa



Relationship with Japan continues….

Japan Has Africa at Heart: JICA President Affirms

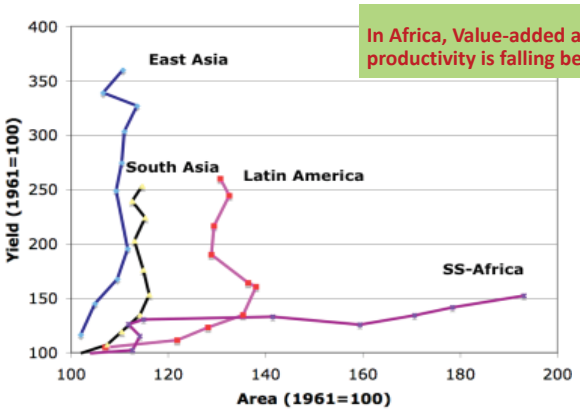
Posted on December 1, 2015 by Corporate Communications Office, JKUAT

Prof. Shinichi Kitaoka interacts with a section of JKUAT engineering students during his visit

Prof. Kitaoka (left) with Prof. Odhiambo (centre) at the modern farming demonstration stations explained by Prof. Shiomi, JICA Expert

1/Dec/2015 at JKUAT

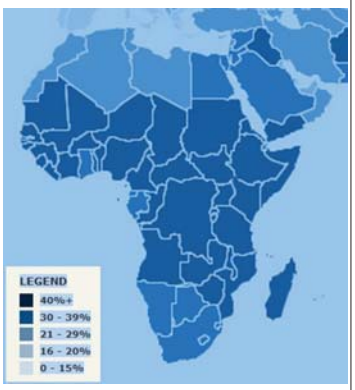
Productivity



In Africa, Value-added and productivity is falling behind …

African Population

- **Africa has more people under 20 years** than anywhere in the world
- Currently, the estimated **median age** in sub-Saharan Africa is **under 19 years**.
- In Sub-Saharan **Africa people aged between 15 and 29 will continue** to constitute about half of the population in most countries for the next 3 to 5 decades.
- Africa has and will continue to have **massive potential work force** that can drive development.



African Population under 15 Years Old
Source: Population Reference Bureau, 2015 World Population Data Sheet [http://www.prb.org]

SUSTAINABLE DEVELOPMENT GOALS

- **For Goal 4 (Quality Education) institutions of higher education and training will play a critical role**
- **Achievement of Goal 4 will contribute to realization of the other 16 goals**

SDG - Goal 4 (Quality Education) Targets

By 2030,:

- Ensure that **all girls and boys complete free, equitable** and **quality primary and secondary education** leading to relevant and effective learning outcomes
- Ensure that **all girls and boys have access to quality early childhood development**, care and pre-primary education so that they are ready for primary education
- Ensure **equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university**
- Substantially **increase the number of youth and adults who have relevant skills**, including technical and vocational skills, for employment, decent jobs and entrepreneurship
- **eliminate gender disparities in education and ensure equal access to all levels of education** and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations
- ensure that **all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy**
- Ensure that **all learners acquire the knowledge and skills needed to promote sustainable development**, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development
- **Build and upgrade education facilities that are child, disability and gender sensitive** and provide safe, non-violent, inclusive and effective learning environments for all
- substantially **increase the supply of qualified teachers, including through international cooperation** for teacher training in developing countries, especially least developed countries and small island developing States

By 2020, substantially **expand globally the number of scholarships available to developing countries**, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries

Engineering and Science

- Engineering and science constitute the engine for sustainable development, especially for Africa.
- Hence the need to enhance engineering and science education in Africa.
- With the youthful population and abundant natural resources that has recently attracted foreign interests, Africa stands at a crossroads in its development trajectory.
- Education and training, buttressed by technological advancements, are necessary tools for the continent to unlock its potential, and to set free the "African giant".

