2019 ATPS ANNUAL FORUM, CONFERENCE & SILVER JUBILEE CELEBRATIONS

Using Science, Technology and Innovation (STI) as a means for achieving the Sustainable Development Goals (SDGs) in Africa

PROGRAMME & BOOK OF ABSTRACTS

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1.0 PREAMBLE

The development of and attention to science and technology in Africa took center stage in the 1980s with African governments making commitments through their Heads of States to allocate at least 1% of their gross domestic products (GDPs) to research and development (R&D) as well as scientific and technological capabilities in what is popularly known as the Lagos Plan of Action for the economic development of Africa 1980-2000. This was against the background that Africa at that time was unable to point to any significant growth rate or satisfactory index of general well-being for almost two decades. Faced with this situation, and determined to undertake measures for the basic restructuring of the economic base of the continent, the African leaders resolved to adopt a far-reaching regional approach based primarily on collective self-reliance which included putting science and technology in the service of development by reinforcing the autonomous capacity of our countries in this field. They noted that the role of science and technology in integrated rural development requires among other things the generation of financial resources and political will and courage on the part of policy and decision-makers to induce a profound change with far-reaching effects on the use of science and technology as the basis of socio-economic development. A well-developed science and technology base and its appropriate application will lead to developments in other sectors such as agriculture; transport and communications; industry, including agro-allied industries; health and sanitation; energy; education and manpower development; housing, urban development and environment among others. Countries were urged to develop appropriate policies and programmes that will utilize the power of science and technology to sustain growth and development. Among the early adopters in the development of science and technology policies since the Lagos Plan of Action were Ethiopia (1992), Tanzania (1996), Zambia (1996), Botswana (1998), Nigeria (1998) and Ghana (2000). Other countries followed later.

One very remarkable outcome of the Plan of Action was the support and strengthening of regional and sub-regional science and technology organizations in Africa with a call to Member States and international agencies to provide resources to enable them attain full operational levels. It was during this period that two distinct networks emerged in Africa: The Eastern and Southern Africa Technology Policy Studies (EATPS) and the Western Africa Technology Policy Studies (WATPS). These networks promoted and advocated for the use of science and technology as a means for achieving socioeconomic development in the regions. They facilitated the development of most of the science and technology policies in most of the African countries earlier mentioned. However, in 1994, the EATPS and WATPS came together under one platform that led to the birth of the African Technology Policy Studies Network (ATPS) with its secretariat in Nairobi, Kenya under the East and Southern Africa Regional Office of the International Development Research Centre (IDRC).

The ATPS has since then grown in leaps and bounds. In 2001 ATPS became an autonomous international organization with diplomatic status in Kenya and working on transdisciplinary science, technology and innovation (STI) themes for African development. Whilst retaining the STI

focus, ATPS has moved towards a *"knowledge for development"* network of researchers, policymakers, private sector and civil society actors that promote the generation, dissemination, use and mastery of science, technology and innovation for Africa's development, environmental sustainability and global inclusion. We implement our programs through members in National Chapters established in 30 countries (27 in Africa and 3 Diaspora Chapters in Australia, United States of America and the United Kingdom) with partnerships across the entire 54 African countries. The ATPS is unique in many ways: It is not only the premier STI institution in Africa; it is unique in the composition of its membership, institutional structures and implementation activities. Today ATPS is made up of over 1500 members spread across 51 countries in 5 continents. As the premier STI institution in Africa, it has successfully mainstreamed STI in African development policy dialogues and assisted many African countries to formulate STI policies as well as develop strategies for its implementation.

Our work is guided by the needs and aspirations of our stakeholders across Africa which we usually put together in consultation with these stakeholders as a Strategic Plan over five year periods. During the current ATPS Phase VIII Strategic Plan (2017-2022), we have identified **four thematic and five programmatic priorities of action**. The **four thematic priorities** are: *Agriculture, food and nutrition; Energy; Climate change and environment; and Health innovations*, while the **five programmatic priorities** include: *STI policy research, policymaking and advocacy; Training, sensitization and capacity building; Youth and gender empowerment; Knowledge brokerage, management and commercialization; and Intra-Africa and global collaboration and partnerships*. Details of these themes and programmes are available online at: https://atpsnet.org/wp-content/uploads/2017/12/ATPS-Phase-VIII-Strategic-Plan-2017-2022_Final.pdf. These strategic priorities (thematic and programmatic) align very well with most of the development agenda in Africa including the Sustainable Development Goals (SDGs), the Africa's Agenda 2063, the African Development Bank (AfDB)'s Hi Five Priorities, and the national development agenda and visions in most of the African countries. We aim to seek for supports and collaborations from different institutions and organizations charged with the implementation of these development agenda especially in Africa. The ATPS has benefitted and continues to enjoy the support from many development partners, donors and governments at various levels in the achievement of our mandate.

Conference Sub-themes

Five inter-related priority subthemes have been identified to buttress the main goal of the Annual Forum, Conference and ATPS Silver Jubilee. Papers were invited from experts under the subthemes.

Sub-themes:

i. **Science, Technology and Innovation priorities for Africa's development**- This sub-theme focuses on how STI is driving Africa's development Agenda in the context of STISA 2024 and in achieving the SDGs on the continent. As the African Union has developed a long-term

agenda 2063 for the continent, science, technology and innovation is playing a major role. The strategy aims to address the challenges that hinder development in critical sectors such as agriculture, energy, environment, health, infrastructure, mining, security and water using STI. What does Africa need to do to enhance the use of STI as a means for achieving the sustainable development goals? Has STI been mainstreamed enough in national development agendas in Africa in terms of investments, research and policy?

ii. **The Fourth Industrial Revolution and Africa's Readiness**- The fourth industrial revolution is the current and developing environment in which disruptive technologies and trends such as the Internet of Things (IoT), robotics, virtual reality (VR) and artificial intelligence (AI) are changing the way we live and work. This year's (2019) World Economic Forum theme of *Globalisation 4.0* addressed the fourth industrial revolution which is taking place globally at an unpredictable rate. Is Africa ready? How effective is the infrastructure in Africa to support these disruptive technologies that will enhance the fourth industrial revolution? Do African countries have enough capacity to exploit these emerging technologies? What needs to be done to support the use of these disruptive technologies in Africa?

iii. **Improving Africa's Intra-Africa Trade using science, technology and innovation**- There are many reasons for the low intra-African trade including: weakness of physical and human infrastructure, small size of individual African country markets, residual tariffs and onerous non-tariff measures (NTM) on processed and semi-processed African products by both developed and emerging markets, export constraints and other pre-border barriers, absence of trade finance, institutional constraints on enterprise growth and inability to achieve scale, currency risk, corruption and rent-seeking clientelism, and civil disruption among many others. The abundance of interest, capital, opportunities, and promises in technology such as artificial intelligence (AI) reminds one of mobile technology just 10 years ago. Mobile money transfer technology took the continent by storm but this has not really translated to significant increases in intra-Africa trade due to the different levels of adoption of the technology in Africa as well as challenges in the development of the required infrastructure. Will technology/automation and AI do to African nations over the next decade what mobile technology did to them in the last one, fueling a dramatic rise in connectivity and unlocking significant gains in economic development? Like mobile technology and communication capabilities, will technology/automation and AI permit African nations to dramatically increase their research, development, and production capabilities? Will technology/automation and AI give African nations even more power to leapfrog the need for old-fashioned infrastructure and outdated strategies of industrialization? In essence, how can intra-Africa trade be realized using STI?

iv. **Funding science, technology and innovation priorities for Africa's development**- African leaders have always committed to increasing funding for national, regional and continental programmes for science and technology and support the establishment of national and regional centres of excellence in science and technology. So far only a handful of the countries have implemented that. Funding for research in Africa is still very low hence very low emergence of new technologies and innovations. This has severely limited growth and development in Africa.

How can African governments increase funding to STI? Has the private sector sufficiently contributed to funding research in Africa? Are the African universities and research organizations contributing enough in funding research in Africa? How can development partners significantly contribute to STI development in Africa?

v. **Gender and inclusivity in science, technology and innovation**- The persistent gender inequalities and exclusivity in Africa can be explained by lack of relevant policies, inadequate and improper curriculum content and strategies, poor didactic materials and negative culture and attitudes which discourage women from training and/or working as scientists, technologists or engineers and the youth from assuming high positions of authority in the polity. This theme focusses on identifying successful international best practices that should be learned, adapted and wisely implemented in Africa to encourage inclusivity and gender mainstreaming in STI. The gender mainstreaming of science and technology policy formulation and review processes have not been sufficient enough to reflect the level of gender awareness that has been created and attitude changes made. What actions need to be taken to ensure there is gender and inclusivity in STI? What data are required to inform decision making on gender inclusivity in STI?

2.0 CONFERENCE OBJECTIVES

The overall purpose of the conference is to critically examine the current conditions, barriers and opportunities in the above thematic areas and provide policy options form transitions to more inclusive sustainable development in Africa.

1. Present and discuss relevant and topical issues on how STI can be further deployed to more effectively achieve sustainable development in Africa
2. Tell ATPS's story in championing STI development in Africa for 25 years
3. Relaunch the ATPS Phase VIII Strategic Plan 2017-2022
4. Provide opportunity for networking among STI stakeholders across the continent and beyond
5. Present papers that address the main theme and subthemes of the conference
6. Celebrate and honour ATPS Legends and Champions

3.0 EXPECTED OUTPUTS

i) Published annual forum and conference proceedings;

ii) A communiqué summarising key recommendations for African policymakers and development partners.

iii) Two Policy Briefs

4.0 EXPECTED OUTCOMES

i) Increased and renewed recognition and deployment of STI as a means for achieving sustainable development in Africa by policymakers, science experts, private sector actors and civil society actors; and

ii) Strengthened networks amongst STI actors in Africa.

5.0 CONFERENCE METHODOLOGY

The ATPS@25 Annual Forum will be a two-day event that will bring together stakeholders including network members, donors and financiers, beneficiaries and government officials from across Africa. The event will adopt participatory approaches to engage stakeholders in relevant discussions. For the main theme and sub-themes, there will be high level presentations by experts in the field and panel discussions on some of the sub-themes. In all, there will be enough time for stakeholder discussions and dialogue on the different subthemes. About 200 delegates are expected from across the 54 African countries and beyond during the Annual Forum, Conference and ATPS Silver Jubilee celebration. Delegates will be drawn from the academia and research institutions, policymakers and high-level government officials, organized private sector actors, informal sector, civil society actors, development partners, donors and financiers, and the Fourth estate among many others. Detailed programme of the event is provided below.

