



Emerging Paradigms, Technologies & Innovations for Sustainable Development: Global Imperatives and Africa Realities

**Proceedings of the 2012 Annual Conference and Workshops
19-22 November - Addis Ababa, Ethiopia**



Emerging Paradigms, Technologies and Innovations for sustainable Development: Global Imperatives and African Realities

Proceedings of the 2012 ATPS Annual Conference and Workshop held on 19-22 November Addis Ababa Ethiopia.



Delegates at the ATPS 2012 Annual Conference

Edited by

Urama, Kevin Chika, Executive Director, ATPS

Ozor, Nicholas, Senior Research Officer



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Conference Organising Committee

Prof. Kevin Uchika Urama, Executive Director, ATPS

Dr. Nicholas Ozor, Senior Research Officer, ATPS

Mr. Ernest Acheampong, Research Officer, ATPS

Mr. Richard Muriuki, Finance and Administration manager, ATPS

Ms. Carol Thuku, Senior Secretary/Programs Administrative Assistant, ATPS

Ms. Eunice Kariuki, Administrative Secretary, ATPS

Mr. Nelson Akenga, Information Technology Assistant, ATPS

Ms. Sarah Wakasa, Assistant Communications and Outreach, ATPS

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Acknowledgement

The African Technology Policy Studies Network (ATPS) this year decided to pick on the Theme “Emerging Paradigms, Technologies and Innovations for sustainable development” to address the global imperatives and African Realities. This report provides a summary of these ongoing engagements through the proceedings of the 2012 ATPS Annual Conference and Workshop which was held at AU offices in Addis Ababa Ethiopia.

The conference engaged a dynamic mix of scientists, policy makers, science journalists and policy research advisors in stimulating debates to address the issue of the emerging paradigms, technologies and Innovations for sustainable development.

On behalf of the ATPS Community, I wish to acknowledge the financial support received towards the organization from various donors including the Rockefeller Foundation, John Templeton Foundation, European Academies Science Advisory Council and the Network of African Science Academies. I am also grateful to the Government of the Republic of Kenya for hosting the ATPS Secretariat and especially The National Council for Science and Technology (NCST) for their continued support and collaboration with the ATPS.

I wish to thank all the delegates from various global locations who participated in the conference. It is my hope the interactions and debates that will come up during discussions will be carried proactively and innovative solutions will be implemented to achieve the ultimate goal of ensuring Africa’s sustainable development.

Finally, I would like to express my gratitude to the entire team at the ATPS secretariat whose collective and dedicated efforts contributed to the success of the conference.

Prof. Kevin Urama

Executive Director

The African Technology Policy Studies Network (ATPS)

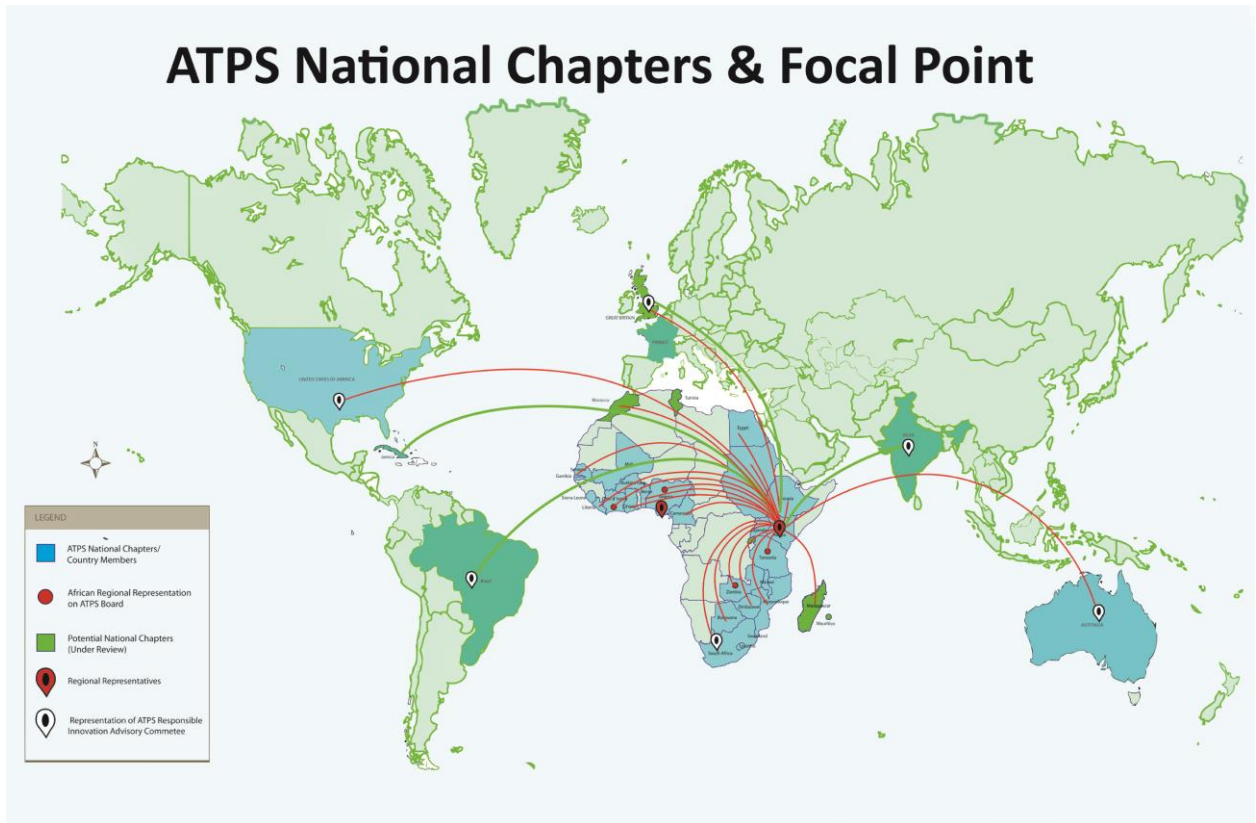
About ATPS

ATPS is a trans-disciplinary network of researchers, private sector actors, policy makers and civil society actors promoting Science, Technology and Innovation (STI) generation, use and mastery for development in Africa. Its vision is to become the leading international centre of excellence and reference in STI systems research, training and capacity building, communication and sensitization, knowledge brokerage, policy advocacy and outreach in Africa. ATPS is a key institution in Africa with significant experience and mastery in knowledge generation (through research and training) knowledge brokerage (through stakeholders' dialogue), knowledge dissemination and outreach (through publication, STI journalism and policy advocacy) and knowledge valorisation (through innovation challenge programs). ATPS collaborates with relevant institutions within and beyond Africa to achieve knowledge sharing and use through research and capacity building, international cooperation and partnership, and youth and gender empowerment.

It acts as a broker between knowledge and technology generators, the policy makers, the private sector and the local communities on the other hand and between regions and countries on the other. The institutional reach-out mechanism and reach-out systems include Research Capacity Building (RCB), Training and Sensitization (TS), Communication and Stakeholder Dialogue (CSD), Outreach, Knowledge Brokerage and Policy Advocacy (OKBPA), International Cooperation and Partnership (ICP), Youth and Gender Empowerment (YGP), and Participatory Monitoring Evaluation (PME).

With a regional secretariat in Nairobi, ATPS operates through national chapters in 30 countries including Diaspora chapters in the United Kingdom, the United States of America (USA) and Australia.

ATPS National Chapters & Focal Point



ATPS has an expansion plan to cover the entire Africa. The ATPS has since been involved in many funded Research, Capacity Building and Advocacy programs in Africa in issues of STI including, but not limited to Climate Sense program, Agricultural Innovation Program, Health Innovation program, Water and Sanitization, Socialization of Science, Research Policy and Practice Linkages, among others.