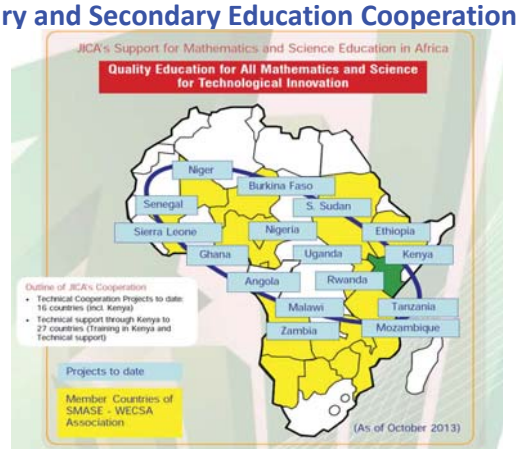
Situation of Engineering in Africa

Situation in Kenya: Case of Registered Engineers

Category	Males	Females	Totals
Registered Consulting Engineers	272 (98.2%)	5 (1.8%)	**277**
Registered Engineers	1298 (96.8%)	43 (3.2%)	**1341**
Registered Graduate Engineers	4974 (92.3%)	413 (7.7%)	**5387**
Graduate Technicians	1128 (98.5%)	17 (1.5%)	**1145**

- Local presence of foreign engineering firms who prefer to import their own skilled labor;
- Reluctance of the graduates to take up poorly paid positions in rural areas; and
- Shortage of engineering technicians who support the professional engineers. Generally, for the effective operation of the engineering industry, the ratio professional engineers to technicians should be of the order of 1:5 or 1:6. In Africa, however, this ratio is more of the order of 1:1 or 1:1.5

Primary and Secondary Education Cooperation by JICA



SMASSE Project (Secondary: 1998-2008):Strengthening of Mathematics and Science in Secondary Education
SMASE Project (Primary: 2009-2013): Strengthening of Mathematics and Science Education in Kenya
SMASE-WECSA (Regional Activity): Western, Eastern, Central and Southern Africa

Source: SMASE-WECSA ASSOCIATION Since 2001

Changing through SMASSE/SMASE Project

【Teacher】
- **Positive changing of teachers' attitude** (preparation of lesson plan/teaching materials, etc.)
- **Focus on more practical aspects** (experiment, hands-on and minds-on activities, group work, etc.)

【Student】
- **Improvement of attendance for classes**
- **Positive attitude and more interests for Math and Science**

【Class】
- Copy from blackboard
  ⇒ **Hands-on and Minds-on Activity by students**
- One way communication from teacher to students
  ⇒ **Participatory classes (student-centered)**
- Focusing on only theory
  ⇒ **More practical aspect with experiment**
- Ready-made equipment ⇒ **Improvisation, Localization**

Source: KENYA SMASSE/SMASE PROJECT (1998-2013)

Need for Engineering and Science Capacity

Africa is in dire need to expand her engineering and science capacity and capability:

- ⊛ for its infrastructural development in tandem with her growth trajectory;
- ⊛ for accelerating its industrial development, especially in manufacturing;
- ⊛ for producing its ever-increasing needs in terms of renewable energy to overcome the acute power shortages;
- ⊛ for empowering Africa to take control of the extraction industry of its rich natural resources; and
- ⊛ for sustaining agricultural productivity and the need for food security base;
- ⊛ for water harvesting in order to curb the challenges faced as a result of lack of water.

Challenges in Engineering and Science Training

- Insufficient output from the engineering and science training institutions to meet the countries' requirements;
- Lack of practical experience and skills of the graduates produced;
- Outdated equipment for training,
- Limited opportunities for industrial attachment and internship for engineering and science students and graduates,
- Mismatch of curricula with the needs of the industry
- It is now self evident that engineering and science curricula need to be linked with their practical results through a "hands on" approach in the form of "lab. based education"
- Lab. based education and Project based learning" which are common in Japan, that showcases the roles engineers play in developing solutions for contemporary issues.