KEY PROGRAMME OF EVENTS:

- Opening ceremony and key messages from donors, sponsors and partners
- A Masterclass on the theme: ***Using Science, Technology and Innovation as a means for Achieving the Sustainable Development Goals (SDGs) in Africa***
- Expert panel discussion
- Plenary presentations on the selected sub-themes
- Celebration of ATPS champions and legends. All Foundation Members of the ATPS, past Executive Directors and Directors, Chairs of ATPS Board of Directors, Core Donors, etc. will receive honours awards.
- Exhibition of science, technology and innovation products and services from around Africa
- Press conference

6.0 FULL CONFERENCE AGENDA

DAY 1- Wednesday 30 October, 2019			
Time	**Topic/Presentation**	**Facilitators**	
8:00- 8:30 am	**Registration**	-Felix Musila	
		-Damaris Kavesa	
Opening Session-Official Opening Ceremony Moderators: Dr. Ernest Acheampong, INBAR Dr. Maurice Bolo, Scinnovent Centre Rapporteurs: Alfred Nyambane and Damaris Kavesa			
Time	**Topic/Presentation**	**Presenters**	**Session Chair**
8:30- 8:35 am	Welcoming Remarks from ATPS Kenya Chapter	**Dr. Stephen Karimi**, Board Member ATPS Kenya Chapter and Director Accreditation and Quality Assurance, NACOSTI.	**Prof. Joseph Obua-** Former ATPS National Chapter Coordinator, Uganda; College of Agricultural and Environmental Sciences Makerere University, Uganda
8:35- 8:40 am	Welcoming Remarks from the ATPS Secretariat	**Dr. Nicholas Ozor,** ATPS Executive Director.	
8:40- 8:45 am	Welcoming Remarks- the ATPS Board of Directors	**Prof. Crispus Kiamba**, Ag. Chair ATPS Board of Directors.	
8:45- 9:15 am	Opening Remarks from our Partners	1. **Prof.BenedictO. Oramah**,President AFREXIMBANK 2. **Prof. Njuguna Ndung'u**, Executive Director AERC. 3. **Dr. Ezekiel Mutua**, MBS, Chief Executive Officer, KFCB 4. **Dr. Philip Osano**, Ag. Centre Director, SEI 5. **Dr. H. Doko Ibrahim**, DG/CEO RMRDC 6. **Prof. Nelson Torto**, Executive Director AAS.	
9:15- 10:00 am	Opening Keynote Address on "Using Science, Technology and Innovation (STI) as a means for achieving the Sustainable Development Goals (SDGs) in Africa"	**Dr. Ouedraogo Mahama**, Director Human Resource Science and Technology, AUC	
10:00- 10:15 am	Official Opening by the Chief Guest of Honour	**Prof. George Magoha**, CS Ministry of Education, Kenya	
10:15- 10:25 am	**Group Photo**		
10:25- 10:50 am	**Health/Coffee/Tea Break**		
10:50- 11:15 am	Panel Discussion on the Opening Keynote Paper	-**Prof. Osita Ogbu,** FNAE, OON; University of Nigeria and Managing Director, ADSI.	**Prof. Joseph Obua-** Former ATPS National Chapter Coordinator, Uganda; College of Agricultural

		-Prof. Michael C. Madukwe, ATPS National Chapter Coordinator Nigeria and University of Nigeria Nsukka, Nigeria. **-Prof. Francis Aduol,** Vice Chancellor, Technical University of Kenya. **-Prof. Emmanuel Nnadozie,** Executive Secretary, African Capacity Building Foundation (ACBF). **-Prof. Sylvester Ndeso-** Lecturer, Epidemology & Public Health Faculty of Health Sciences University of Buea, Cameroon. **-Prof. Crispus Kiamba** CBS, MBS, Ag. Chair ATPS Board of Directors**;** School of Built Environment, UoN. **-Dr. Jemimah Onsare,** Ag. CEO National Research Fund-Kenya.	and Environmental Sciences Makerere University, Uganda
11:15-11:25 am	Facilitated Discussion	All Delegates	

Plenary Session 1-Keynote Presentations			
Time	**Topic/Presentation**	**Presenters**	**Session Chair**
11:25-11:55 am	Science, technology and innovation priorities for Africa's development	**Dr. George Essegbey,** Chief Research Scientist, Science and Technology Policy Research Institute (STEPRI)/CSIR, Ghana.	**Prof. Nelson Torto**, Executive Director AAS.
11:55-12:05 pm	Case interventions	**-Dr. Nadia Hassan,** ATPS National Chapter Coordinator, Sudan. Economic Studies Department Industrial Research & Consultancy Centre (IRCC) Sudan. **-Mr. Benson Zwizwai**, ATPS National Chapter Coordinator, Zimbabwe. Chairman, Economics Department University of Zimbabwe.	.
12:05-12:15 pm	Facilitated Discussion	All Delegates	
12:15-12:40 pm	Funding science, technology and innovation priorities for Africa's development	**Dr. Akanimo Odon,** CEO, Environfly Consulting, and Lancaster University, UK.	
12:40-12:50 pm	Case Interventions	**-Mr. Wondwossen Belete,** ATPS National Chapter Coordinator, Ethiopia and Director of Intellectual Property	

		Protection and Technology Transfer, EIPO. -**Prof. Dr. Saïd Boujraf** ATPS National Chapter Coordinator Morocco and Director of the Clinical Neuroscience Laboratory, University of Fez Morocco.	
2:50- 1:00 pm	Facilitated Discussion	All Delegates	

1:00- 2:00 pm	**Lunch Break**		
Plenary Session 2-Keynote Presentations **Rapporteur: Mr Marsden Momanyi and Damaris Kavesa**			
Time	**Topic/Presentation**	**Presenters**	**Session Chair**
2:00- 2:25 pm	Improving Intra-Africa Trade using science, technology and innovation	**Prof. Benedict Oramah,** President, AFREXIMBANK.	**Prof. Njuguna Ndung'u**, Executive Director, AERC.
2:25- 2:35 pm	Case Interventions	**-Prof. Arsène Kouadio,** ATPS National Coordinator, Cote d'Ivoire and University of Abi-djan-Cocody, Cote d'Ivoire. **-Ms. Manal Moustafa Samra,** ATPS National Chapter Coordinator, Egypt.	
2:35-2:45 pm	Facilitated Discussion	All Delegates	
2:45- 3:10 pm	The Fourth Industrial Revolution and Africa's Readiness	**Ms Ann Therese Ndong-Jatta,** Director UNESCO Regional Office for Eastern Africa.	
3:10-3:20 pm	Case Interventions	-**Eng. Lourino Alberto Chemane**, ATPS National Chapter Coordinator, Mozambique and ICT and Planning Advisor, Executive Secretariat, ICT Policy Commission, Mozambique. -**Dr. Wollor Emmanuel Topor**, ATPS National Coordinator, Liberia and College of Science and Technology, University of Liberia.	
3:20-3:30 pm	Facilitated Discussion	All Delegates	
3:30- 3:45 pm	**Health/Coffee/Tea Break**		
3:45- 4:10 pm	Gender and inclusivity in science, technology and innovation	**Dr. Kathryn Toure,** Regional Director Sub-Saharan Africa International Development Research Centre (IDRC)	**Prof. Agnes Mwang'ombe EBS**, University of Nairobi, Kenya
4:10- 4:20 pm	Case Interventions	**-Mrs. Martha Ada Ugwu** ATPS National Chapter Coordinator, United Kingdom	

		-**Prof. Musa Dube**, Faculty of Agriculture Luyengo Campus University of Eswatini.	
4:05- 4:15 pm	Facilitated Discussion	All Delegates	

End of Day 1

DAY 2- Thursday 31 October, 2019			
Time	**Topic/Presentation**	**Facilitators**	
9:00- 9:20am	Re-cap of Day 1	Dr. Ernest Acheampong	

Parallel Sessions **9:20- 12:50 pm**				
Sub theme 1: Science, technology and innovation priorities for Africa's development	**Sub theme 2: The Fourth Industrial Revolution and Africa's Readiness**	**Sub theme 3: Improving Africa's Intra-Africa Trade using science, technology and innovation**	**Sub theme 4: Funding science, technology and innovation priorities for Africa's development**	**Sub theme 5: Gender and inclusivity in science, technology and innovation**
Providing Off-Grid Solar Light To Rural Areas In Sierra Leone By: **K. G. Mansaray and T. Morlai**	Leveraging 4th Industrial Revolution (4IR) to Drive Africa's Transformation **Dr Julius Gatune**	The potential for STI in assessing the environmental implications of the African Continental Free Trade Area (AfCTA) **Dr Philip Osano**	Funding science, technology and innovation priorities for Africa's development **Dr Akanimo Odon**	Gender Gap Analysis of Adoption of Technology and Innovation (TI) among Rural Farmers in Nigeria: A Case of Gender Mainstreaming and Development Policy in Africa **Adama Alami, and Omeje Emmanuel E.**
Nagging Food Insecurity In Nigeria: The Missing Links **A.N. Eneh and Eneh Onyenekenwa**		Trajectories of knowledge and innovation systems among cassava cooperative farmers towards improving livelihoods and industrial development in Southern Nigeria **Prof. Edwards Adeseye Alademerin**	Climate Change and Sustainable Development Focus on Sahel and Sahara Region of Africa: Sustainability Analysis Research Study for Pan African Agency on Great Green Wall (PAGGW) **Dr Chidi Magnus Onuoha**	Agroforestry - Coping Mechanism for Food Insecurity and Unemployment In Nigeria: A Case of Rural Women / Youths In Imo State, Nigeria. **Ogueri Emma Ifeanyi and Mgbada, Justina**
Sustainable Agricultural Innovations And Tools: The Solution to Africa's Food and Environmental Challenges **Kum Christian & Prof Sylvester Ndeso**				
Innovation, Inclusion and SDGS in Sub-Saharan Africa: Challenges and Opportunities **Nepeti Nicanor**				

Field Extension Agents' Utilization of Mobile Applications for Agricultural Extension Service Delivery in Ebonyi State Agricultural Development Programme **Ann N. EZEH and Anayochukwu V. EZE**		Xenophobia: Retarding Africa's Intra-African Trade, Science-Technology-Innovation (STI) Transfer and agricultural Development **Omeje, Emmanuel Ejiofor**		Early Childhood Malnutrition and Labour Productivity Growth in West Africa **Fredrick Onyebuchi Asogwa, Okeke Donatus Ifeanyi, Joseph Amuka and Nathaniel Urama**
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Could Sustainable Agricultural Innovations in Africa be the Solution to Soil Health and Climate Change for Enhanced Food Production? **Kum Christian Tegha and Sylvester Ndeso Atanga**				Gender-Based Analysis on ICT Accessibility and Utilization for Enhanced Performance among Undergraduate Students in Ogun State, Nigeria **Omobolanle Marcus Nosiru and Oshionebo, Esther Emike**
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Healthcare Services Satisfaction in the prison: a cross-sectional survey and comparative analysis of inmates' perspectives in an African country **Ochonma, Ogbonnia G**				
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Status of the Adoption of Modern Biotechnology for Agriculture in Africa **A.M. Dlamini,** **M.A. Dube and B.Z. Nkhabindze**				

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NERICA Technological Innovation for Improved Rice Economy in Nigeria **Omobolanle Marcus Nosiru & Mohammed Abdul Yekeen Rahji**				
Speedy Development of Africa Using Smart Energy Options and Air Pollution Reduction **Kingsley Ukoba**				

Silver Jubilee Celebrations Moderator: Dr. Ernest Acheampong, INBAR Dr. Maurice Bolo, Scinnovent Centre		
2:00- 2:30 pm	**ATPS@25: The journey so far**	**-Dr. Nicholas Ozor,** Executive Director, ATPS
2:30- 3:00 pm	**Remarks by Key ATPS Stakeholders**	-Prof. Osita Ogbu -Prof. Emmanuel Nnadozie -Prof. Judi Wakhungu -Prof. Charles Igwe -Prof. Agnes Mwang'ombe -H.E. Ambassador Sheidu Momoh -Prof. Crispus Kiamba
3:00- 3:15 pm	**Remarks and Launch of ATPS@25 (Silver Jubilee) by the Chief Guest of Honour**	**Hon. Joe Mucheru, E.G.H.** Cabinet Secretary, Information and Communication Technology (ICT), Kenya.
3:15- 3:30 pm	**Award of Prizes and Certificates**	
	-Institutional Awards -Individual Awards	
3:30- 3:50 pm	**Closing Remarks and Way Forward**	**-Dr. Nicholas Ozor,** Executive Director, ATPS
3:50- 4:00 pm	**Vote of thanks**	**-Prof. Crispus Kiamba,** Ag. Chair ATPS Board of Directors
4:00- 4:30 pm	**Coffee Break**	
4:30- 5:30 pm	**Annual General Meeting**	**ATPS Members Only**
	Celebrations-Music and Dance	
6:00- 8:00 pm	**Cocktail and Networking**	
End of ATPS Annual Forum, Conference and Silver Jubilee Celebrations: Delegates to leave at their own pleasure		

Annex 1: Abstracts

Sub Theme 1: Science, technology and innovation priorities for Africa's development

NAGGING FOOD INSECURITY IN NIGERIA: THE MISSING LINKS

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Nigeria has had five decades (1970-2019) of numerous public policies, strategies, programmes and projects aimed at boosting agricultural production for the attainment of food security. But, the outcome is that seven out of ten Nigerians are food insecure. The study set out to establish the missing links. Theoretical and documentary research methods were used to identify the missing links, which were subjected to factor analysis to ascertain the significant ones. A survey research design was adopted to get four hundred (400) purposively selected academics and practitioners in food production to authenticate the significant missing links. Respondents' online visibility guided their selection as people in the best position to respond to questions on Nigeria's agricultural production and food security. Each of them was engaged in virtual interaction through internet and social media platforms to obtain information as guided by a questionnaire covering questions on the ascertained significant missing links and their relationship with science technology and innovation (STI) with answer options in likert scale. Scores were analysed by comparing calculated values with decision values to confirm affirmation and otherwise. Results showed six (6) authenticated significant missing links: predominance of smallholder subsistence farming, use of rudimentary tools, unimproved varieties of seeds and other inputs, traditional storage and preservation practices, deficit of marketing infrastructure, and dependence on rain-fed agriculture. All of these were related to STI, attributable to poor STI adoption, and can be solved by STI adoption, which can as well address the four dimensions of food security. The study recommended STI adoption for agricultural production to attain food security status in Nigeria.