Acronyms

AAU	Association of African Universities
ACET	African Centre for Economic Transformation
ACPC	African Climate Policy Centre
ADEA	Association for the Development of Education in Africa
ADPs	Agricultural Developmental Programmes
AfDB	Africa Development Bank
AFSJ	African Federation of Science Journalists
AHER	African Higher Education & Research Area
AIRF	Agricultural Innovation Research Foundation
APHRC	African Population and Health Research Centre
ARIPO	African Regional Intellectual Property Organization
ATPS	African Technology Policy Studies Network
AU	African Union
AUC	African Union Commission
AWFST	African Women Forum for Science and Technology
AYFST	African Youth Forum for Science and Technology
AYICC	African Youth Initiative on Climate Change
CBD	Convention on Biological Diversity
CBOs	Community Based Organizations
CDM	Clean Development Mechanism
CEDR	Centre for Entrepreneurship and Development Research
CIC	Climate Innovation Centre
CPA	Consolidated Plan of Action
CSOs	Community Based Organizations
DPD	Directorate of Planning and Development
EASAC	European Academies Science Advisory Council
ECA	Economic Commission for Africa
ECOC	Executive Conference Organising Committee

ECOWAS	Economic Community of West Africa Countries
EMCA	Environment Management and Coordination Act
FANRPRAN	Food, Agriculture and Natural Resources Policy Analysis Network
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FES	Fair and Equitable Sharing
FGDs	Focus Group Discussions
FSAP	Farming Skills Acquisition Programme
GCI	Global Competitive Index
GDP	Gross Domestic Product
GHI	Global Hunger Index
GM	Genetic Modification
GSEEP	Grassroots Socio-Economic Empowerment Programme
GTP	Growth & Transformation Plan
IAE	International Energy Agency
ICT	Information and Communications Technology
IDRC	International Development Research Centre
IFPRI	International Food Policy Research Institute
IK	Indigenous Knowledge
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectually Property Rights
IS	Information Systems
MDG	Millennium Development Goals
MLP	Multi Level Perspective
MOU	Memorandum of Understanding
NARIS	National Agricultural Research Institute
NEPAD	New Partnership for African Development
NIAS	Nigerian Institute of Animal Science
NISER	Nigerian Institute of Social and Economic Research

NITC	National Information Technology Centre
NRCRI	National Root Crops Research Institute
PESP	Polytechnic Educations Support Program
PPP	Public Private Partnership
Q&A	Questions and Answer
R & D	Research and Development
RD&I	Research Development and Innovation Research
RRP	Research, Policy and Practices S&T Science and Technology
SSA	Sub-Saharan Africa
STEPRI-CSIR	Science and Technology Policy Research Institute-Council for Scientific
STI	Science Technology and Innovation
TTO's	Technology Transfer Offices
UNECA	United Nations Economic Commission of Africa
UNESCO	United Nations Education, Scientific and Cultural Organizations
USDA	United States Department of Agriculture
WB	World Bank
WFSJ	World Forum for Science Journalism

1. About the Conference & Workshop

1.0 Introduction

The quadruple challenges of imploding economies, deepening and widening poverty, climate change and disappearing environmental assets (natural resources and biodiversity) around the world necessitate a careful rethinking of knowledge platforms and development pathways at global, continental and national scales. With the recent global financial crisis and deepening social and environmental crisis in the past decade, science experts and policy makers alike are united in the search for alternative development paradigms. Major global policy support institutions such as the World Bank (WB), the United Nations (UN), Organization for Economic Cooperation and Development (OECD) amongst others, now sing the same song: “There is need for new paradigms and pathways for economic growth that is inclusive of social and environmental sustainability.”

A recent report launched by the World Bank (2012) aptly concludes that, “inclusive green growth is necessary, efficient and affordable....the search solutions needs to shift from the search for more financial resources to “getting smart”. In the same vein, the recent Global Green Growth Summit held in South Korea, re-echoed the collective voice of global leaders that “technological innovations will be central to the creation of a new and more sustainable development paradigm”. Many global assessments and reports now converge in the conclusion that having the right kind of science, technologies and innovations is at the heart of sustainable development (UNESCO 2010, UNEP 2011, UNDP 2012, UNCTAD 2012, World Bank 2012). Be it the first and second carbon intensive industrial revolutions which are now foundering or the third industrial revolution which is now evolving under different nomenclatures (Green economy, Green Growth, Inclusive Growth, Climate Resilient Economy, Low Carbon Economy etc). STI has remained the constant driver of productivity and efficiency gains in economic development history.

In June 2012, World Leaders, the Academia, the Private Sector Actors and the Civil Society convened in Rio De Janeiro Brazil, under the auspices of the United Nations Conference on Sustainable Development. Reconnaissance surveys in Africa suggested that 20 years after the first Rio conference, stakeholders’ expected more proactive and practical actions in addressing poverty, hunger, energy access, energy security, efficient and sustainable resource use and ecosystem management, improved agricultural value chain management, etc. The general feeling amongst policymakers and policy analysts consulted was that the global governance architectures be it in the socio-political, economic or environmental realms still leaves Africa disadvantaged in many ways. This is largely due to lack of political will to implement negotiated agreements and international commitments; global mechanisms and institutions that favour binomial relationships between the global north and the global south with knowledge, technologies and innovations predominantly flowing from the former to the latter and general inequalities in the distribution of skills and capacities for innovation and wealth creation. The Ministers of African states have therefore aptly noted that the critical foundation for sustainable development must include more inclusive global governance; strong and responsive pro poor institutions for wealth creations, social equity and equality; poverty eradication and environmental sustainability, as well as sustained progress in the achievement of internationally agreed commitments including the Millennium Development Goals (MDGs). They called on Rio+20 to reinvigorate political will and international

commitment to implementing the goals and ideals of sustainable development and urge developed countries to proactively fulfil previous commitments and pledges to help Africa's efforts to achieve sustainable development.

The optimism that the Rio+20 Conference outcomes was expected to deliver greater global commitment to sustainable development and encourage countries of the global north to step up development assistance to African countries was well placed. However, a pragmatic assessment of global development trends and resource potentials suggest Africa is on the move (UNDP 2012) and the technical resource and productivity potentials for green growth are substantial. Huge opportunities therefore exist for home grown development on the continent, but the STI capacities of the African countries to effectively participate in harnessing these comparative advantages remain dismal (Urama et al.,2010). Though Africa's scientific capacities and Gross Domestic Products(GDP) growth have Improved during the past decade, technological and innovation capacities remain low and the requisite institutional and governance infrastructures are only just emerging (Urama et al., 2010; UNESCO 2010, UNDP 2012). Whereas there are pockets of success in application of STI including the mobile telephony and telecommunications, among other factors which contributed to sustained economic growth in the continent during the past decade, the continent generally lags behind in skills and competencies required to fully reap the benefits afforded by STI for its development. This can be attributed to many factors, but key amongst these are lack of skills and competencies required to fully reap the benefits afforded by STI to guide and foster an African development agenda, inadequate implementation of STI policies and programmes and limited political commitment.

It is expected that as the world "gets smarter", transitions away from hydro-carbonated industries and natural resource intensive economies will be imperative. Continued reliance on cheap exports of primary resources will not only be environmental unsustainable and economically inefficient, but also socially unacceptable. Building STI capacities, knowledge systems and structures, knowledge circulation and networks and effective valorization of STI knowledge will therefore be the bedrock for sustainability of nations in the coming decades.

Africa cannot afford to remain recluse of the emerging global realities social, economic and environmental challenges of climate change, biodiversity loss, deepening water stress, energy, price hikes etc; neither should she remain a global consumer of knowledge, technologies and innovations in the new global economy, the architecture of which it is emerging today. The first Africa Forum on STI hosted by the Republic of Kenya from 1-3 April 2012 and co-organized by African Development Bank (AfDB), African Union Commission (AUC), United Nations Economic Commission for Africa (UNECA), United Nations Educational, Scientific, and Cultural Organization (UNESCO) and Association for the Development of Education in Africa (ADEA) called for African countries to among other things, design STI policies and programs to implement strategies to support inclusive growth, employment opportunities and sustainable development in Africa.