Special features for SMASE/SMASSE

Continuous learning process by teachers through INSET to improve classes with the concepts of;

- **Participatory classes by students (student-centered)**
- **Practical-oriented (Experiment)**
- **Hands-on and Minds-on Activities**
- **Practice of ASEI-PDSI**

ASEI:
Activity (more focus on student activity)
Student-centered (to make student think)
Experience (including experiment)
Improvisation (develop teaching materials with utilizing of items around us)
PDSI:
Plan (Plan of Lessons)
Do (Practice of lessons)
See (Observation of lessons)
Improve

Engineering and Gender

- **Gender imbalance in engineering training**
- **With regard to gender imbalance, it is reported that the overall percentage of young women pursuing higher education in Africa in the disciplines of science, technology, engineering and mathematics (STEM) is relatively low, for example only 10% of the engineering workforce is female in South Africa and 8% in Kenya.**
- **Taking note of the global impact of women in sustainable development, there is urgent need to address the issue of perception and encourage more women to study engineering since women are well positioned to integrate engineering practice in daily lives and chores of citizens.**
- **There is also the challenge of lack of policies to implement gender parity**

Addressing the Engineering/ Science Education in Africa challenges

The future of engineering and science education in Africa lies heavily on strategic decisions evolved by the African people themselves within the African context. For a bright future, African governments/universities will have to:

- invest in modern infrastructure and laboratories
- update curricula to accommodate industry demands, while at the same time seeking to rationalize the requirements for accreditation of engineering/science programs by the regulating bodies
- re-orient teaching styles in engineering/science faculty from the current magisterial or masterly mode to the Project-Based Learning approach
- Closely linked to improving teaching methodology in engineering/science faculty is the need for pedagogical training of engineering lecturers as well as short-term attachment in industry to keep pace with advancements in technology and design.
- The faculty and study also require extensive use of state-of-the-art ICT in engineering/science education and training.

Addressing the Engineering/ Science Education in Africa challenges - University-industry linkages

- To keep pace with ongoing foreign investments in Africa, university-industry linkages is now paramount.
- These linkages may adopt several formats such as
  - involving industry in advising on curricula reform
  - inviting representatives or professional practicing engineers to serve as adjunct professors
  - provision of practical training to the students during industrial attachments and post-graduation internship
  - ensuring that final year projects are always laboratory or industry based.
- A collaborative approach and joint efforts by African governments, engineering/science education institutions and representatives is required to address the challenges
- To precede the above mentioned steps, African countries/universities will need to undertake a national assessment of both engineering/science capacity and needs. At some stage, joint accreditation of programs may be necessary.

Initiatives for improving Engineering Education in Africa

- **Tuning Africa Project (2012)** for curricula reform, involving over 20 African Engineering Faculties;
- **Africa-UK Engineering partnership (2010)** to promote collaboration among African-UK engineers e.g. in curricula reform;
- **UNESCO Engineering Initiative (2011)** to address major challenges in engineering education e.g. curricula reform, QA, accreditation;
- **African Engineering Education Association (2006)** to promote networking among engineering educators,
- **The Federation of African Engineering Organisations (2012)** to act as an umbrella body for all African engineers,
- AU funded **Pan African University of STI** at JKUAT,
- **African Women in Science and Engineering**, and
- **Nelson Mandela**

Promoting Digital Literacy (Examples of Initiatives)

❶ Government laptop project

- The Government of Kenya will provide primary school pupils with laptops at a cost of KSh 17 billion.
- Eight firms tendered to the Information and Communication Technology (ICT) Authority.

❷ JKUAT Contribution

- JKUAT designed a locally assembled laptop.
- JKUAT is one of the firms that tendered to supply laptops to schools

❸ Avallain digital learning programme

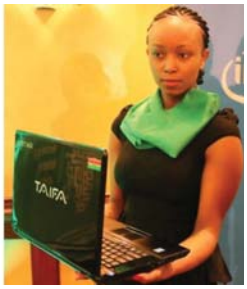
- 10,000 children in 200 schools across the country have so far been enrolled to an interactive digital content platform.
- The project aims at supplementing the government's efforts to promote digital content at the primary school level.
- Public schools and non-formal schools in urban and slum-based areas are target beneficiaries of the project dubbed a-Academy.
- The programme has so far seen the production of Science and English for primary school children.