***Keywords**: Nutrition and diet, Food and livestock systems, Food security and agricultural production policy, STI adoption, Nigeria*

FIELD EXTENSION AGENTS' UTILIZATION OF MOBILE APPLICATIONS FOR AGRICULTURAL EXTENSION SERVICE DELIVERY IN EBONYI STATE AGRICULTURAL DEVELOPMENT PROGRAMME

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The high penetration of smartphones and advances in software that they can host, have compel private and public agencies to rapidly change the mode of service delivery through the use of mobile applications/apps. The use of mobile apps can enhance effectiveness and efficiency of extension service delivery in terms of time and coverage at a minimal cost. Extension agents can use mobile apps to provide vital extension information to its clients – farmers, research stations, suppliers and market actors through smartphones. It can help them to connect and work with extension workers and farmers at any time. Despite the growing use of mobile apps as the dominant means of communication in both public and private agencies, it is still unclear whether mobile apps have being utilize for extension services in Ebonyi State. Consequently, this study assessed field extension agents' utilization of mobile apps for extension service delivery in Ebonyi State Agricultural Development Programme (EBADP). Specifically, the study assessed the types of mobile apps that are in use for extension service delivery; extent of utilization and constraints to use. The study employed multi-stage random sampling technique to select 120 Field Extension Agents who were administered with structure and validated questionnaire. Descriptive statistical tools were employed in the analysis of data generated. The result of the analysis shows that the most utilized mobile apps for extension delivery are WhatsApp (76.4%) and Facebook (42.5%). However, these apps were highly underutilized for extension services due to constraints such high cost of smartphones (82.3%), poor internet connectivity (66.1%), poor knowledgability of the farmers on the use of mobile apps (58.5%), high cost of data subscription (53.8%), low ownership of smartphones among farmers (73.3%), among others. The study recommended the development of specific apps that will support extension service delivery which can be operated on any mobile phones.

Keywords: *Mobile apps, smartphones, extension service, utilization, Whatsapp, Facebook*

DESIGN, CONSTRUCTION AND DETERMINATION OF THERMAL EFFICIENCY OF A MODEL SOLAR POWER IRRIGATION SYSTEM

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The alternative energy source such as solar energy is a clean, cheap and dependable energy source that has no adverse effect on the environment, human and animals. This source of energy is generated as a result of incident solar radiation on semiconductor crystals (solar cells) giving rise to photo-electricity. African agricultural systems in rural settlements are in dire needs for modernization to achieve millennium goals for self-sufficiency in crops, and livestock's production. Also frequent bloody clashes between farmers and pastoralists in some African communities called for an urgent solution by establishment of cattle ranches in selected rural areas equipped with solar powered irrigation pumping system. In most rural farms in Africa, where agriculture are practiced, access to electricity from the national grid is non-existence, while the cost of procurement of diesels to fuel generators for water pumping is too expensive for an average subsistence rural farmer. The only solution to solve these mired of problems is solar generated electricity (DC or AC). A model small scale prototype solar powered irrigation system sited near a stream in Tai Solarin University of Education, Ijebu-ode, Nigeria, was designed, constructed and tested at CENVOS vegetable farm. The solar project utilizes a 320watts poly crystalline solar panel connected using a flexible insulated 6mm copper cable to a 12V/75 Ah battery via a 12V charge controller. Also, a 12V DC submersible pump connected to the load terminal of the charge controller provide pumped water piped through 12.7mm pipe through a water rate meter connected to 200 liters water storage tank at 5.3m height. To store water for irrigation purposes without the use of power every times due to erratic energy supply during raining and cloudy weather, a potential energy principle was adopted which consist of water reservoir tank placed on an elevated height of about 3.7m above the ground level for maximum daily crop consumption, using a drip irrigation system at low pressure. The results from the field indicated gradual rise in water pumping rate from day break when sun was bright and decreases gradually during rain and cloudy interception of the sun. An experimented water pumped using the model gives 200 liters of water in a cumulative pumping average time of 90mins when sun shines. The solar agriculture project when implemented at a higher scale with an elevated water storage tank that provides potential energy fed water lines to a drip irrigation system can be used efficiently in savannah and semi-arid region of Africa.

***Keywords**: Solar energy, Irrigation, Photo-electricity, Agriculture, Semiconductor Crystal*

IMPACT OF CLIMATE CHANGE ON ADAPTIVE STRATEGIES THAT LEAD TO SUSTAINABLE LIVELIHOODS

Resource Base Carrying Capacity, Climate Change Variability, and Population Growth: A Case Study of four Communities in Wonago Woreda, Ethiopia

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The study area is located in the northern parts of the Wonago Woreda, covering a total area of about 3340 ha and comprises four Quebelle Associations (QAs) namely Bale Bukisa, Tumata Chirecha, Hase Haro, and Kara Soditi. The research was under taken using PRRA to assess the socioeconomic situation, key informant interviews and secondary data (Climatic data, SPOT 5 images, published and unpublished research articles). The area falls between the upper moist Kolla and the moist Woina Dega agroclimatic zones of the country. The rainfall distribution is bimodal, with mean annual rainfall of about 1311 mm. The mean annual temperature is about 20.3^{0}C. The altitude of the study area ranges from 1270-2070 m. The topographic feature consists of gently sloppy and undulating areas to hilly terrain with some incised valleys. The natural vegetation type can be broadly classified into moist evergreen montane forests with major species that include Croton *macrostachys, Albizia schimperiana, Milletia ferruginea, Erythrina abyssinica, Ficus sycomorus, Polyscias fulva, Pouteria adolfi-friderici, Calpurnia, Cordia Africana* and *Vernonia amygdalina.* Based on the information from Qubelle office, the population of the study area totals about 26787, with 4842 households. Accordingly, the population density (crude) is computed to be approximately 802 persons/ Km^2. The average family size of the sampled households is about 7.1. Based on the available population data given in different years, the population of the study area is growing at the average annual rate of 2.9%. All the households covered by this survey are engaged in farming activities, out of which the minority (17.6%) indicated that they are also engaged in off-farming activities such as safety net programme, coffee trading, civil service, carpentry works and retail trades. In general, the farming community is besieged with problems of interrelated environmental constraints. Traditional coping strategies that have been under use for generation, have now reached a tipping point. Therefore, the future for the majority of the households in this area could be disastrous unless appropriate measures are taken to provide viable alternatives that will supplement household income. There are two alternatives. The first is introduction of non-farm activities. In this case, schemes of alternative means of income generations such as cottage industries have to be introduced. However, this proposal is not an easy task to be achieved in a short time. Hence, in the face of such limited resources, it seems that the most appropriate (the second alternative) is relocation. In other words, those households with

smallholdings and the landless have to be relocated to sparsely populated areas within the region or in the country. Any strategies to control and or reduce the problem of population pressure have to be supported by appropriate government policies and political commitment if it is to bring a sustainable solution to the problem. Finally, a "Sustainable Livelihoods Approach", an integrated package of policy, technology and investment strategies together with appropriate decision-making tools is recommended to promote sustainable livelihoods by building on local adaptive strategies

Keywords: *Wonago Woreda, climate change, temperature, rainfall, tropical storms, sustainable livelihoods.*

EFFECTS OF LAND USE CHANGE ON SOIL QUALITY IN MAI MAHIU ECOSYSTEM IN NAIVASHA SUB-COUNTY, KENYA

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Land-use changes are the main cause of soil degradation and associated human and environmental problems especially in many developing countries in Africa and Asia. Study was conducted in Mai Mahiu, Nakuru County, Kenya whose aim was to assess the impacts of land-use changes on soil productivity and ecosystem functioning. Specific objective was to understand the nature and extent of land use changes/practices and there impacts on soil quality indicators. Landsat archive was utilized was used to detect land-use change from 1985 to 2015 at an interval of 15 years and analyzed based on supervised image classification. From four land-use practices (undisturbed forest, disturbed forest, cropland and glassland), plots measuring 20 m x 20 m were laid out and soil sampled within the plots with core samplers (196 cm^3) to the depth of 15 cm. From each plot, nine sub-samples were pooled to form a composite sample. From each site, three individual cores were left un-bulked for undisturbed soil analyzes. Analysis of variance (ANOVA) was used to identify differences at 0.05 level of significance while least significant difference (LSD) was used for mean separation. Results showed a remarkable land-use and land-cover change between 1985 and 2015. Cropland significantly increased by 135% from 27.3 km^2 in 1985 to 64.2 km^2 2015 at the expense natural forest. Built-up area and roads coverage had increased by almost three times from 9.8 to 29.9km^2. Soil quality deteriorated significantly with land-use change. There were significant differences ($p<0.001$) in soil bulk density that increased from 0.93±0.02 g/cm^3 in forest soil to 1.27±0.02 g/cm^3 in disturbed grassland. Soil acidity increased significantly ($p=0.002$) with land conversion with pH ranging between 6.19±0.14 and 7.18±0.12. Soil organic carbon declined significantly ($p=0.008$) with losses of up to 63% while total nitrogen declined significantly ($p=0.005$) from 0.34% to 0.15 with land conversion. The study concluded that land use changes and modifications in Mai Mahiu have negatively affected the soil productivity with a potential drop in other ecosystem services production. For the sake of the present and future generation in this region, it is recommended that management decisions should take into consideration integrated landscape approach, enforcement of relevant laws and policy implementation that are aimed at maintaining resilience of soil quality attributes for sustaining this type of ecosystem.