1.1 Conference Sub-themes

The conference offered an opportunity for our range of stakeholders including researchers, policy makers, private sectors, civil society organization, non-governmental organization, farmers' organization, etc to deliberate on the following interlinking subthemes with the aim of looking at the emerging paradigms, Technologies and Innovations for sustainable development, global imperatives and African Realities.

1. Transitions to Low Carbon Development Pathways and implications for sustainable development in Africa

Papers under this subtheme explored country experiences, policy questions and options for a sustainable structural transformation in African economies that will protect Africa's natural capital while growing her economies. These included but not limited to, renewable energy options for energy access and energy security, greening industries and green growth; institutional arrangements to support such transitions including global financing mechanisms, climate/green change technology transfer mechanism, trade rules, regionalization and internationalization of STI, extension services, etc. It also sought information to establish baselines, understand current and future barriers, potentials/opportunities and provide policy actions and measures required to achieve more inclusive growth and sustainable development in Africa.

2. Governance of Science, Technologies and Innovation including Genetics for Farming, Biotechnologies, Nanotechnologies and Indigenous Knowledge Systems

Papers under this subtheme addressed issues on governance of STI for food security and sustainable development with special focus on biotechnologies, genetics for farming, nanotechnologies and indigenous knowledge system for improved productivity and value addition in agriculture, health delivery, water management etc. This provided an opportunity to address many of Africa's development challenges including food and energy insecurity, poor access to quality drinking water and sanitation, and increasing disease burden. The aim of this subtheme was to provide critical assessments of country case studies to establish baseline knowledge of the current potentials, barriers and opportunities in the development, deployment and diffusion of these technologies in Africa as well as explore policy options for optimizing the potentials and minimizing the risks associated with these technologies.

3. Institutional Structures and Social Innovations for Sustainable Development in Africa

Papers under this subtheme explored the institutional and social structures needed to deliver on sustainable structural transformations towards inclusive growth in Africa. This included the new forms of public policies shaped by new models of innovation that enhanced resource efficiency, resource productivity, greening economies, greening industries, and decoupling economic growth from social and environmental impacts, among others. The subtheme also explored the implications of emerging global changes, global recession and the shift in global partnerships, etc., for African development and the role of STI. Other areas considered under this subtheme included; privatization and commercialization of enterprises, innovation incubation, entrepreneurship and public-private partnerships (PPP) in the new global economy.

4. Youth and Gender Empowerment for Sustainable Development in Africa

Papers under this subtheme addressed regional and global experiences on youth development and engagement in science, technology and innovations which served as a knowledge asset for both practioners and policy makers to foster activities on youth development, empowerment and leadership in Africa. The potentials and challenges of youth and gender engagement/empowerment for African sustainable development through STI were also covered in this sub theme.

5. Mainstreaming Trans-disciplinary in STI in Higher Education

Papers under this subtheme addressed the concept of trans-disciplinarity in higher education with respect to its application in science, technology and innovation for African sustainable development. This included new pedagogies, models, curricula, incentive structures, policies and reforms on teaching, learning, research and community service required for a sustainable higher education and development in Africa.

1.2 Conference Objectives

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

1.3 Expected Outputs

- I. Published conference proceedings.
- II. A book volume with selected conference papers showcasing success stories, barriers and opportunities for transitions to low carbon development pathways in Africa.
- III. A communiqué' summarizing key conference recommendations for African policy-makers and development partners.

1.4 Expected Outcomes

- I. African policymakers, science experts, private sector actors and civil society appraised of the pros and cons of alternative development pathways and policy choices including actions and inactions.
- II. Strengthening networks amongst STI actors in Africa

1.5 Conference Methodology

In order to unearth the context specific lessons from the mix of researchers, policymakers and practioners; learn from the successful cases as well as identify and strategize on how the emerging paradigms, technologies and developments contribute to sustainable development; the workshop adopted multiple approaches to ensure active participation of each stakeholder grouping in the dialogue, identification of gaps and prioritization of strategies for improvement. These included:

- Plenary sessions: This involved keynote lectures by selected renowned researchers, policy makers and practitioners in the different thematic areas. Keynote presentations focused more on practical experiences and less on theoretical issues. They provided

details on the experiences of the presenters and their institution (both successes as well as frustrations) and the contextual reasons for the successes and failures.

- Facilitated questions and answer (Q&A) sessions: This session afforded the presenters the opportunity to respond to specific issues raised by the participants using practical experiences.
- Country case studies: This aimed to highlight the experiences of different countries and regions in the linkages between research, policy and practice. These case studies emphasized specific scenarios of linkages amongst research, policy and practice and the role of each stakeholder in fostering the relationship for a specific agenda. It also buttressed on the lessons learnt from the process.
- Working group sessions: Participants were divided into groups representing a mix of researchers, policy makers and practitioners with the aim of discussing the emerging paradigms, technologies and Innovations for sustainable development

1.6 Conference Venue and Date

The conference and workshops were held at AU offices, Addis Ababa Ethiopia from 19-22 November 2012

2. Conference Opening & Workshop Opening Session

2.1 Welcoming remarks by Mr. Wondwossen Belete, ATPS National Coordinator Ethiopia



Mr. Belete expressed joy at the cream of delegates that attended the 2012 ATPS Annual Conference and Workshops, including senior government officials, representatives of international and regional organizations, senior scientists, distinguished intellectuals and members of ATPS from the 30 National Chapters across Africa and in the Diaspora. He noted that the choice of the African Union Commission in Ethiopia as the venue for the meeting is very significant for socioeconomic developments in Ethiopia citing that the national science and technology capacity development is high on the Government's agenda.

According to Mr. Belete, there is an increasing interest at the national level in science and technology issues. Much more attention is given to technological progress as a source of economic growth in an effort to promote sustained economic growth and poverty reduction. Governments have realized that ignoring a policy to promote technological progress as a basic source of economic growth means marginalization within the global economy. This understanding led to the adoption of a new science, technology and innovation policy early in 2012. The policy is mainly aimed at increasing interest at the national level in science and technological issues. Much more attention is given to technological progress as a source of economic growth in an effort to promote sustained economic growth and poverty reduction.

This understanding led to the adoption of a new science, technology and innovation policy early in 2012. The policy is mainly aimed at building innovation system and developing the capacity for rapid learning, adaptation and utilization of foreign technologies. He further noted that science, technology and innovation issues are incorporated in the Five Year Growth and Transformation Plan of Ethiopia which covers the period 2011-2015 and is the first national plan to devote a separate section on science and technology. The STI policy and the Growth and Transformation Plan emphasize among other things, the need for the establishment of a strong STI governance framework, reforming of higher education institutions to produce highly qualified STI manpower, strengthening university-industry linkage and building of a green economy. The focus areas of the Ethiopian Government are also part of ATPS mandates and therefore a clear indication that ATPS could play an important role in the development and implementation of STI policies in Ethiopia.

2.2 Welcoming remarks by the Commissioner for Human Resources, Science and Technology (HRST),AUC, Ethiopia H.E. Prof Jean-Pierre Ezin

Commissioner for Human Resources, Science and Technology (HRST), AUC, Ethiopia



In his welcoming remarks, His Excellency, Professor Jean Pierre Ezin, Commissioner, Department for Human Resources, Science and Technology (HRST) represented by Dr. Mahama Ouedraogo who is the Head of Division, Science and Technology, AUC stressed on the timeliness of the ATPS meeting and highlighted the major programs of HRST Division for Science and Technology namely; The Kwame Nkrumah Scientific Awards, The African Union Research Grants, The African Science Technology, The Innovation Observatory hosted by Equatorial Guinea and The Pan African University Project (PAU). He congratulated ATPS for its excellent work and outstanding achievements in promoting STI policy and looked forward to closer collaboration and joint activities.