Pupils in Valley View, Mathare slum, Nairobi, use the a-Academy content during a lesson. Source: The STAR Jan. 12, 2016 **[http://www.the-star.co.ke/news/2016/01/12/10000-kids-in-slums-join-digital-learning-programme_c1274086]**

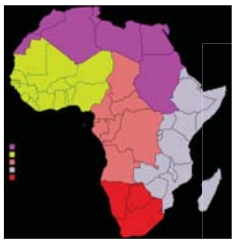
Taifa Laptop – Locally designed and assembled laptop

- JKUAT rolled out Taifa Laptop to the Kenyan market.
- The computing device was conceived and designed by JKUAT
- It was a maiden product of the **Nairobi Industrial and Technology Park (NITP)**

Prof. Mabel Imbuga (second left) takes Dr. Matiang'i through the Taifa Laptop as JKUAT Chancellor, Prof. Maloiy (second right) and Kiambu Deputy Governor, Gerald Githinji (left) follow



A model displays the Taifa Laptop during the event



African Union
a United and Strong Africa

Five themes critical to Africa's development:

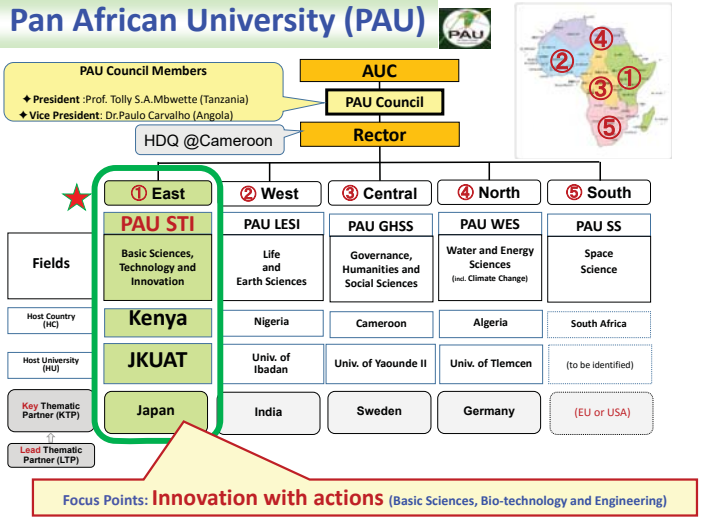
- **Basic Sciences, Technology and Innovation at JKUAT (Civil, Electrical, Maths, Molecular Biology and Biotech.)**
- **Water and Energy Sciences (including Climate Change), Univ. of Tlemcen in Algeria**
- **Governance Humanities and Social Sciences, Univ. of Yaounde II in Cameroon**
- **Life and Earth Sciences, University of Ibadan in Nigeria**
- **Space Sciences at Southern Africa**

PAU PAN African University
Life and Earth Sciences Institute
University of Ibadan

PAN AFRICAN UNIVERSITY
INSTITUTE OF BASIC SCIENCES, TECHNOLOGY AND INNOVATION

❑JKUAT was competitively selected to host PAUSTI. PAUSTI is one of the five institutes that form the Pan African University (PAU). The decision to establish PAU was made by the AU Heads of State and Government Summit in 2010, and the university enrolled its first students in 2012.

Pan African University (PAU)



Admissions

(As of Jan.,2016)

Level	Batch 1			Batch 2			Batch 3 (TBP)			Grand Total		
	F	M	All	F	M	All	F	M	All	F	M	All
MSc	8	48	56	14	32	46	12	43	55	34	123	157
PhD	--	--	---	6	16	22	12	33	45	18	49	67
Total	8	48	56	20	48	68	24	76	100	52	172	224

Batch 1 graduated in Nov. 2014 | Batch 2 : Currently 2nd Year | Batch 3: To be enrolled in 2016

Programmes

- Mathematics
  - Statistics Option
  - Computational Option
  - Financial Option
- Molecular Biology / Biotechnology
- Electrical Engineering
- Civil Engineering