***Keywords**: Land use change, Soil properties, Mai Mahiu*

PROPOSED PLAN FOR ACCELERATION OF MEDICAL TRAINING THROUGH ENHANCED ENROLMENT, OUT-TURNS IN REDUCING SHORTAGE OF PHYSICIANS IN NIGERIA

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The paper assessed availability of physicians and supply-side and demand for medical workforce, alongside forecast of requisite output to meet minimum ratio of physicians to population in Nigeria (2021 -2040). It also provides projection of the financing requirement by prospective medical trainees and government towards achieving the targeted number of physicians in the medium term to long run. Ex-post 'facto' quantitative research design and method is employed. Data sets obtained from Medical and Dental Council of Nigeria, Nigerian Medical Schools, National Universities Commission (NUC), Federal Ministry of Health (FMOH), etcetera and utilized for the analysis. Analytical techniques include simple numerical analysis, descriptive statistics, moving average system, demographic estimation methods and projections of future budgetary resource allocation procedures. Findings indicate that the existing density of physicians in Nigeria is currently one to 2700 people in 2019 as against the prescribed minimum of one-doctor-to-1818 people. Therefore, Nigeria's medical schools should be enrolling about 5000 to 7000 in first instance, and latter from 8000 to 10000 annually and expected to be producing about 4000 newly licensed doctors around 2027 (in first new cohort); which rises up to 8000 by 2036 which peaks at 9500 about 2040 to be able to eliminate shortages of medical work force in the light of her rapidly increasing population. In terms of financing, the result of preliminary investigation and analysis indicate that indicate that the estimates average unit total cost for 6-year medical education in Nigeria is N30 million currently and by the inception of the proposed plan and would rise N42 million per head by 2036 -2040. Financial projections for the plan reveal that Nigeria should provide annual medical education subvention amounting to N60 billion initially and up to needs to minimum of N240 billion in last quartile phase of funding in the plan. The result of the demographic forecasting of annual out-turns of new physicians and injections to the pool during the proposed plan show that shortage of medical workforce in Nigeria shall be eliminated as from 2035 .In return, Nigeria could to derive over N1 trillion savings from medical tourism, and in addition to savings from recruitment of expatriate doctors and other unquantifiable benefits that accrues to the economy from implementation of the proposed accelerated medical training. Conclusion: Physicians' supply-side projections which is based on population's need-based demand estimates that spreads over almost two decades and supported with forecast of governments annual budget allocation with the assumptions incorporated thereon, would enable Nigeria achieve the target annual production of new doctors, satisfy the prescribed minimum doctors density for developing countries by 2036 up to 2040. Other

sovereigns are to benefit from this planned accelerated medical education. The study has conceptualizes new strategy to promote international mobility of medical experts, contribute towards attainment of the Sustainable Development Goals (SDG) and enhancement of population health in this contemporary era of fast rising population.

Keywords: *Physicians requisite density, shortage of medical workers, population health, labour mobility, accelerated medical training, Nigeria*

PROMOTING NUTRITION AND FOOD SECURITY IN AFRICA: ROLE OF UNIVERSITY RESEARCH, TECHNOLOGY AND INNOVATION

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The attainment of food security remains a big challenge for most governments in Africa including Kenya. As a complex problem, food and nutrition insecurity requires sustainable solutions to ensure that everyone has access to safe food at all times. This situation is worsened by the triple burden of hunger and malnutrition in Africa. Food security has been highlighted as a focal area of concern by the United Nations' Sustainable Development Goals (SDGs) and African Union (AU) Malabo declarations (2014). Therefore, to address the food security situation in Africa, a multi-faceted approach is needed which consists of exploring alternative strategies and technologies to sustainable crop and livestock production. Majority of African nations are faced with severe food insecurity problems as depicted by a high proportion of the population having no access to food in the right amounts and quality/safety. The aim of this paper is to present key findings and recommendations by scientists and innovators from the University of Nairobi in partnership with other Universities and research institutions including private sector. These findings are technological solutions and innovations generated from a 5 year project on Reducing Losses and Adding Value (RELOAD) aimed at addressing postharvest losses in the food value chains as a strategy of reducing food insecurity. This North to South cooperation has been instrumental in disseminating agro-processing technologies for loss reduction in various food value chains including meat, milk, fruits and vegetable. The technologies have been adopted and adapted for various end users including farmers/farmer groups, women groups, private sector and Small-Medium Scale (SMEs) food processors and are transforming the lives of rural poor communities and households in Africa. The University has also partnered with the Food Security Center in the University of Hoheheim with programs on "Global Food Security". This interdisciplinary collaboration incorporates a multi-faceted strategy that includes diverse approaches and expertise to tackle food insecurity. Although, the project focused on all the food value chains in East Africa, this paper will focus on the livestock value chain. This paper will give details of some of the technologies and innovations that have been disseminated to reduce food insecurity and generate income for rural poor in Kenya.

***Keywords**: Food Security and Nutrition, Science, Innovation and Technology, Institutional Linkages*

EARLY CHILDHOOD MALNUTRITION AND LABOUR PRODUCTIVITY GROWTH IN WEST AFRICA

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This paper is motivated by the debate on early childhood malnutrition and labour productivity in Less Developed Countries. It examined the consequences of early childhood malnutrition on labour productivity growth in ten selected West Africa countries. The theoretical framework for this paper is the health theory of Grossman (1972) which maintains that health is a robust capital stock that differs from other forms of human capital and the demand for healthcare is derived from the fundamental demand for good health. The inter-temporal model of childhood malnutrition and adulthood labour productivity growth model was adopted. It assumes that individuals have a period of childhood where they need proper and well-nourished feeding for the development of both cognitive and physical stature and the period of adulthood where they are bestowed with enough strength for childrearing and labour force production. Labour productivity growth was captured using agricultural value-added growth as the region under the study is more of the agrarian region than industrialized region. Childhood malnutrition was captured using height-for-age (h_age) and weight-for-height (w_height) of children below 5 years of age whose Z-score is less than -2SD (standard Deviation) as stated by UNICEF and WHO. The study used maternal level of education, type of earning of the household, age of the mother at first birth and place of residence to determine the cause of early childhood malnutrition. The adopted panel random effect estimation technique was to capture the variability within the countries. The study found a significant impact of early childhood malnutrition on labour productivity growth in the selected West African countries. The study further found that maternal level of education, age of the mother at first birth and place of residence determine childhood malnutrition in West Africa. It was also found the threshold level of maternal education necessary to make significant reductions in child malnutrition is at a higher level of education. Below this threshold level, maternal education has no significant impact on reducing childhood malnutrition. The usefulness of female education in the region is inevitable especially at a higher education level that significantly changes early childhood malnutrition.

Keywords: *Childhood Malnutrition, Labour Productivity Growth, West Africa, Less Developed Countries*.

PROSPECTS OF FARMER MANAGED NATURAL REGENERATION (FMNR) AND ITS IMPACT ON FOREST CONDITION IN SINYALA, LILONGWE, MALAWI

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Deforestation and forest degradation have been a problem the world over and exacerbates climate change and Malawi is experiencing the impacts of this problem. For so long, Malawi government in an effort to conserve the environment and reduce emission from forest degradation and deforestation has been trying to plant trees with emphasis on exotic species but the efforts have not been to expectations. Recently, a community involved technique, Farmer Managed Natural Regeneration was adopted in some areas in order to restore forest in degraded lands and farmlands. The aim of the study was to examine the prospects of Farmer managed Natural Regeneration in Sinyala village, Malawi with a view to provide information to people on best and simple way of regenerating degraded areas. The technique has helped to regenerate sinyala Village Forest areas (VFAs) and farmlands. A total of 165 respondents, farmers which are practicing Farmer Managed Natural Regeneration were identified using simple random technique. Results of the study found that 165 farmers interviewed practiced FMNR and they managed to regenerate 77 hectares of VFA comprising of 35 tree species. Species mostly regenerated include *Fadherbia albida, Magnifera indica, Bauhinia thonngii, senna spectablis, Uapaka kirkiana, Lonchocarpas capasa, Markhamia obtusifolia, Albizia lebbeck, Psorospermum febrifugum, Combretum apiculatum, Parinari curatelifolia, Albizia versicolor, Leucaena leucocephala, Bridelia micrrantha, and Pterocarpus angolensis.* The results show that FMNR is a strategy to go for hence it was recommended that FMNR should be promoted by including bee keeping practices to those regenerating VFAs and also incentives to farmers that regenerate certain number of tree species.

Keywords: *Farmer Managed Natural Regeneration, Species diversity, Adaptive Approach*

SUSTAINABLE AGRICULTURAL INNOVATIONS AND TOOLS: THE SOLUTION TO AFRICA'S FOOD AND ENVIRONMENTAL CHALLENGES

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The two most pressing and interlinked challenges facing humanity in the 21st century are Climate change and food security (Godfray et al., 2011). The world's population is forecasted to increase from the present 7-8 billion to about 10 billion people in 2050 (DESA UN, 2015) with most of the increase coming from less developed regions such as Africa. This growth in population will consequently generate and increase in the demand of food to feed the world's people. As a result, the United Nations and World Health Organization suggested doubling of food production by 2050. Africa's development plan by 2063 guided by SDGs is largely dependent on agriculture. The agricultural system in Africa is faced with complex challenges such as; climate change, food insecurity, infertile soils, political instability, land for urbanization and forest conservation, and unsustainable agricultural practices. This complex nature of the agricultural sector in Africa necessitated an urgent need for the development of new scientific and innovative agricultural systems and tools in solving these agriculture's problems. African scientists have over the years develop and/or adapted sustainable scientific agricultural innovations to fit the African context such as LANDPKS mobile app technology by ATPS, PUSH-PULL technology by INCIPE, and other agro-ecological practices as a means to solving the African agriculture challenges. Evidence from the pilot projects and a few deployments around the continent have shown that these innovations ideally give more yield and environmental protection. The expansion and deployment of sustainable agricultural innovations in Africa are challenged by climate change, policies and politics, and institutional setup. This paper provides a review to sustainable agricultural systems and innovations in Africa supporting crop production. It classifies these practices according to efficiency. This paper also analysis their advantages and draw backs with evidence from published works on the benefits of these systems in terms of SOC, yields, and climate change mitigation. In addition, it evaluates the potential use of these innovations for future African agriculture in terms of the challenges that hinder the expansion and deployment of these innovations round the region and provide suggestions to farmers, policy makers, and scientist to facilitate expansion and

deployment. Our major finding are; (1) we identified 8 categories of sustainable scientific innovations/tools all of which involved increasing efficiency. (2) LandPKS, push-pull technology, and drip irrigation are still not well integrated in actual agriculture of the continent. (3) The other practices which includes; minimum tillage and intercropping with legumes, crop rotation, agroforestry with timber and fruit trees, residue management, and use of organic manure are well integrated in the continent. It is recommended that efforts should be made during the development stages of the innovation system to investigate the impacts of agricultural policies and poor institutional setup on the efficiency of the innovation. Also more studies should be carried out to quantify the benefits (SOC sequestration, and increase yield) and consequences (GHG emissions) of these sustainable innovations up to 2063 based on the African Union development plan to aid choice of agricultural systems and policy development.

***Keywords**: Sustainable agricultural innovations, climate change, food security, Soil Organic Carbon, yield.*

COULD SUSTAINABLE AGRICULTURAL INNOVATIONS IN AFRICA BE THE SOLUTION TO SOIL HEALTH AND CLIMATE CHANGE FOR ENHANCED FOOD PRODUCTION?

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Climate change and food security are the two most important interlinked challenges to sustainable development in Africa that affects food production, and both aquatic and terrestrial ecosystems. The leading factor of climate change is the accumulation of CO_2 in the atmosphere (IPCC, 2001). The reductions of CO_2 in the atmosphere by artificial means are very expensive and so carbon sequestration by soils, oceans and plants turn to be the simplest and most economically practical way to face the climate change and food crises in Africa. Increasing the amount of carbon stored in Africa's soils could significantly help reduce Africa's emissions of GHGs from agriculture, by offsetting some of the CO_2 emitted into the atmosphere. Although there is already carbon stored in Africa's agricultural soils as organic matter, opportunities exist to store more by altering current agricultural management practices. The continued development of sustainable agricultural innovations and soil organic carbon storage premised on – *producing more from less* - is essential to maintain the quality and quantity of agricultural products for society, particularly with the scarcity of natural resources, climate change, a growing Africa's population, and the physical limitation of productive agricultural land. We believe using the currently available agricultural lands more efficiently and sustainably can avoid the need for agricultural expansion into the remaining natural habitat, such as forests, peat land, wetlands, etc. that is vital for biodiversity conservation and carbon storage. This paper is out to share knowledge and gather feedback on ways and means to mitigate land use change and land use based carbon emissions. To facilitate a dialogue we are showcasing approaches and results of two of our projects that support comparative analysis of conventional vs conservational land use practices to avoid emissions. The first is the "Soil Organic Carbon Storage under different land uses South of Mount Cameroon National Park (MCNP)" with main purpose being to estimate Soil Organic Carbon (SOC)

quantities in different land uses as an impetus to forest conservation and promotion of sustainable conservation agriculture. And the second being “Soil and Water Protection in the Bamenda Highlands of Cameroon” with the objective to evaluate impacts of sustainable agriculture innovations such as reduced tillage and cover cropping on soil erosion in arable land compared to conventional practices. The results demonstrated the advantages of forest conservation and sustainable conservation agriculture to help optimize farm profitability and build ecosystem resilience against climate change. Overall, our learning shows that no single set of practice works in all places, in fact a range of approaches is required: specific to crops, climates, and cultures. Therefore, sustainable practices and technologies must be tailored to the local landscape conditions and the socio-economic conditions of farmers compromising the key elements of the technology being to sequestrate SOC, minimize GHG emissions and increase yield. Policy programs will need to provide further financial or technical assistance to farmers, particularly those who are younger or more entrepreneurial and willing or able to change their approaches.