In his concluding remarks Prof. Ezin reiterated the timeliness of the ATPS conference pointing out that African countries are signatories to many international conventions which have many exigencies that are sometimes challenging. He noted that the ATPS conference offers a good platform to understand how to deal with such exigencies in such conventions. He maintained that STI development is the way for Africa to fulfil many of the obligations from these conventions by ensuring proper training, capacity building and institutional reforms. Finally, he noted that the AU consolidated plan of action remains Africa's framework for implementing STI development in the continent. He congratulated the ATPS Network for their work and declared the 2012 conference and workshops open.

2.3 Welcoming/Opening remarks by the ATPS Executive Director Prof. Kevin Urama



In his welcoming remarks, Professor Kevin Chika Urama, Executive Director of ATPS applauded the Africa Union Commission (AUC) for hosting the conference noting that “The quadruple challenges of imploding economies, deepening and widening poverty, climate change, and disappearing environmental assets (natural resources and biodiversity) around the world necessitate a careful re-thinking of knowledge platforms and development pathways at global, continental and national scales”.

He recalled that in the wake of the recent global financial crisis and deepening social and environmental crisis in the past decade, science experts and policymakers alike are increasingly uniting in the search for alternative development paradigms.

He cited a recent World Bank report which aptly concludes that, “inclusive green growth is necessary, efficient and affordable,..., the search for solutions needs to shift from the search for more financial resources, to “getting smart”. In the same vein, the recent Global Green Growth Summit held in South Korea, re-echoed the collective voice of global leaders that “technological innovations will be central to the creation of a new and more sustainable development paradigm”.

Many global assessments and reports now converge in the conclusion that “having the right kind of science, technologies and innovations (STI) is at the heart of sustainable development”. Be it the first and second carbon intensive industrial revolutions which are now foundering, or the “third industrial revolution” which is now evolving under different nomenclatures (Green Economy, Green Growth, Inclusive Green Growth, Climate Resilient Economy, Low Carbon Economy, etc.), STI has remained the constant driver of productivity and efficiency gains in economic development history. Every experience of successful industrial transformations ranging from Germany and the United States of America (almost two centuries ago), all the way to Korea, Taiwan, Brazil, China and India nowadays, have entailed major processes of accumulation and use of endogenous knowledge and innovation capabilities at the levels of the individual, organizations and countries.

He emphasized on the Sustainable Development Goals (SDGs) agreed by the United Nations Conference on Sustainable Development dubbed the Rio+20 conference, which is only possible if countries build endogenous STI capacities. “The optimism that the Rio+20 conference outcomes was expected to deliver greater global commitment to sustainable development and encourage countries of the global north to step up development assistance to African countries was well placed,” he said. However, a pragmatic assessment of global development trends and resource potentials suggest that Africa is on the move and the technical resource and productivity potentials for green growth are substantial. Huge opportunities therefore exist for home grown development on the continent. He recalled that Africa remains the “resource basket” for the new development paradigm that is emerging as it did during the previous industrial revolutions. Africa accounts for about 75% of the world’s platinum supply, 50% of diamonds and chromium, one-fifth of gold and uranium supplies. However, the STI capacities of the African countries to effectively participate in harnessing these comparative advantages remain dismal. Though Africa’s scientific capacities and Gross Domestic Products (GDP) growth have improved during the past decade, technological and innovation capacities remain low and the requisite institutional and governance infrastructures are only just emerging. Whereas there are pockets of success in application of STI including the mobile telephony and telecommunications, among other fields, which significantly contributed to the sustained economic growth in the continent during the past decade, the continent generally lags behind her peers in skills and competencies required to fully reap the benefits afforded by STI for its development. This can be attributed to many factors, but key amongst these are the lack of skills and capacities in the area of STI to guide and foster an African development agenda, inadequate implementation of STI policies and programs, and limited political commitment.

According to Prof. Urama, “It is expected that as the world “gets smarter”, transitions away from hydro-carbonated industries and natural resource intensive economies will be imperative. Continued reliance on cheap exports of primary resources will not only be environmentally unsustainable and economically inefficient, but also socially unacceptable”. He maintained that one major conclusion of recent meta-analyses of global economic trends over the millennia is that divergence and heterogeneity have been and continue to be the dominant tendencies of the world economy. Again, there appears to be a lot of hype about the benefits of globalization of short term financial flows via the financial markets, but little, if any in terms of technological capabilities. Building STI capacities, knowledge systems and structures, knowledge circulation and networks, and effective valorisation of STI knowledge will therefore be the bedrock for sustainability of nations in the coming decades. Africa

cannot afford to remain reclusive of the emerging global realities and social, economic and environmental challenges of climate change, biodiversity loss, deepening water stress, energy price hikes, etc.; neither should she remain a global consumer of knowledge, technologies and innovations in the new global economy, the architecture of which is emerging today.

The 2012 international conference and workshops convened by the African Technology Policy Studies (ATPS) and its partners reflected on post-Rio+20 futures for Africa. To make good use of the global commitments for sustainable development in Africa, African countries will need strategic transformative reforms in its: STI knowledge structures (from mono-disciplinary “certificate education” to trans-disciplinary systems studies, entrepreneurship and innovation capacity development); institutions and governance structures (from neo-colonial knowledge dependence to governance structures that are fully embedded in Africa’s socio-political, economic and cultural realities); Agricultural and resources systems research and policy (from focus on rent seeking and incremental productivity enhancing measures value chain approaches and technologies that may enhance quantum leaps in value addition; intra-Africa cooperation, knowledge circulation and networks (to enhance intra-African knowledge flows and networks), and develop pathways that enhance transitions towards wealth creation for inclusive green growth and development on the continent. “Without aggressive policies and commitment to build endogenous capacities on the continent, Africa will remain a knowledge consumer NOT a knowledge producer in the third industrial revolution,” he concluded.

2.4 Welcoming/Opening remarks from Prof. Shaukat Abdulrazak,

Executive Secretary, NCST and Chair ATPS Board



Prof. Abdulrazak on behalf of the Board of Directors of ATPS and the entire Network in Africa and in Diaspora welcomed delegates to the 2012 ATPS annual conference and workshops holding from 19-22 November at the African Union Commission Headquarters, Addis Ababa, Ethiopia. He noted that the ATPS has carefully crafted this year’s annual conference theme to coincide with the emerging issues, paradigms, technologies and innovations required to enable Africa leapfrog development in a much sustainable way by drawing from global imperatives and African realities. He continued by emphasizing that the dialogue could not have come at a more opportune time than now when Africa is confronted with imploding economies, deepening and widening poverty, health issues, climate change, and disappearing environmental assets in the form of natural resources and biodiversity. This calls for urgent actions to rescue the continent through ‘Smart’ technologies, innovations and capacity strengthening at individual and institutional levels.

He recalled that sustainable development, the practice of improving human life while protecting the environment, is perhaps the most important and the most daunting long-term challenge that the world faces today noting that technology and innovation have however proven to be crucial components for this sustainable development to happen. Unfortunately, about 1.3 billion people who currently live on less than a dollar a day do not enjoy the benefits that many modern technologies and innovations have brought. Majority of these

people live in Africa – a continent characterized by poverty and hunger; incidences of ill health such as malaria and HIV AIDS, erosion of biodiversity and genetic resources, climate change impacts, illiteracy, inequality and unemployment, conflicts and population explosion to mention but a few. To worsen the situation, the technological and innovative capacities needed to reverse these alarming trends are woefully deficient. In many cases it is the poor, particularly women and children who are most vulnerable. They live in environmentally fragile areas, depend on marginal lands, they are exposed to health hazards and natural disasters, they have very little coping capacity, and hardly any assets to fall back upon in times of crisis. As a consequence, Africa is the region most likely to miss the first Millennium Development Goals that aims to reduce by half extreme hunger and poverty by 2015, he said.