Countries

o Algeria	o Eritrea	o Niger
o Benin	o Ethiopia	o Nigeria
o Burkina Faso	o Gambia	o Rwanda
o Burundi	o Ghana	o Senegal
o Cameroon	o Kenya	o Sudan
o Chad	o Lesotho	o Tanzania
o Comoros	o Liberia	o Togo
o Congo	o Malawi	o Uganda
o DRC	o Mali	o Zambia
o Egypt	o Namibia	o Zimbabwe

Students from 30 countries up to now

Joint Degree

Case of Mr. GULMA, Sadiq Abubakar, M.Sc. Civil Engineering (Environmental & ASAL)

Certificate No. 0035

The Pan African University and Jomo Kenyatta University of Agriculture and Technology

L'Université Panafricaine et Université Jomo Kenyatta d'Agriculture et de Technologie

jointly confer with all rights, privileges and obligations the degree of
conférent conjointement, avec tout les droits et privilèges, le diplôme de

MASTER OF SCIENCE IN CIVIL ENGINEERING (Environmental and ASAL)
MASTER ES SCIENCE EN GENIE CIVILE (Environnement et TASA)

On
A

Sadiq Abubakar Gulma

who has satisfied all requirements for the award of the Degree
qui a satisfait a toutes les exigences requises pour l'obtention du diplome
at a congregation held at Jomo Kenyatta University of Agriculture and Technology on Monday the
lors de l'assemblée réunie à l'Université Jomo Kenyatta d'Agriculture et de Technologie
Twenty Fourth day of November in the year Two thousand and Fourteen
en ce Lundi Vingt-quatre Novembre de l'an Deux mille Quatorze

RECTOR, PAU / RECTEUR, UPA — VICE CHANCELLOR, JKUAT / VICE-CHANCELIER, JOUAT — DEPUTY VICE CHANCELLOR (Academic), JKUAT / VICE-CHANCELIER ADJOINT (Académique), JKUAT

Rector, PAU | VC, JKUAT | DVC(AA), JKUAT

PAUSTI Master Students at Civil Eng.Lab at JKUAT for Research Activities
(left: M2 student from **Uganda**, right: M2 student from **Cameroon**)
<July, 2014>

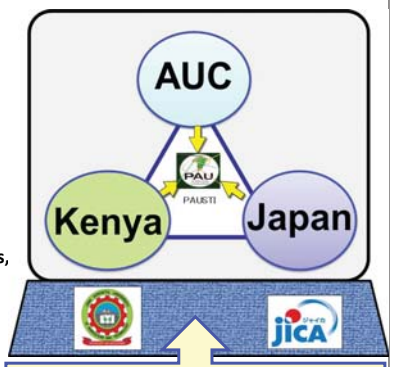
Africa-*ai*- JAPAN Project/JICA

Africa Union-*african innovation* - JKUAT AND PAUSTI Network Project

This project will strengthen the knowledge and skills in the fields of
- ♦agriculture,
- ♦engineering,
- ♦science, and
- ♦biotechnology

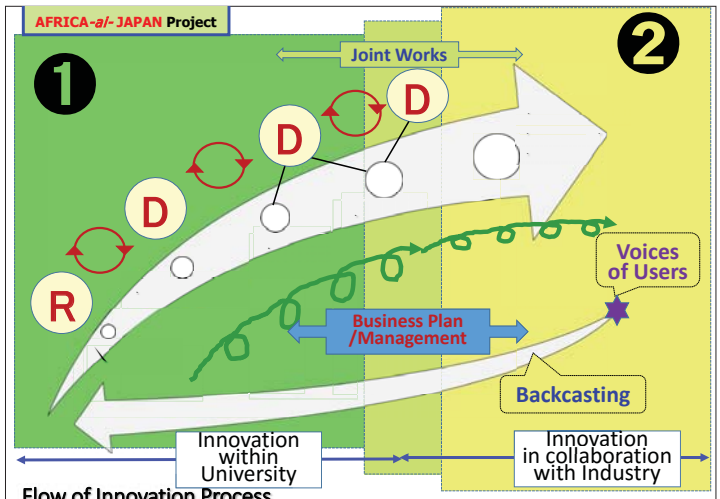
of both PAUSTI and JKUAT students.