Keywords: *Sustainable agricultural innovations, climate change, food security, Soil Organic Carbon, GHG emissions*

STATUS OF THE ADOPTION OF MODERN BIOTECHNOLOGY FOR AGRICULTURE IN AFRICA

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Modern biotechnology, particularly genetically modified (GMO) crops have potential to improve agriculture productivity. Despite that transgenic technology has been commercialized in crop production for the past twenty three years, there has been a slow adoption rate of this technology in Africa. The purpose of this paper is to elicit the role of policy in the use of modern biotechnology in agriculture and food production in Africa. A desktop study was done to review the literature and archival records on the adoption of modern biotechnology in Africa. There has been a slow adoption rate of transgenic crop technology in Africa. South Africa-1998, Burkina Faso and Egypt-2008 followed by Sudan-2012 were amongst the early adopters of the technology. Over the past three years, records from the biosafety clearing house (BCH) have shown that a few additional countries have commercialized production of transgenic crops in Africa. These includes: Eswatini, Ethiopia, Nigeria, and Zambia. A Few other countries are conducting field trials of transgenic crops Examples in this group include Ghana, Kenya, Malawi and Mozambique. The adoption rate of the technology has been hampered by lengthy regulatory frameworks, public skepticisms, conflicts between civic society groups and technology developers, and high costs associated with the technology. The concerns about the products of modern biotechnology include fears for: the relatively new technology (20 years); unknown allergic reactions; negative perceptions; possibility of development of drug resistance of gut pathogens; and monopoly by Multinational Corporations. The claimed benefits by the proponents of the technology include: reduced usage of chemical pesticides; control of viral diseases; reduced labour costs; increased yields and farm revenue; and precision breeding. Worldwide commercialized GMOs have been done for the following traits: stress tolerance, altered growth/yield, disease resistance, insect resistance, herbicide tolerance, modified product quality and pollination control systems. Key traits that have been exploited in Africa include: stress tolerance, herbicide tolerance and insect resistance. Key crops that have genetically modified in Africa include: maize; cotton and Soybean.

Although many countries benefited from the UNEP-GEF funded biosafety project during the initiation of national regulatory frameworks, it was recommended that member states' governments have the responsibility to put in place policies for implementation, monitoring and sustainability of their biosafety legal frameworks to ensure precautionary adoption of modern biotechnology in Africa.

Keywords: *modern biotechnology; biosafety framework; transgenic technology; genetically modified crops; Biosafety.*

ACHIEVEMENTS AND CHALLENGES FROM AFRICAN TECHNOLOGY POLICY STUDIES NETWORK BY ESWATINI NATIONAL CHAPTER: A SUCCESS STORY

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Eswatini joined the African Technology Policy Studies (ATPS) Network in the 1980s while there were two networks: the West African and the East African Networks. Like other Member States, Eswatini has had many achievements from ATPS Network even though she was faced with challenges in popularising Science, Technology and Innovations (STI), including promotion of the vision and mission of the Network. Sharing such information to mark the Silver Jubilee of the ATPS Network was considered important as evidence of growth of ATPS Network being the core driver of STI in the Member states. The purpose of this paper was to systematically document the Eswatini Chapter's achievements and challenges encountered while supported by ATPS Network. The paper was developed through desk work, review of reports, proceedings from various meetings of the National Chapter, Initiatives by ATPS such as capacity building, policy formulation and dissemination of research reports through policy briefs. It was concluded that the Eswatini Chapter under the auspices of ATPS Network and over the 25 years has achieved many things, namely: human capacity building on (i) writing research grants, (ii) policy studies, (iii) translating research findings into innovations (products, processes and services), (iv) writing policy briefs, (v) general popularization of STI and (vi) influence on policy development. The paper recommended that ATPS Network should continue to support African countries in capacity building, policy formulation and information dissemination, and it should expand to all countries in the continent.

Keywords*: Achievements, benefits, challenges, experiences and lessons*

INNOVATION, INCLUSION AND SDGS IN SUB-SAHARAN AFRICA: CHALLENGES AND OPPORTUNITIES

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There is increasing pressure for countries in Sub-Saharan Africa (SSA) to diversify and structurally transform their economies in ways that reduce poverty and inequality, create quality employment and catch-up with countries at the frontier. At the same time, there is a global commitment through the UN Sustainable Development Goals (SDGs) to do this sustainably with climate change and environmental considerations. Innovation and technology have potential to play a significant role in achieving these global, regional and national ambitions. While innovation and technology are regarded as key drivers of economic growth and structural transformation, they also have a significant role to play in addressing the sustainable development goals on education, health, nutrition, food production and security, accessible and resilient industrial and social infrastructure, decent employment, inclusive industrialization, sustainable settlements and cities, climate change, marine and terrestrial ecosystems and global partnerships for sustainable development. Yet, innovation and technology policies and practices are major contributors to the creation of some of the global sustainability and inequality challenges facing the world today, but this is often neglected in the innovation and industrial development literature. This paper argues that the neglect to critically evaluate their socio-economic and environmental effects is a major oversight that needs to be addressed. It further argues that innovation and technology contribute significantly to: inequalities within and between countries, climate change, resource depletion, terrestrial and marine pollution, ill-health, hunger and poor nutrition, security risk and injustice. The paper then identifies some of the channels through which unsustainable innovation and technology manifest such as business models, global value chains, intellectual property rights protection and concentration, tax havens, mass production systems, financial institutions, international trade policies and land use practices. The paper further identifies some of the relevant technologies that need to be strongly diffused in SSA to achieve development needs. The originality of the paper lies in its unique indicators for innovation which departs from those used in the mainstream innovation literature but which are most relevant to SSA. The paper finally develops an innovation policy framework that can guide how SSA can achieve its SDGs objectives through innovation and technology strategies and policies that are inclusive within the context of STISA 2024 and the Agenda 2063.

***Keywords**: Inclusive innovation, SDGs, structural transformation, inclusive innovation policy framework, technology diffusion*

NERICA TECHNOLOGICAL INNOVATION FOR IMPROVED RICE ECONOMY IN NIGERIA

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Nigeria has favourable agricultural landscape that supports large scale rice production. In spite of this, the country has huge demand-supply gap and self-insufficiency for rice due to low productivity. Rice is a major staple in Nigeria; hence this self-insufficiency contributes significantly to national hunger. The United Nations' Sustainable Development Goal (SDG) 2 highlights on achieving zero hunger. Nigeria comprises of about 20 percent of Africa's population. Hence, implementing SDG 2 in Nigeria has implication of reducing Africa's hunger by 20 percent. The New Rice for Africa (NERICA) variety is a modern technological innovation that has been developed to enhance rice farmers' productivity and also reduce the demand-supply gap. However, there is little documentation on efficiency and productivity of NERICA technology innovation in Nigeria. Hence, the study aims to investigate the level of efficiency and productivity of rice farmers that adopted NERICA technology innovation in northern part of Nigeria. Four-stage sampling technique was used which involved purposive sampling of the two states, random selection of four local government areas (LGAs), random sampling of five rice-growing villages from each LGA, and random selection of rice farmers that adopted NERICA technology innovation in the villages. A total of 164 rice farmers that cultivated NERICA rice alongside its technological innovation package were selected for the study. Data that were collected from the selected farmers include the socio-economic characteristics, inputs of NERICA technologies and their respective farm output levels. The analytical techniques that were used to analyze the collected data include descriptive statistics, Cobb-Douglas production function and Ordinary Least Square (OLS) regression analysis. The study revealed that inputs such as NERICA technology seeds, labour, fertilizers and herbicides had positive influence on farm output. The socioeconomic characteristics like level of NERICA technology adoption, frequency of extension contact, access to credit, level of farm commercialization, household size and cooperative membership influenced total factor productivity, average productivity and marginal productivity of selected rice farms. Most of the farmers were operating at increasing returns to scale. In addition, NERICA technology enhanced the technical efficiency and managerial efficiency of the rice farmers that adopted the innovation. It was recommended that rice production can be significantly improved through institutionalization of programs that would accelerate the promotion and adoption of NERICA innovation technology in the country. Proper implementation of NERICA innovation programs has potential to bring about improvement in rice farmers' efficiency and productivity. The resultant effects of these would be reduction of national rice self-insufficiency and hunger.

Keywords: *NERICA technology innovation, Rice, Returns to scale, Productivity, Efficiency.*

HEALTHCARE SERVICES SATISFACTION IN THE PRISON: A CROSS-SECTIONAL SURVEY AND COMPARATIVE ANALYSIS OF INMATES' PERSPECTIVES IN AN AFRICAN COUNTRY

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Assessment of patient satisfaction allows general practitioners to investigate the extent to which their service meets the needs of their client group, identify aspects of the service where patients are less satisfied, and potentially improve these aspects of care. However patient satisfaction surveys have been conducted in a number of different settings in Nigeria but are scarcely investigated in prisons and this informed the study. This was a cross-sectional study conducted at three prisons in Enugu, Oji River and Ibite-Olo all in Enugu State of Nigeria. Included in the study were all the prisoners who at one time or the other had used or presently using prison healthcare services as patients. Application was made through the Deputy Comptroller of Prisons--Enugu to the Comptroller of Nigeria Prisons, Abuja (the nation's capital), for permission to conduct the study. Ethical approval for the research was gotten from a local ethical clearance committee (University of Nigeria ethical and review committee) to conduct the research. One hundred and fifty patient inmates were interviewed who consented verbally. This method of consent was preferred by the patients. In general, for all prisons put together, the patients were dissatisfied with all the listed services. Greater dissatisfaction was on services such as: the physical appearance of the facilities and the quality of the equipment (2.40±1.33) and timely availability of laboratory result (2.46±1.36). The between prisons satisfaction comparison revealed that the satisfaction level differed significantly between the prisons, $p < .001$. Satisfaction of the health services was associated more to Oji-River prison and Enugu prison. The likelihood of being unsatisfied was 1.7 and 2.4 times higher in Ibite-Olo prison than Enugu prison [95% C.I of 1.45-2.08] and Oji prison [95% C.I of 1.63-3.53] respectively. Enugu prison and Oji prison had the same likelihood of being unsatisfied. Satisfaction with healthcare services in the prisons was low. Even though there were recorded variances in the assessment of healthcare services satisfaction in all the prisons, the overall result points to low satisfaction even when broken down using age, education, occupation and length of jail service as predictors of satisfaction. These results, it is hoped would be used in the on-going prison reforms necessitated by incessant prison riots by inmates.