According to Prof. Abdulrazak, harnessing new and emerging technologies and innovations becomes imminent if Africa will have a stronger chance to address poverty, disease and environmental destruction. Already, one of the most ambitious strategies in recent years for strengthening science, technology and innovation (STI) in Africa was the adoption of Africa's Science and Technology Consolidated Plan of Action (CPA) for 2008-2013. The CPA was adopted in 2005 by the African Ministerial Council on Science and Technology (AMCOST) as a framework for STI to respond to the socio-economic and environmental challenges facing the continent. It remained the framework for channelling investment into STI in Africa and outlined flagship research and development (R&D) programs in four areas including; biosciences, water; materials science and manufacturing; and information and communication technologies (ICTs). In a *Declaration* adopted by the African Union Summit in Addis Ababa in 2007, the United Nations Educational, Scientific and Cultural Organization (UNESCO) agreed to work closely with the African Union and NEPAD Secretariat in the implementation of the CPA. Nevertheless, seven years after the CPA's adoption, not many progresses have been recorded in harnessing the potentials of emerging STI for sustainable Africa's development. One key impediment that has been identified is the lack of dialogue, collaboration, coordination and harmonization among various initiatives designed to promote science and technology across the continent.

Prof. Abdulrazak further noted that it is against this background that the ATPS drawing from its mandate of improving the quality of STI systems research and policymaking in Africa convened this year's international conference and workshops with stakeholders to map a proactive way forward through which Africa can leapfrog sustainable development by harnessing emerging technologies and innovations. This comes against the backdrop of the United Nations Conference on *Sustainable Development* tagged Rio+20 in Rio de Janeiro, Brazil. Recalling the African Position for Rio+20, the Ministers of African States already noted that the critical foundation for sustainable development lies in good governance, strong and responsive institutions, wealth creation, social equity and equality, poverty eradication and environmental sustainability, as well as sustained progress in the achievement of internationally agreed commitments including the Millennium Development Goals (MDGs). They called on Rio+20 to reinvigorate political will and international commitment to the goals and ideals of sustainable development; adopt concrete measures, supported by adequate means of implementation that would ensure accelerated implementation of sustainable development commitments and urge developed countries to fulfil previous commitments and pledges to help Africa's efforts in achieving sustainable development. Prof. Abdulrazak maintained that African countries will need to take advantage of this global mood and engage

development partners in achieving sustainable development which has been elusive. The ATPS conference serves as a post-Rio+20 African response activity/platform for African member states, developed countries and other development agencies to make real their commitments in realizing sustainable development for Africa. He expressed optimism on the expected outcomes from the conference noting that delegates have been drawn from regional bodies in Africa including the AU, regional economic commissions (SADC, ECOWAS, COMESA, etc); the United Nations organizations (UNECA, UNESCO, UNIDO, UNEP, etc); African national governments; researchers; private sector actors; civil society actors; and other partners from both developed and developing countries.

“It is my belief that at the end of this conference and workshops we would have charted a better course towards ensuring Africa’s transition to low carbon development pathways, improved governance of STI through genetics, biotechnology, nanotechnology and indigenous knowledge systems, improved institutional structures and social innovations for sustainable development; youth and gender empowerment, and reforms in higher education that embrace trans-disciplinarity and systems thinking” he remarked.

Once more, he welcomed delegates to the 2012 ATPS annual conference and workshops and encouraged them to utilize the opportunity of the multidisciplinary, multicultural and empirical experiences of delegates for this year’s conference to form new alliances in research, policy and practice for overall Africa’s sustainable development. Prof. Abdulrazak concluded by encouraging delegates to explore the cultural richness of Ethiopia by taking out time to visit historic and monumental places. He also thanked the ATPS Secretariat for organizing yet another wonderful conference and workshops and wished delegates a happy and a fruitful stay.

2.5 Remarks by Representatives of the ATPS Consortium of Development Partners

2.5.1 Rockefeller Foundation

Mr. C. D. Glin, Associate Director, Rockefeller Foundation, Nairobi, Kenya

Mr. Glin thanked the ATPS for inviting the Rockefeller Foundation (RF) to its 2012 annual conference and workshops. He noted that the Foundation has been committed towards promoting the wellbeing of humanity throughout the world since its inception in 1913 and this has remained unchanged. Next year 2013 the Foundation will be celebrating its feat being the first global philanthropy of its kinds.

Mr. Glin further remarked that the mission of RF is applied to an era of rapid globalization. According to him, “Our vision is that this century will be one in which globalization's benefits are more widely shared and its challenges are more easily weathered”. To realize this vision, the Foundation seeks to achieve two fundamental goals. First, we seek to build resilience that enhances individual, community and institutional capacity to survive, adapt, and grow in the face of acute crises and chronic stresses. Second, we seek to promote growth with equity in which the poor and vulnerable have more access to opportunities that improve their lives

In order to achieve these goals, Mr. Glin maintained that the Foundation constructs its work into time-bound initiatives that have defined its objectives and strategies for impact. These initiatives address challenges that lie either within or at the intersections of five issue areas which include: basic survival safeguards, global health, environment and climate change, food, security, market access, social and economic security, and sustainable development. He noted that innovation has also been a key driver in the Foundation's mission and vision.

He pointed out the several strategic principles that guide the Foundation's work which include; the mobilization of systemic transformations by integrating policy, financial, social, and technological solutions; testing pilot projects, spin them off, or join others to help implement successful demonstrations on a wider scale; informing public policy through support for research, advocacy and coalition-building; taking advantage of tipping points and break bottlenecks that are impeding progress and seeking to create an enabling environment for our work by fostering innovation, convening partnerships and building networks. In particular, he noted that RF approach focuses to help social sectors through research in the way organizations apply innovations, build skills for leaders who seek to increase innovative capacity, encouraging collaborations and linkages amongst the leading sectors in development and promoting innovation systems for social impacts and wider adoption.

Mr. Glin further remarked that RF is glad to have supported ATPS in particular for the 2012 annual conference and workshops and they look forward to the final outcomes emanating from this exercise and hope that the emerging paradigms, technologies and innovations discussions will contribute to Africa's sustainable development. He wished the delegates a fruitful deliberation during the conference

2.5.2 Woodrow Wilson Centre

Mr. Steve McDonald

Mr. McDonald, The Consulting Director, Woodrow Wilson International Center for Scholars Africa Program, was represented by Ms. Alyson Lyons who thanked ATPS for inviting them to the 2012 annual conference and workshops. The Woodrow centre's main goal is to bridge the gap between policy, practice and academia. This is achieved through dialogue and scholarship. The African program and leadership project promotes this objective in several ways in Africa including programs on peace building, economic growth, development, climate change adaption and resilience, youth and emerging leadership in Africa, food security, environmental sustainability and more recently science, technology and innovation (STI).

As part of a joint initiative that started about a year and half ago, the Africa Program and Leadership Project at the Wilson Center held a 3-day meeting series that featured prominent African scholars titled, "Southern Voices in the Northern Policy Debate: African Perspectives." This conference series was the third activity aimed at providing the opportunity for African voices to present their policy research on an international policy issue of their choice to a U.S. policy audience. The Southern Voices Initiative will not only elevate African perspectives on serious issues, but it will also serve to create a network of African think tanks and research institutions both with each other and their US counterparts that will help them keep their voices heard. Twelve (12) African institutions representing about 20 countries participated in the conference. ATPS as an organization and Prof. Kevin Uruma and Prof Turner Isoun representing the ATPS participated in the conference. Their participation was important as they led the discussion on STI development in Africa. The conference culminated in a presentation of six joint research policy papers in Washington DC which shall be presented to a USA policy audience. According to him, "This initiative will continue to expand in the coming years with a selection of one representative from each of the Southern Voices Organizations who are members. The ATPS has been and continues to be a valued partner in this initiative and we look forward to working together in the future".

2.5.3 H.E. Mukhtar Abdul Kareim Adam Bormah,

State Minister for Environment, Forestry and Physical Development, Sudan

In his opening remarks, H.E. Mukhtar Abdul Kareim Adam Bormah thanked ATPS Secretariat, The Ethiopian National Chapter of ATPS, The African Union Commission and other ATPS partners for organizing and hosting the 2012 ATPS annual conference and workshops. He recalled the occasion of the launching of the ATPS Sudan Chapter which he participated in early 2012 and which was very encouraging for Sudan. He reminded delegates of the need for implementation of decisions reached in this type of conference and charged them to implement such decisions accordingly in order to ensure sustainable development. As the Minister of State for Environment, Forestry and Physical Development in Sudan he expressed interest particularly in collaborating with the ATPS on environmental issues that will promote sustainable development in Sudan and in Africa. He wished delegates a successful deliberation during the meeting.