"*ai*" is unique since it promotes the full utilization of **local/indigenous knowledge, resources, experiences and wisdom** generated and accumulated in Africa to solve Africa's problems.



AUC: African Union Commission
PAU: Pan African University
PAUSTI: PAU of Institute of Basic Sciences, Technology and Innovation

Stable Foundation of Research and Education towards African Innovation for PAUSTI/JKUAT Students and Staff



Flow of Innovation Process

R(Research) ⇒ D(Development) ⇒ D(Demonstration)⇒ D(Dissemination)

Africa-*ai*- JAPAN

Example of Research & Innovation Outputs

Completion of Motorized Block Press, and improved Manual Press

By Clement Nduati Nganga, Moses Njeru, Peter Ngugi

Addressing the gender disparity

Women's Training for 20 Years

Collaboration and Partnership

Joint Seminar
JKUAT and Okayama Univ. 19/Oct/2015

JKUAT Scientific Conference
Jointly organized with Japanese counterparts

University ⇔ Community(Farmers)

Examples of Innovation Activities at JKUAT

Biotechnology

Tissue-culture *Aloe vera*

Tissue culture banana seedlings

Oyster mushrooms

Engineering Technologies

Electrical Discharge Machine

Micro-hydro Power Generating Plant

"Pick and Place" Robot

Engineering Technologies

Tricycle-trailer

Fruit-pulper

Plant Mill

Screw Briquetting Machine

Value addition for enhanced food security

Addressing the Energy Challenge

BRIGHT Project

There are nine (9) on-going sub-projects for Appropriate Technology in energy:

Solar PV	1		
Small wind energy	2	Small hydro power	2
Biomass generation	3	Hybrid system	1
Total-9			

Portable Flexi-Biogas

Gasifier

Wind Mill & Monitoring Equipment

Small Hydrum

University ⇔ Industry

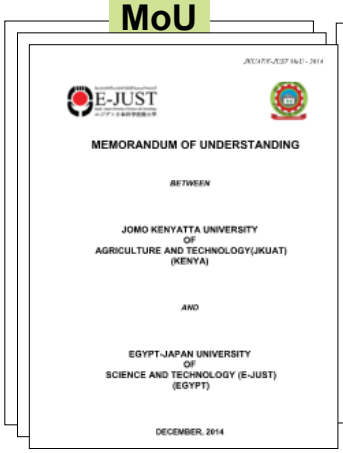
Joint Venture between JKUAT and NISSIN HD (May, 2013)

Kenya Oishii Project /Nisshin Foods Holdings

JKUAT Nissin Foods Limited @ JKUAT

University ⇔ University

MoU



MEMORANDUM OF UNDERSTANDING

BETWEEN

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY(JKUAT) (KENYA)

AND

EGYPT-JAPAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (E-JUST) (EGYPT)

DECEMBER, 2014

MoA

MEMORANDUM OF AGREEMENT

Findings and Messages/Comments on Japan's International Education in Africa

Merits/Uniqueness;

- Face to Face Cooperation
- Monozukuri and Hitozukuri
- 5S-KAIZEN
- Lab. Based Education
- Approach to encourage creativity towards African Innovation
- Capacity Development
  (System + Human Resources + Teamwork)

Challenges;

- Encouragement of Quality Japanese Approach
- Sustainability of Collaboration/Global Human Network

Concluding Remarks

- Sub-Saharan Africa is experiencing unprecedented economic growth by attracting significant foreign investment especially capital development.
- The foreign investment projects have to be undertaken by foreign skilled labor due to the acute shortage of domestic skilled labor especially in the areas of engineering and technology.
- Therefore there is a dire need for engineers in Africa.
- Concerted efforts need to be geared towards engineering and science education, training and practice.
- Universities in sub-Saharan Africa must markedly improve the standard of education if the region is to move beyond the stage of assembling products and achieve sustainable industrial growth.
- Engineering and science education and training, buttressed by technological advancements, are necessary tools for the continent to unlock its potential, and to set free the "African giant".
- With support from Japan, JKUAT is playing a role in addressing the challenge but we still need more institutions to meet the targets.

Thank you