Keywords: *Healthcare Services, Satisfaction, prison patient inmates, cross-sectional survey, comparative analysis, Nigeria.*

FROM 'COMMUNICATING' TO 'ENGAGEMENT': SUSTAINABLE AGRICULTURE AND AFRO- RELATIONALITY FRAMEWORK FOR CLIMATE CHANGE COMMUNICATION

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Climate change poses a significant threat to Africa's development trajectory; to the social, economic and ecological systems in the continent. The economic landscape of the region depends largely on the performance of sectors such as agriculture, forestry, energy, tourism, coastal and water resource which are highly susceptible to climate change impacts. With governance fragility in the region, climate change risks exacerbate challenges relating to food and water security, health management, economic stability, land-use, social and cultural cohesion with implications for agricultural practices. Despite acknowledged Africa's peculiarities, however, public awareness and engagement on climate change are considered problematic in the region. There is a need to drive campaigns on sustainable agricultural practices that have social, economic and environmental benefits, including meeting the need for increasing food demands. This study interrogates current practices in mediated climate change communication (CCC) as a forum where transformative ideas are shaped. Besides the dominance of non-African epistemologies in literature analysing the media-climate change and public nexus, there is little attention given to problematizing 'public engagement' (PE). Common assumption pitches 'the public' on the one side and 'the communicator' on the other side. This bifurcated model of 'communicating' climate change has import for the forms of subjectivity in climate (in) action, including a weakened citizenship representation in climate discourse and the depluralisation of ideas. This study argues that because it is people that stand to be engaged in climate campaigns, it is important to draw attention to what understanding of "person" and "community" undergird current CCC practice. Utilising a "conversational method" of inquiring, the paper discusses these concepts from African political philosophy – Afro-communitarianism and Ubuntu – and intersects them with contributions from non-African traditions to tease out implications for reorienting CCC towards "engaging" the public as persons-in-relationship. The paper argues that a relational perspective on our sociality, one which takes into cognisance, context specificity of experience to account for a view of human agent-hood as persons-in-relationship or persons-in-community (1) can inform a media ethic that can counter the normative valence of oppositional discursiveness which mark conventional mediated CCC and (2) provide space for inclusivity of subjectivities within it. The paper contributes to the discussion on the epistemologies of the South and challenges the binary approach to the knowledge economy on climate change.

Keywords: *Climate change, person and community, African communitarianism, Ubuntu, Afro-relationality, communication*

HARNESSING THE POWER OF TECHNOLOGY: THE STATE OF WOMEN IN THE 21ST CENTURY UMULUMGBE *ODO* PERFORMANCE

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Over the years, technology has revolutionized the world, even the African traditions are not left behind. This study is a part of the fieldwork conducted in Umulumgbe in order to ascertain the influence of modernity on the contemporary performance of *Odo* masquerade ritual in the community. Thus, this study is an aspect of the fieldwork that studied the influence of modernity on the participation of women in the performance, its focus is on how the women of Umulumgbe are taking advantage of the power of technology to 'enlarge their coast' during the performance of *Odo* masquerade ritual. *Odo* masquerade ritual is an oral tradition of the people of Umulumgbe, in the Southeastern Nigeria, which is passed down from generation to generation through the word of mouth. *Odo* masquerade performance is both social and communal in nature. This is because masquerades are agents of transmission of ancestral wisdom from one generation to the other. It is also used to enforce law and order in the community. However, the performance is entirely males' affair; this is because the secret that guides the *Odo* masquerade society is only known by men and this is why the actors are only the indigenous males of the community. In Umulumgbe, *Odo* masquerade as males' performance is traditionally performed by the initiated young or adult males. During the performance of this ritual, women are forbidden to move around freely which hinders their economic growth and their fundamental human rights. Nevertheless, there is a saying that change is the only constant thing in life. In order to carry out the above investigations, the objectives of the study revolved around the question of how the 21st century women of Umulumgbe have been able to liberate themselves during the performance of this tradition. The study asked the following questions: Has technology affected the communal view of Umulumgbe *Odo* masquerade performance? In what ways are the 21st century women of Umulumgbe harnessing the benefits of technology during the performance of *Odo* masquerade? How has technology promoted the issue of gender inclusivity in this performance? The study will be approached from modernist point of view.

Keywords: *Technology, Tradition, Odo masquerade, Umulumgbe Women, Umulumgbe*

SOCIO-ECONOMIC CONTRIBUTIONS OF FOREST RESOURCES TO LIVELIHOODS IN ALIMOSHO LOCAL GOVERNMENT AREA OF LAGOS STATE

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There is an increasing understanding that forests play crucial roles in sustaining livelihoods among the rural communities and in poverty reduction strategies. This study assessed the socio-economic contributions of Forest Resources to Livelihood in Alimosho Local Government Area of Lagos State through a random selection of two hundred (200) respondents interviewed with a questionnaire with both open and closed ended questions to elicit needed information on respondents' socio-economic and other relevant characteristics. The data gathered was collated and analyzed using regression analysis and frequency distribution. The findings showed that more than half (63%) of the respondents were females between ages 15 and 50 years; a greater part (76%) was married with average of 5-10 persons in their households. All respondents (100%) had one form of formal education or the other and were engaged in different forms of vocation. Regression results confirmed that access to forest products was associated with household's characteristics such as age, position in the household, level of education and distance to the forest all indicating significant relationship with forest access and utilization of forest resources. Households' dependence on forests and activities they engaged in also had a significant impact on the forest in terms of conservation and sustainability of forest resources. The study concluded that forest resources played vital roles in the livelihoods of the respondents and recommended that more attention should have been given to forest resources conservation by the government and assistance should have also been given to foresters in the form of subsidy.

Keywords: *Forest, Livelihoods, Socio-economic, Lagos, Sustainable.*

TECHNOLOGY, INNOVATION BEHAVIOUR AND RICE PRODUCTION EFFICIENCY DIFFERENTIALS IN NORTHEAST, NIGERIA: POLICY IMPLICATIONS FOR AFRICA'S TECHNOLOGICAL DEVELOPMENT

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The role of technology and adoption of innovation for agricultural development requires, among other things, the generation of financial resources for provision of science and technology based inputs and political will to support the rural farmers by promulgating favorable policies at all levels of governance. This study empirically investigates production efficiency differentials and adoption behaviour among rice farmers in Nigeria. The specific objectives were to analyze the socioeconomic factors of rice production; measure the technical efficiency (TE) under traditional and modern production technologies and innovations; identify the determinants of TE; and identify factors that influence the adoption of modern technologies and innovations. Data for the study were collected from a sample size of 280 rice farmers from Northeast, Nigeria. Descriptive statistics, stochastic frontier production function, cost function, tobit regression and logit regression were used to analyze the data. Results show that adopters of modern rice technologies, techniques and innovations obtained higher average yield than non-adopters, and significant at 1%. The frontier result showed that the mean TE was 69.1%, and 67.6%, respectively for adopters and non-adopters. Tobit result identified household size, level of education, number of extension contacts, access to farm input credit and land tenure systems as major determinants of efficiency in the sub-sector. The logit result showed that annual farm income, access to information, access to credit, education level of the households heads, family size and membership of cooperative groups played significant roles in influencing farmers' adoption behaviour. Irregular rainfall patterns, herders/farmers crisis, high cost of inputs, among others, were identified as major problems affecting their decision to adopt innovations or technologies. Inaccessibility and or unavailability of technologies and innovations were the major issues that needed urgent policy formulation. The study, therefore recommends among others, that African governments should begin to make urgent and significant policy commitments, to allocate at least 5% of their gross domestic products (GDPs) to technological research and development (TR&D) as well as engage other stakeholders in scientific and technological capabilities in a manner that is driven by genuine political will. Secondly, since rice is a major staple food in Africa, African Heads of States should promulgate a common policy designed for Africa's technological development for rice production where intra-African exchange of skills, innovation, sciences and technology can be harnessed.

***Keywords**: Technology, innovation, rice production, Nigeria.*

TRAJECTORIES OF KNOWLEDGE AND INNOVATION SYSTEMS AMONG CASSAVA COOPERATIVE FARMERS TOWARDS IMPROVING LIVELIHOODS AND INDUSTRIAL DEVELOPMENT IN SOUTHERN NIGERIA

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Innovation is a social process and it starts with mobilising existing knowledge in the productive areas of agriculture. It has the ability to increase profit and encourage economic and industrial development. It has existed since the creation of man and in the production, processing and utilization of arable crops like cassava. Cassava researches and development have improved tremendously over the last five decades in most tropical countries in the continent. These are as a result of improved attention from national, international and non-governmental organizations within the growing countries across Africa. As a food crop, it has some inherent characteristics which make it attractive to the smallholder and resource poor farmers in tropical areas of Africa - Nigeria, Ghana, Cameroon, Congo, Zaire etc. It is a poverty alleviation crop and since the crop is mostly grown by the rural poor, they should be capable of initiating and expanding economic investments of their own. Significant numbers of knowledge systems and innovations have evolved in the production of the crop over the period particularly within farmers groups and farmers' cooperative societies in these countries. These have improved their livelihoods in diverse forms thereby leading to emerging industrial development as have been observed using Southern Nigeria as a case study. This paper takes a cursory look into the emerging nature of rural knowledge systems, innovations, models of innovation and knowledge systems, research methods, government intervention initiatives on cassava development, diverse livelihoods of cassava farmers, emerging and industrial development of cassava in Southern Nigeria; and the implications on grassroots development and industrial growth. Four research questions and two research hypotheses guided the study. Three states one from each geopolitical zone in Southern Nigeria was purposively sampled and from them, 360 accessible cooperative farmers (males and females) were randomly sampled for the study. The study was a survey and a 20-item structured questionnaire validated by 13 experts in different areas of cassava development was used for data collection. The internal consistency was established using Cronbach Alpha. Three hundred and sixty copies of the instrument were administered to the respondents out of which 331 were completed and returned. Data were analyzed using percentages, means, t-test, analysis of variance (ANOVA) and scheffe test. Based on the findings and available literatures with specific examples, some recommendations are made on better ways to harness these potentials of native intelligence of the farmers in the rural areas for the overall National and continental sustainable agricultural as well as industrial developments. The overall outcomes of these will be towards the

achievement and realization of Sustainable Development Goal no 2 which is “End hunger, achieve food security and improved nutrition, and promote sustainable agriculture”.

Keywords *- Cassava, dietary energy, smallholder, poverty alleviation, rural innovation, indigenous knowledge etc.*

THE UNTAPPED POTENTIAL OF LOCAL INNOVATIONS FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS IN AFRICA: THE EXPERIENCE OF ETHIOPIA

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Literature on local innovations as well as the potential contribution to achieve Sustainable Development Goals (SDGs) in developing countries particularly in Africa is very scarce. Thus, as a case point, this article presents the stocking of local innovation in different livelihood settings of Ethiopia and elaborates for which SDGs goals and targets each local innovation responsive. Thus, the objective of this study is to explore the local innovations structure, drivers for creating innovations and to suggest how to synchronize with the modern knowledge systems to facilitate the achievement of Sustainable Development Goals (SDGs). Desk review of published and unpublished studies complemented with experts' on the area/subject discussion and observation used as source of data. Result showed that most of the local innovations are accessible, inclusive, environmental soundness, climate responsiveness; and gender responsiveness. Local innovations emerging from community-based settings create meaningful livelihood impacts for their users and that, more significantly, the act of innovating contributes to building and strengthening a set of system capacities which are essential for local economic development. In spite of having this positive value, there is weak link and integration among modern knowledge systems and local innovations. Therefore, this study suggests there should be established a continuous engagement with local innovation holders and communities in all aspects of the SDGs process at all levels. To support this engagement national level process should create conducive space for entrenchment and respect of traditional knowledge. It is also essential to design strategies and practical interventions to combine science and traditional knowledge. As practical interventions, it could be establish or mainstream the traditional structure of local innovations with the modern knowledge systems and/or create an institution at national level to capture the database of local innovations and unlock its potential for achieving the sustainable development goals in systematic manner.