2.5.4 Opening Keynote Address: The Fragility of the Recent Africa's Growth and the Opportunity for Creating Jobs through a New Technology and Industrial Policy

Prof. Osita Ogbu



Prof. Ogbu thanked ATPS and the Executive Director Prof. Kevin Urama for inviting him to give the keynote address to the 2012 ATPS Annual Conference and Workshops. He noted that Prof. Urama has taken ATPS to a new height since he (Prof. Ogbu) left the organization as an Executive Director. He maintained that he is very proud to be associated with the ATPS.

He went further to deliver his keynote paper and emphasized that there is currently a celebratory tone about Africa's recent growth and continued prospects noting that Africa's growth if not driven by a diversified production structure, essentially by growth in manufacturing, it would deliver lots of quality jobs and raise incomes; it would also remain trepid, fragile and susceptible to negative shocks. He pointed out that there is an emerging consensus on a new industrial and technology policy regime that, if well-crafted, contextualized and implemented, could stimulate greater manufacturing in Africa and lead to structural change. The RIO+20 agenda affirms this and calls for genuine partnerships in Africa with respect to technology transfer; it underscores the need for growth with quality employment and strategic strengthening of capacities and institutions in Africa.

According to Prof. Ogbu, historically, industrial policy in various shades has always been used by every nation to climb the industrialization ladder. Unfortunately, Africa's initial attempts were not very successful. Rather than re-strategize, Africa and those advising Africa abandoned this strategy completely in spite of its being responsible for the basic industrial structure that currently exist. There is now a greater opportunity for African governments and the organized private sector to work together to address the problems that have hindered the emergence of a dynamic manufacturing sector in Africa. These opportunities include the emerging consensus in industrial policy, the rising cost of production in China, the "youth bulge" in Africa and the existence of basic manufacturing hubs. Can Africa exploit this policy space and new opportunities? He asked.

Africa's fragile growth and its discontent

Prof. Ogbu reported that in the December edition, the Economist ran a cover story, "Africa rising", detailing Africa's growth performance. It reported that "at least a dozen African countries have expanded by more than 6% a year for six or more years". Inflation is down and average per capita income is also rising, telephone penetration is increasing and there is relative political stability according to the report. These are all good news. The Economist concludes that "Africa's growth is underpinned by a permanent shift in expectation" and quotes an African Development Bank's executive who characterized the "boom" as representing a "structural change." But there is danger in the untold half of the story, he retorted.

Africa's growth is still very fragile. In spite of the impressive growth rates, Africa's economic transformation has not occurred, and any talk of structural shift is not backed by evidence. No doubt, Africa's growth is driven by rising commodity prices. Low productivity agriculture dominates the economy, with yields way below international standards. Increases

in output are from intensification, bringing more land under cultivation (with serious ecological consequences) rather than intensification that would require the application of appropriate technologies. Sub-Sahara Africa fertilizer consumption per hectare is 11kg compared to South Asia (148kg), World (119kg). Exports are still dominated by primary commodities and minerals. Primary commodity export is 90% of all exports from sub-Sahara Africa (excluding South Africa); and Africa's share of global manufacturing export is 0.5%.

Nigeria is one of the countries that have been growing at an average of 6% in the last six years. This growth is driven, in part, by rising oil prices that is fuelling retail trade and communication with limited opportunity for only skilled workers. Nigeria's manufacturing sector's contribution to her GDP is only 4%. Other similarly growing African countries exhibit similar low manufacturing contribution to GDP: Kenya (11.5); Ghana (8.5); Botswana (3.6); Tanzania (6.9); Senegal (13.9); Ethiopia (5.3); Rwanda (8.5) and Cameroon (18.1) and Mauritius (19.1) (World Bank, 2008). Compare that to the significance of the manufacturing sector in emerging economies where structural change is occurring: Brazil (20); China (34); Malaysia (30); Thailand (35); and Indonesia (28). Africa's commodity boom has also turned into import boom with Africa importing basic manufacture that it should produce, rather than use the foreign exchange she earns to import technology and acquire skills necessary for the structural change. Nigeria spends about US\$8 million daily importing food. That is the other side of the story and this is not an "economy build to last" he remarked.

The new opportunity for industrial policy in Africa and historical antecedents

A new vista of opportunity now exists for Africa to re-engineer its industrial base. First, the emergence of a policy space arising from the writing and utterances of political leaders and scholars around the world who are now embracing the partnership between the state and the market as necessary for re-engineering growth with jobs in what can be characterized as a forceful support for and return of open industrial policy. Second, the rising commodity and mineral prices which provide the foreign exchange and revenue that would be used to source technology, capital goods and equipment as well as to offer "smart subsidies" that are market friendly. Third, the seemingly declining Chinese competitiveness in the lower-end manufacturing opens up additional opportunity for Africa to exploit. Fourth Manufacturing is critical for sustained the possible renewal of AGOA with export opportunities into the USA market if supply constraints can be overcome.

The use of industrial policy to engineer industrialization is not new. That the industrialized economies of the West are returning to it more forcefully in order to create jobs at home, in a dialogue that mixes patriotism with state support, may be new. Otherwise, almost all countries have used industrial policies to engineer structural shift in their economy and to industrialize, moving up the ladder from traditional low productivity agriculture to higher productivity manufacturing and services (Chang, 2002).

The environment to some extent presents both a challenge and an opportunity; the opportunity of technological adaptation as a result of the "tipping point" of Chinese lower-end manufacturing as well as the challenge of putting in place the necessary building blocks for a successful manufacturing sector. Both India and China present Africa with huge lessons on what works and how to avoid the pitfalls of the past. Interestingly, whether it is in the use of smart subsidies, building domestic skills and technological capability, enforcing domestic

content requirements, work ethics, maintaining macroeconomic stability or the return or use of Diaspora, Africa has a lot to learn from China and India. So how do we move from made in China to made in Kenya, Nigeria, Senegal, Ghana or Tanzania? He retorted.

Why Manufacturing?

Inclusive growth, innovation and creation of quality jobs. Hence, Africa's structural shift will come from rapid growth in the manufacturing sector. Youth unemployment problem in Africa is so severe: up to 30% in many countries. Understandably, the discourse in Africa tends to focus on the unemployment of university graduates, underscoring the hopelessness of the situation. Africa also needs growth that can address the growing inequality in the African economies that lead to youth restiveness and insecurity. The manufacturing sector that employs both skilled and unskilled labour can provide the platform for resolving these issues. Writing on India's new industrial policy, Niranjana Rajadhyaksha (2012) noted that "the Asian experience tells us that no country can banish mass poverty unless it creates millions of new jobs a year in manufacturing and services". After interviewing an Executive of the respected Indian Planning Commission, he concludes that "the goal of the new India's industrial policy is jobs".

Several empirical studies have shown manufacturing to be an important source of growth for developing countries. Growth in the manufacturing sector occurs when entrepreneurs increase their demand for innovation. Quite often, to increase this demand requires direct government actions. Prof Ogbu reflected on a recent article on manufacturing policy, in the Time Magazine, where Fareed Zakaria (2012) quoted an American CEO who is advocating government support for industry as saying that "innovation doesn't just happen in laboratories by researchers, it happens on the factory floor." According to Prof. Ogbu, what happens in the laboratories are inventions, it is the factory and the market that confer the innovation status to those inventions. How can the inventions be moved rapidly to the factory floors in order to address Africa's urgent need for job? He asked. The government can facilitate this through a robust industrial policy, he concluded. The technological opportunities that now exist for low-end manufacturing means that Africa can leapfrog in order to innovate. Growth is important, but the drivers, the sources, of this growth are equally important.