Keywords: *Local Innovations, Sustainable Development Goals (SDGs), Traditional Knowledge, Modern Knowledge Systems*

SCIENCE, TECHNOLOGY AND INNOVATIONS IN PRACTICE IN DRIVING THE AFRICA'S DEVELOPMENT AGENDA AND IN ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS: A CASE OF 'TINGADALIRE ORGANIC FOOD PRODUCTS' USING SCIENCE, TECHNOLOGY AND INNOVATIONS IN AGRICULTURAL VALUE CHAINS AND WASTE MANAGEMENT SYSTEMS IN MALAWI

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There is an increasing need to improve value addition and take care of the environment in order to realize maximum benefits from agricultural and waste management systems. Application of science, technology and innovations (STI), could not be avoided if agricultural and waste management systems are to be efficient and sustainable in Africa. This paper illustrates how Tingadalire Organic Food Products- a business owned and managed by a former chairperson of African Youth Forum in Science and Technology (AYFST) is applying STI in integrating value addition and waste management systems in Malawi. Using raw material purchasing and finished products sales data from 2015 to 2018, the impact of value addition on incomes of smallholder farmers, plastic waste collectors, and aggregators were analyzed. The contribution of Tingadalire Organic Food Products towards achievement of some of the Sustainable Development Goals (SDGs) was also examined. The analysis revealed that cost and revenue extents increased with value addition for both smallholder farmers and plastic waste collectors and/or aggregators. It is also evident that, Tingadalire Organic Food Products is contributing in one way or another towards achievement of SDGs through her activities that ensures social inclusion, economic growth and environmental protection. It is therefore recommended that governments should be allocating adequate resources in STI capacity building among the youth if Africa is to realize its development agenda.

Keywords: *Science, Technology and Innovations; agricultural value chains; waste management; sustainable development goals.*

PROVIDING OFF-GRID SOLAR LIGHT TO RURAL AREAS IN SIERRA LEONE

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Biomass, especially wood and coal, dominates the energy sector in Sierra Leone, accounting for some 80 per cent of consumption, followed by imported petroleum products at some 13 per cent. Grid-generated electricity makes up the remainder, or approximately 7 per cent. Less than 1 per cent of the country's rural population has access to electricity. Households use almost exclusively wood fuel, the traditional form of energy, for cooking and other activities – despite its significant health and environmental concerns and failure to provide night-time lighting. People's health and productivity are seriously hampered by their dependence on traditional fuels and technologies, with women and children most at risk. This project is designed to tackle this challenge by providing lighting/power in off-grid rural areas of Sierra Leone through solar photovoltaic (PV) lanterns, thereby improving medical services and children's education, and empowering women. The fee-for-service/rental model for dissemination of solar lanterns piloted in India in the early 1990s was adopted in the Sierra Leone village of Kychom where six charging stations for 50 solar lanterns each were set up. The project has had tangible impact in different areas, such as children's education (doubled enrolment and a 60 per cent rise in examination success), job creation (thanks to the need for technicians, organizing committees and extended business hours), better health services (solar energy powering lights at clinics), and women's socioeconomic status. The use of solar energy to provide light to off-grid households and communities is the initiative's major innovation. It is unique in the sense that Kychom village had never had easily accessible energy; only urban residents have access to grid electricity. The project has a strong capacity building and training component for local technicians, while the income generated from lantern rentals and mobile phone charging is used to pay salaries and address system costs. Further research on profitable sectors and segments in the agricultural value chains in rural communities in northern Sierra Leone proved the need for mini-grid solar power in the agricultural value chain for sustainable income of women entrepreneurs in rural Sierra Leone. The Fisheries, poultry and Livestock sectors of the value chain particularly show high potentials for higher returns on investment (ROI) if solar power is applied as a trajectory.

Keywords: *Solar energy, PV Lantern, off-grid electricity, agricultural value chain, rural development*

SPEEDY DEVELOPMENT OF AFRICA USING SMART ENERGY OPTIONS AND AIR POLLUTION REDUCTION

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Sub-Sahara Africa continues to struggle with power supply and with the few countries having regular power supply powered by fossil fuels. These fossil fuels pose a huge risk to the earth. Although, Africa is positioned geographically to benefit from the enormous supply of resources such as wind and solar to meet her energy especially power needs. This paper discussed the roles renewable energy especially solar energy can play in the development of Africa and actualization of the sustainable development goals (SDGS) and Fourth Industrial revolution. The last part of the paper discussed Africa's silent killer known as air pollution and ways Africa can reduce the menace of air pollution through social-cultural practices already existing in the continent. This paper also discussed the opportunity and challenges mitigating full utilization of smart energy options especially solar energy in the continent and solutions to the utilization. Also, emerging solar materials and how Africa can domesticate photovoltaic technology to reduce cost and enhance the advancement of the continent is presented. The danger associated with continuous usage of fossil fuels and energy in Africa is highlighted. This paper also discussed ways the country can transition from air pollution causing-practices to alternate method of providing heat and cooking without using wood thereby curbing air pollution. It also shed light on air pollution caused by vehicular emission by proffering green and renewable alternative mixed with Africa culture. The technologies of smart energy will play a vital role in speedy actualization of the SDGs and help Africa in the Fourth Industrial revolution. Adequate, reliable and affordable energy especially power is needed for successful implementation of automation, Robotics, Internet of a thing (IoT) and other associates technology of the Fourth Industrial Revolution. A stable and affordable power supply will drive industrialization and help entrepreneurs grow. This paper will contribute to body of knowledge and proffer solution needed to develop Africa through provision of affordable, efficient, sustainable power supply and reduction of mortality and respiratory diseases caused by air pollution.

Keywords: *Energy, development, SDG, Air pollution*

LEVERAGING 4TH INDUSTRIAL REVOLUTION (4IR) TO DRIVE AFRICA'S TRANSFORMATION

Dr Julius Gatune

Africa development challenges are well known but not the solutions. Proposals for transformation strategies have been advanced (see ACET, AfDB, Brookings). Many still propose some of the paths trailed by Asian tigers e.g. light manufacturing. However, the technological changes that have heralded the so-called 4th Industrial Revolution have made some of the transformation pathways untenable. Indeed the assumptions that have underpinned development are being challenged and some economic models being rendered useless. While long term planning seems to be the way to securing sustained development, one might ask what longterm planning should like in the era where technological changes are changing the world rapidly and in fundamental ways. What now is needed is better ability to anticipate and agility to respond to opportunities while not losing the long term goal. The 4th Industrial Revolution is indeed providing a challenge even to the most developed countries. Africa is particularly challenged given the low levels of skills and technologies. All the same the paradigm shifts being presented by 4IR also provide new opportunity for powering the transformation and indeed even leapfrogging as we have seen with mobile phone technologies. Africa needs to re-imagine its future in the context of the emerging 4th industrial Revolution. This paper will review readiness of Africa for 4IR, transformation opportunities that 4IR presents how Africa can leverage 4IR to drive transformation. This will draw from a number of studies and roundtables we have done on future of work in Africa and also transformation strategies.

Keywords: *Industrial Revolution, African Development, Technologies, Technological changes*

Sub Theme 3: Improving Africa's Intra-Africa Trade Using Science, Technology and Innovation

XENOPHOBIA: RETARDING AFRICA'S INTRA-AFRICAN TRADE, SCIENCE-TECHNOLOGY-INNOVATION (STI) TRANSFER AND AGRICULTURAL DEVELOPMENT

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Foreigners from other African countries have faced various forms of discrimination, targeted violence and wanton destruction of property and businesses in South Africa. This has also caused reappraisal attacks by some citizens of other countries in their domestic nations, leading to multiple effects on the African economy, intra-trade relationship and infringement on science-technology-innovation (STI) transfer potentials. These xenophobic attacks, among other vices such as corruption, low value of currency, low trade finance, institutional constraints, poor infrastructure, smallness of country markets, multiple tariffs and taxation on processed and semi-processed agricultural products by both developed and emerging markets, have affected and may likely continue to affect Africa's intra-trade potentials in the future if nothing is done urgently to tame these vices. The main objective of this work was to review the negative effects of xenophobia on intra-African trade, science-technology-innovation (STI) transfer and agricultural development. Specific objectives of the paper were to: investigate the major cause of xenophobia in South Africa; examine the immediate effect of xenophobia on South African economy; examine the temporal and long term effects of xenophobia on their agricultural sector; and examine the impact on science-technology-innovation (STI) transfer. The research adopted literature review methodology and highlighted the following thought-provoking findings and proffered solutions: results suggest that the major cause of xenophobia was that foreigners from other African countries, mainly Nigerians, Somalis, Malawians, Zimbabweans, Mozambicans, Ethiopians and Congolese, allegedly suffocated their businesses, hijacked jobs meant for locals and as well as their women. Results also show that in fear of their lives, non-South Africans were forced to close their businesses and to go into hiding, thereby leading to massive pull out of capital from the South African economy. Further investigations show that major agricultural inputs such as feeds for livestock, perishable fruits and vegetable, and other products were not delivered on time or never got to their destinations, and this has far-reaching impacts on agricultural productions. Reprisal attacks across many other African countries have led to temporal closure of South African owned technological companies such as MTN and is a disincentive to further investment in STI in Africa. The paper recommends among others, that South African government and other African Heads of State should collaborate with Non-Governmental Organizations (NGOs) and other private sectors to coordinate, sensitize and educate people on the effects of xenophobic attacks on

Africa's intra-trade relationships and must also ensure that perpetrators are prosecuted according to the laws.

Keywords: *Xenophobia, Africa's intra-African trade, science-technology-innovation (STI), agricultural development.*

Funding science, technology and innovation priorities for Africa's development

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The African Union Science, Technology and Innovation Strategy for Africa 2024, emphasizes that African states have the potential for a 1% contribution of their GDP towards financing STI programmes. African leaders have always committed to increasing funding for national, regional and continental programmes for science and technology but so far only a handful of the countries have implemented that. In 2013 Africa's gross expenditure on research and development was about 0.45 percent of GDP, compared with 2.71 percent in North America, 2.10 percent in Southeast Asia 1.75 per- cent in Europe, 1.62 percent in Asia, and 1.03 percent in Latin America and the Caribbean. The African figures have not changed much since then. Africa was home to just 2.4 percent of the world's researchers (1.1 percent for Sub-Saharan Africa and 1.4 percent in North Africa), compared with 42.8 percent in Asia, 31.0 percent in Europe, 18.5 per- cent for North America, and 3.6 percent for Latin America and the Caribbean. In most African countries, STI-inclined research institutions depend wholly on their federal government who now struggle to fund them; they don't engage strategically well with private sector organizations or industry who can potentially fund them; Memorandum of Understandings (MoUs), when they exist, that can attract funding are not well operationalized and often gather dusts on shelves; solution-driven research, even when problems abound, is an afterthought; access to increasing international funding is a struggle; and when they apply for funding, proposals are poor and not commercially viable because grantsmanship is deficient. As Africa witnesses an increase in private sector investment, technological development and industrialization across a wide range of STI-sectors, there is need for national policy level considerations of sustainable resource mobilization models that considers STI-research and development as mandatory. Backing this up with a holistic capacity building of STI-stakeholders on models of internationalization, eco-innovation and grantsmanship is also non-negotiable if Africa is to substantially increase its funding landscape for STI priorities.

Keywords *– eco-innovation, resource mobilization, internationalization, grantsmanship, funding.*

CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT FOCUS ON SAHEL AND SAHARA REGION OF AFRICA: SUSTAINABILITY ANALYSIS RESEARCH STUDY FOR PAN AFRICAN AGENCY ON GREAT GREEN WALL (PAGGW)

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The Africa Union (AU) in 2006 established a mandate and endorsed the Great Green Wall Africa Programme (GGWAP). It was launched in 2008 for 23 African countries affected by drought and desertification: Algeria, Burkina Faso, Benin, Cameroun, Central African Republic(CAR), Chad, Cape Verde, Djibouti, Egypt, Ethiopia, Eritrea, Gambia, Libya, Mali, Mauritania, Morocco, Niger, Nigeria, Senegal, Somalia, Sudan, South Sudan and Tunisia. The Pan African Agency on Great Green Wall (PAGGW) located Nouakchott Mauritania is supervising the mandate.