It is in manufacturing that innovation and skills and knowledge transfer take place and from where Africa can learn to compete. It is the sector most likely to witness diffusion of knowledge through unrestricted labour.

Turnover in the absence of enforceable formal labour contracts; further increasing these positive externalities that call for government actions. It is the sector with dynamic economies of scale with forward and backward linkages. Manufacturing also lends itself to clustering, bringing entrepreneurs engaged in similar activities together with co-location activities that reduce transaction costs and costs of government support. In Africa, these clusters usually set up trade associations that become the institutions for collective promotion and for engaging the governments.

The manufacturing clusters as entry points

The manufacturing clusters that have emerged almost informally represent an entry point for active government intervention emphasizing that this intervention should take the form of

innovative, creative support. He suggested that the first thing to do is to coordinate scarce assets or investment in assets around existing manufacturing or “innovation” hubs or clusters. Dealing with existing hubs bypasses the policy action of choosing winners that may be fraught with imperfect information, politics and rent seeking. In Nigeria, for instance, these hubs would be in motor spare parts, textile, leather and leather products, computer and computer accessories assembly and furniture. And for the future, in fruit and cassava processing, rice milling etc. The spare parts hub emerged as a result of trading relationship with the East Asian countries and a technological relationship that allowed the initial entrepreneurs to acquire and adapt “old” technologies as the manufacturers in East Asia, especially Taiwan, upgraded theirs (Oyelaran-Oyeyinka, 1997). All of these clusters are engaged in some limited exports to other African countries, through mostly informal trade, but their products are clearly import substitutes. In essence, Prof. Ogbu emphasized that the type of enterprises he is describing are those whose owners have demonstrated willingness to take risks with “great social value” and have, therefore, already invested in what Hausman and Rodrick call “self-discovery” (Hausman and Rodrick, 2004

Prof Ogbu identified the following reasons as being responsible:

- Manufacturing-focused industrial policy makes sense
- Potential for rapid job creation
- To consolidate the transition from trading (original business) to manufacturing (the new business) – without Industrial Policy support, trading is often more lucrative
- To induce the transition from informal to formal manufacturing
- Although they have overcome initial information difficulties and have “self-discovered”, the firms in the clusters are not able to reap the rent because of “imitative entry” and many do go out of business
- Without rent, technological upgrading and related investments could become unprofitable
- Entry costs are also usually high
- Proximity between economic actors with significant agglomeration externalities
- Potential for technology diffusion and learning
- The scale of production activities of each entrepreneur does not allow for optimal investment in technology
- Information asymmetries between firms
- Risks and uncertainty are high
- Potential for latent competitive advantage and growth efficiency
- Low acquisition of technological capability which is usually cluster (industry) specific
- Dependence on informal learning
- Need to codify knowledge
- Poor standards and poor marketing information
- To encourage domestic competition
- To resolve coordination failure that are usually industry specific.

Elements of the new technology and industrial policy

The new industrial policy is unlike the old. Key elements of this policy are fundamental: training of skilled workers especially in science and engineering, supporting innovation and using public resources to develop technologies that industries use. This requires a different approach. This skills building and training should be directed at resolving problems that the private sector have identified. In other words, greater priority would be given to training and skills up-grading targeted at resolving manufacturing cluster specific problems. One advantage of this approach is that it forces the training to be practical with high returns on its investment- those trained are problem solvers engaged in improving the productivity and profitability of specific manufacturing activity; and have the advantage of quickly improving the capacity of these firms to absorb additional labour. In other words, firm-level activities should dictate the curriculum of polytechnic and vocational education.

The advantage of this formal training is that it would very quickly replace the pervasive informal apprenticeship system that exists in the many of the manufacturing clusters and crafts production centres in Africa, where the “masters” skills are transferred to the apprentice in a loose contractual agreement. The apprentice pays for his informal schooling with his service over a number of years and hopes that the master would not only train him but would also provide him with an initial grant to take-off on his own. This process according to Prof. Ogbu has been very useful, but the limits are now very obvious. In particular, the informal learning allows for the conversion of tacit knowledge to tacit knowledge, denying the system the opportunity which codified knowledge represents– the relative ease of transfer, adaptability and improvement (Oyelaran-Oyeyinka, 2006). Formal training is therefore required to augment tacit knowledge for “externalization of knowledge”, formalization and enterprise growth. A second set of capacity building would be targeted at unlocking the latent comparative advantage and would be, more or less, opportunistic.

The government can also supply skills and subsidize formal employment through the Industrial Training Funds that already exist in many countries. Or in the case of Nigeria, through a National Youth Service Scheme that has graduates of University or Polytechnics doing one year national service in various public and private establishments. This scheme is currently searching for a strategic purpose. One key economic reason why the government should provide some form of subsidy or support for these firms is to compensate them for the social gains arising from their entrepreneurship. This social gain arises, in part, from their willingness to transfer their knowledge to others who are likely future competitors through the internship or apprenticeship process, culminating in what Rodrik (2007) characterized as “imitative entry”. And there is plenty of that in Africa. Most, if not all, are not able to patent any of their innovations; in part because there is no policy appetite for recognizing such innovations and enforcing their patents in Africa.

Other forms of training and extension services can be used to extend the benefits of new discovery to the entrepreneurs. Such new knowledge can come from publicly funded R&D or through government negotiated technical transfer agreements with established businesses or owners of such technology or technological capability from outside the country. Some of the more modern, very expensive equipment’s can be bought by the government and made available for use at a subsidized fee for the clusters. In any case, it is important that the government is able to synchronize its intervention with the needs of the entrepreneurs,

beyond that which they are, verifiably, unable to provide profitably by themselves. This partnership would not only improve the quality of the output of these firms, it provides the infrastructure for learning how to compete, improves industry growth as employee graduates to become entrepreneurs, and reduces entry costs. But there has to be performance requirements. Administering performance requirements presents another challenge due to the potential of bureaucratic capture. But adequate safeguards can be put in place and appropriate incentives used to reward and punish participants, both the private sector operators and public sector administrators.

The State as a Venture Capitalist

The other instrument available for governments is to act as a Venture Capitalist and to provide investment guarantees. There are no venture capitalists in Africa, creating a vacuum in one of the vital instruments for economic diversification, for opportunistic innovative investments, for defining a new technological trajectory and basically for defying a nation's static comparative advantage. If we can create funds to bail-out banks, we can certainly create funds to chart a new course in our manufacturing sector, a new course that allows Africa to climb the industrial and technological ladder and to create decent jobs; Africa can operate at both ends of the ladder just as Brazil and China are currently doing. According to Prof. Ogbu, Venture capital is particularly important for capital intensive, technological firms with product innovation risks that would not initially attract support from commercial banks (Lin, 2012). But governments acting with clear vision, in the best interest of the nation, can create a vehicle for equity participation in firms that advance the technological frontier of the nation provided the right incentives and adequate safeguards are put in place. In the least, this fund can fund research that directly reduces the cost and risks associated with first discovery and first entry.

In implementing this suggestion, only the best ideas or projects with high commercial potential should benefit. This is where our high sense of nationalism would be tested because this national fund would be to further Africa's development at all level, including through facilitating the transfer of technology needed by African countries as mutually agreed."¹ Africa's transformation and strategic response to RIO+20 would depend on the lessons learned from the emerging economies, in devoting significant assets in generating, adapting and mastering certain key technologies that allows her to control the value chain of her natural resources.

3. Keynote Address: Emerging Paradigms, Technologies and Innovations for Sustainable Development in East African Countries

Prof. Margaret Kamar, Hon. Minister for Higher Education, Science and Technology, Republic of Kenya



In her keynote address, Prof. Margaret Kamar, represented by Prof. Vasey Mwaja expressed delight in joining ATPS network to share experiences on the emerging paradigms, technologies and innovations for sustainable development in East African countries. She thanked all the organizers of the conference and workshop and expressed joy on the honor given her to present a keynote speech. She congratulated all the Africans and friends of Africa present in the conference stressing that it is an indication of expectations on the important role that science, technology and innovation (STI) can play in Africa's development.