Since the establishment of the PAGGW, its impact has been dismal and are not able address most of the objectives due to various administrative and technical constraints. These concerns was further buttressed in 2015 by the Executive Secretary of PAGGW, Abdalla Teah when he implored Member Countries ''to set up mechanisms for conducting activities and launching dialogues for the interest of the communities at the Great Green Wall region.'' Therefore the objective of this study is to address the gaps identified in the implementation and to proffer solution as highlighted in our deliverables. In line with the scope of study, the prospects in the value chain especially among the beneficiary countries is huge.

The Methodologies and Deliverables are as follows:

1. Advocacy and sensitization among stakeholders at three levels-All tiers of Government; Community at the PAGGW corridor; and media/civil society.
2. Conduct of technical baselines studies with emphasis on various Reports on soils, water, demography, meteorology, and indigenous plant species.
3. Programme Assessment and Sustainability Analysis with emphasis on vulnerability assessment tools for other countries successful in the shelterbelt system through comparative analysis, review study visit for the 23 countries, peer view of the two studies through Sahel-Sahara stakeholder dialogue.
4. Establishment of Demonstration/Pilot Nursery along the minor shelter belt to fortify the Wall through Demonstrations, engagement of Horticulturists and Green Rangers.
5. Planting of Trees along the major belt through engagement of Tree Planters, Belt Managers/ Supervisors and purchase of delivery trucks, and working instruments.
6. Achieving sustainable water content through rain water harvesting and dam reservoir transfer facilities, ground water exploration, water tanker and spray trucks and protecting the existing water shed.

7. Consultancy services are designed to organise national and regional sensitization workshops, community/youth relation centres, and exploring climate finance windows and carbon trading platforms.

The study will enable PAGGW be investor haven having been given an opportunity for the development of carbon market model and also functioning as a shelter belt. It will also be in line with the Paris Agreement where all the 23 Countries submitted their Nationally Determined Contribution (NDC) with attendant opportunities therefrom.

***Key Words**: AU, PAGGW, NDC, Drought& Desertification, Sustainability*.

Sub theme 5: Gender and inclusivity in science, technology and innovation

ASSESSMENT OF FACTORS MILITATING AGAINST RURAL WOMEN'S PARTICIPATION IN MODERN INNOVATIVE PALM OIL PROCESSING IN SOUTH EAST NIGERIA

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The study was conducted in Enugu State south east Nigeria; to ascertain the reasons for low use of modern innovative palm oil processing by women. It sought answers as to the factors that hinder the productive role of women in palm oil processing. Specifically, the study examined the socio economic characteristics of the women and their effects on modern palm oil processing, source of palm fruits available to the rural women, determine cost and benefits involved and examine specific task done by women in palm oil processing. Primary data was obtained by the use of a well-structured questionnaire and personal interview. Data were collected from 150 rural women palm oil processors in the study area. Descriptive and inferential statistical tool were used in analyzing the objectives. Result revealed that most of the respondents (74%) obtained fresh palm fruit bunches for processing from the villages or open markets. They obtained palm oil, palm kernel, palm wine, brooms, basket, livestock forage and fuel wood from palm oil production and processing. All the women processors (100%) used leg in processing palm oil while fifty-six percent (56%) of the women used hydraulic pressing. The major source of labour used for oil palm processing was household members (68%). The effective source of information for rural women was ADP officers (68%), radio (56%) and fellow processors (51%). Oil palm processing is a profitable business in the area with a gross margin of N560,350 (about USD 1500) for an average enterprise. Serious constraints to mainstreaming rural women in modern palm oil processing in Enugu state south east Nigeria were lack of modern processing equipment (80%), lack of finance (78%), lack of technical knowledge (73 %), etc. The study recommended the need for government to hasten the supply of rural infrastructures and processing machines. The women should be encouraged to form cooperative societies, this will enable them to generate funds for themselves, access credit and receive free education on modern innovative methods of processing palm oil. Also, provision of enabling environment for improving productive capacity of women will increase productivity.

***Keywords**: rural women, oil palm processing, innovative method, constraints, south east Nigeria*

AGROFORESTRY - COPING MECHANISM FOR FOOD INSECURITY AND UNEMPLOYMENT IN NIGERIA: A CASE OF RURAL WOMEN / YOUTHS IN IMO STATE, NIGERIA

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Food insecurity and unemployment heighten insecurity in Nigeria. Women bear more consequences of food insecurity as they spend longer hours with hungry household members. Youths (mostly graduates) indulge in cyber fraud, combined with kidnapping and armed robbery as a result of unemployment. It is feared that these trends could increase prostitution, divorce, ritual killings and kidnaps in Nigeria. Given scarcity of land, Agroforestry had been introduced to increase resource management by rural women to tackle food insecurity whereas business profitability through Extension Education attracted youths to form co-operatives to harness benefits of Agroforestry towards reducing unemployment. Objectives of the study were to determine rural women perceived effects of agroforestry as coping mechanism for food insecurity and willingness of youths to undertake agroforestry and value chain as business concern. Methodology was participatory approach where 270 rural women as respondents from co-operative groups amongst three agricultural zones in Imo State, using multistage sampling techniques were trained to participate in the research. Data were collected using questionnaire, semi structured interview and focused group discussion (FGD) - especially for the Youths. Descriptive – frequency, mean, percentage and inferential statistics – analysis of variance were used to analyze collated data to obtain results. Results showed that 60% of rural women organized into co-operatives do not understand what agroforestry is all about though 85% of co-operative members were willing to practice agroforestry to support household food security in dwindling economy. Study revealed average age of farmers involved in study was 51years, 77% married with average household of 6. Implication is that younger women relocated to rural areas perhaps as a result of accommodation problems in cities and increased hardship. Married with responsibility to feed average of 6 in household, agroforestry and value chain activities became coping mechanism. With Educational level (34.4%), completion of secondary education, extension had better impact on agroforestry technology transfer. Monthly average income of N35,000 ($100), $3.3/day, agroforestry farmers lived above poverty line of $2/day as stipulated. Among the youths, 75% during FGD opined willingness to embrace agroforestry as business and coping mechanism against continued unemployment if training/input-driven extension education with market linkage opportunities are available. Study concluded that agroforestry /value chain have

potentials to address social problems by ensuring food security and alleviating poverty occasioned by high level of unemployment amongst youths. Recommendations were that Public Private Partnership approach should be deployed to popularize agroforestry practice. Federal Ministry of Agriculture should establish 74 agroforestry demo farms in Nigeria. Encourage Agroforestry Practice Club (APC) with incentives like Extension Education, Improved species of oil palm fruits, citrus, grains, cassava and vegetables to sustain interests among adopters of agroforestry technologies.

Key words: *Agroforestry, Women, Youths, Unemployment, Poverty.*

GENDER-BASED ANALYSIS ON ICT ACCESSIBILITY AND UTILIZATION FOR ENHANCED PERFORMANCE AMONG UNDERGRADUATE STUDENTS IN OGUN STATE, NIGERIA

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In modern day urbane Nigeria, Information Communication Technologies (ICTs) is turning into a family name being utilized almost everywhere and every sphere to gain access and obtain necessary information. Most global modernizations that are achieved in recent times are products of introduction and contact with the ICTs. These technological advancements however should of necessity also be carried along with women empowerment. In the pursuit of gender equity, ICT should be adopted and accepted as an instrument for gender development. This is in consonance with the Conference in Beijing 1995. However, in spite of the importance attached to ICTs in Nigeria, women are frequently inadequately represented in terms of ICT accessibility and utilization. In addition, the United Nations' Sustainable Development Goals (SDG) 4 and 5 focus on achieving quality education and **gender equality for women and girls.** Therefore, this study examines the gender differences in ICT access and utilization by gender using **a public** Higher Education Institution in Nigeria as case study. It also considered the relationships between ICT usage and students' performance by gender. Multistage sampling technique was used for the study. This involved purposive selection of students of second, third and fourth years of undergraduate study. Simple random sampling technique was used for selection of the respondents. A total of two hundred and ninety respondents were selected for the study; this comprised of 136 female and 154 male students. Descriptive statistics and Ordinary Least Squares (OLS) regression analysis were used as analytical techniques for the study. The study revealed that the female students had less access to ICTs like laptop, smart phones and tablet devices. Most of the female students only had access to internet through by patronizing cyber café as against the access to same facility in the comfort of their homes. Broadband internet connectivity was mainly available in the university library, and male students were more frequent at utilizing this facility than the female counterparts. Wi-Fi / wireless internet connectivity was utilized more by the male

students than the female students. On average, the male students spent more time on internet-related activities than the female students. The major computer skills possessed by the selected students were email, search engines databases, digital audio, learning management system and web tools. In all these internet-related activities, the female students were less skillful than their male counterparts. On the other hand, the female students had better academic performance than the male students. There was significant relationship between ICTs usage and academic performance among female students, while the two variables were not significant among the male students. The study concluded that the female students should take more advantage of the ICT facilities within their disposal for much more better academic performance; while the male students should justify their access to ICTs by judiciously using the technology for academic purposes rather than being tools for distractions. ICTs should be incorporated as critical teaching aid components for all classes in public institutions.

Keywords: *Gender Differences, ICT accessibility, ICT utilization, Academic Performance, Undergraduate Students*

GENDER GAP ANALYSIS OF ADOPTION OF TECHNOLOGY AND INNOVATION (TI) AMONG RURAL FARMERS IN NIGERIA: A CASE OF GENDER MAINSTREAMING AND DEVELOPMENT POLICY IN AFRICA

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Gender inequalities, women exclusivity and some social imbalances such as poor or unequal access to land and farm input credit have been militating against adoption of Technology and Innovation (TI) among women in Africa. These can only be addressed when relevant policies and research-based strategies are employed to modify some gender exclusive culture, norms and tradition which discourage women from engaging, trainings, and adoption of technology and innovation for sustainable agricultural development. The study, therefore, investigates gender gaps in adoption of Technology and Innovation (TI) among rural farmers in Nigeria. The specific objectives of the study were to: describe the gender gaps in adoption of science, technologies and new innovations among rural farmers; examine the gender gaps characteristics in the yield, access to land, and input credit; determine the effects of TI adoption on agricultural growth; and genderize the major constraints militating against the adoption of science, technologies and new innovations among rural farmers. Data for the study were collected from a sample of 920 rural farmers. Results showed that 69% of the rural farmers were women. The differences in

engagement and adoption of TI among women and men were high under different categories. In the women categories, those with zero level of adoption of TI were 30%, while 31%, 28% and 11% were fairly adopting, moderately adopting and highly adopting categories, respectively. Also, for the men, those with zero level of adoption of TI were 11%, while 41%, 30% and 18% were fairly adopting, moderately adopting and highly adopting categories, respectively. The gender gap ratios showed that 40% and 75% of the women and men, respectively had access to all season farming land, while 32% and 20% of the women and men respectively had no access to farm input credit. The difference between their average yields annually was 24%, with men 75% and women 51%. The effect of TI adoptions on yield shows that yield increased significantly at 1% as rural farmers' level of adoption increased. Out of the 20 constraints suspected to be militating against the adoption of TI among rural farmers, 10 and 8 loaded significantly against women and men respectively. This study noted that women have more challenges and lesser opportunities of access to resources due to culture and nature, and therefore recommend gender-sensitive best practices that should be adapted and implemented in Africa to encourage inclusivity and gender mainstreaming in the emerging world of science, technology and innovation.

Keywords: *Gender gap, adoption, technology, innovation, rural farmers, Nigeria*

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