According to her, Africa has over the years been considered a victim of emerging paradigms related to suffering such as uncontrolled population growth, disappearing environmental assets due to climate change, emerging diseases, hunger and absolute poverty in some pockets of the continent. The African countries have also continued to face the protectionist barriers placed by the industrialized countries on their goods. These barriers have continued to undermine the potential benefits of international trade for developing countries and have also raised major questions on the types of technologies and industrial adjustments that need to be introduced in Africa in order to compete favourably on the international market. As a result of this observation, the African leaders need to note that the critical foundation for sustainable development must address issues of global governance, emphasize on pro-poor wealth creation strategies, poverty alleviation and environmental sustainability. The answer lies with the application of science, technology and innovation for sustainable development.

All over the world, STI are recognized as highly essential for the economic transformation, growth and competitiveness and meaningful employment. They are also considered as key components of social integration, sustainable development and poverty reduction. Indeed it is recognized that effective leverage of STI is essential for wealth creation in all nations of this world.

Under the current global social, economic and environmental challenges of population growth, resource constraints, climate change and biodiversity loss, Africa cannot afford to remain a passive consumer of knowledge, technologies and innovation. There is need for Africa to take active part in developing and applying STI to achieve sustainable development and growth. The STI sector should seek to integrate knowledge into all production systems in Africa as a whole and at the country levels. The focus should be laid on attainment of sustainable growth and societal development, while realizing a safe, full and high-quality life for citizens as the guiding principles. The involvement of STI should emphasize on strategies that enable collective action not only within the communities but with special reference to specific needs of a country.

The Hon. Minister pointed out that global bench marking is important for Africa because technological developments taking place in world laboratories have a direct impact in determining the fate of human existence within national economies worldwide. Therefore, as

the developed countries push their STI frontiers further and further into areas such as space science, microchips, fiber-optics and other emerging technologies, Africa should not wait to be surprised with the emerging developments at the expense of their citizens' welfare and wellbeing.

The African continent should therefore take advantage of huge opportunities that exist for home grown development even if it may mean tapping, adapting and application of scientific advances made elsewhere. This may involve sourcing and transferring appropriate technologies from elsewhere in the short run especially in some of the hi-tech areas in which the continent may not be able to develop capacity in the near future. According to Prof. Kamar, some of the areas that may need a closer consideration in prioritization of STI application for sustainable development include:

Transition to low carbon development pathways for sustainable development

The developing economies are increasingly becoming sources of global economic growth that is accompanied by fast population growth that demands more intensive use of natural resources which leads to growing emissions. The potential economic and social impacts of environmental degradation are particularly serious for developing countries given their dependence on natural resources for economic growth and their vulnerability to energy, food, water security, climate change and extreme weather risks. The ST&I efforts for sustainability should address issues that revolve around the land-water-energy axis, including such issues as resource-efficient production, water access for productive uses, threats to food security, and bio-fuels as well as the move towards a global low-carbon world by promoting energy efficiency and renewable energy production technologies.

Green growth technologies are where the challenges of natural resource exploitation and management meet. Green growth offers an optimistic, realistic alternative to countries looking for new sources of growth that make economic, environmental and social sense when applied with high levels of innovation. Research has shown that green growth offers more sustainable and inclusive growth that enhances productivity and reduces negative unpredictable shocks to economic growth. Green growth plays a critical role by ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies.

The easiest way of ensuring worldwide green growth is to develop a vibrant knowledge sharing system that helps foster innovation and building of competencies by encouraging the free flow of ideas, knowledge and innovations. The various modes of multi-disciplinary and multi-sectoral cooperation enable various actors to attain valuable knowledge and skills beyond their own boundaries and thus enlarge their capabilities and enhance their assets through participation by multiple communities. The Global Knowledge Initiative's programs should focus on locating critical resources, building the capacity of people and institutions to make the most of opportunities to collaborate and The easiest way of ensuring worldwide green growth is to develop a vibrant knowledge sharing system that helps foster innovation and building of competencies by encouraging the free flow of ideas, knowledge and innovations. The various modes of multi-disciplinary and multi-sectoral cooperation enable various actors to attain valuable knowledge and skills beyond their own boundaries and thus enlarge their capabilities and enhance their assets through participation by multiple communities. The Global Knowledge Initiative's programs should focus on locating critical

resources, building the capacity of people and institutions to make the most of opportunities to collaborate and connect people, resources, and institutions together in partnerships that work to generate new knowledge or transfer it from where it is to where it is needed.

The Hon. Minister concluded that one area of concern for Africa is of the characteristically weak environmental laws at the countries and continent level. There is need to develop effective and uniform environmental laws under the auspice of the African Union to support environmental sustainability in the continent. Such laws should empower the communities so they can play a more active role in ensuring sustainability and resilience. The laws should be made to support the generation of creativity, tap on the potential of the human population and ensure removal of barriers to equality between women and men. This will encourage and give everyone the full power to make their own decisions and realize their full potential towards the realization of sustainability.

Governance Support for Utilization of Emerging Science, Technology and Innovation Areas

The scope of science, technology and innovation is wide with enormous challenges. In view of this, research and development priorities must be clearly set based on the expected impact on sustainable economic development in terms of the range of application in relation to the costs involved. The emerging ST&I areas such as biotechnologies, nanotechnologies and the application of indigenous knowledge have proved capable of providing the advantages mentioned above if applied in a regulated manner through appropriate governance structures. This is because technologies are known to be like a double edged sword that can make or destroy. Emphasis should be put on regulations that ensure appropriate application of these technologies, ensure protection of the intellectual properties and provide subsidy or some form of support to home grown basic research

However, in developing countries especially in Africa, there is inadequate ability to generate new knowledge and very little basic research and development in the private sector because of small sized home grown companies which have little motivation for research and development (R&D). The situation is worsened by the fact that most of the technologies that firms in developing countries import and use are likely not to be the latest because of the costs involved due to stringent patent laws in source countries which in most cases are the developed countries.

This has made the developing countries to always remain behind in the global technology updates. This calls for urgent regulatory and governance strategies both at the national and institutional levels to provide for interventions that are flexible enough in applications if the continent is to make use of home-made and more advanced imported technologies generated from emerging areas. The policies should place emphasis on support for the development of technological knowledge and capabilities of individuals through education and training and development of firms through provision of support on trade protection, subsidies, effective IPR protection and public procurement support strategies.

Additionally, special reference should be made to small and medium size enterprises (SMEs) to support the commercialization of home grown innovations in the local and international markets. This can be done by ensuring that the policies put in place support commercialization of enterprises through development of relevant innovations that go

through the development process successfully the support for the incubation process through Public private partnerships is equally important and cannot be avoided

Youth and gender discrepancy in science technology and innovation especially in developing countries has prevailed for quite a long time. As a resolution, emphasis on gender parity in ST&I has been recommended in several national, regional and international forum and from these meetings, initiatives have been drawn to consolidate plans of action. Despite this, the gender mainstreaming is still far from the target stipulated in these plans of action.

One possible cause for this status could be the fact that when these initiatives are generally put down in the plans of action at international level, they appear to be too wide and therefore the need to have focused small groups to make implementation a reality. The fact that this has been realized as a challenge requires partnership activities which support national governments in implementing the recommendations to provide support and advice for mainstreaming gender concerns in STI for development. It is my sincere hope that the wide range of national and regional stakeholders will support the gender mainstreaming in STI work towards national and regional policy formulation efforts.

Mainstreaming Trans disciplinarity in STI and Higher Education

Africa lags behind in skills and competencies required to fully benefit from global STI paradigms for its development mainly because Africa lacks a home grown development agenda that can inspire the developed world. Based on this observation, Africa needs to develop its STI capacities as well as build knowledge institutions, knowledge systems and structures that support capacity building and skills-based development.

The easiest approach for ensuring this is to build transcontinental knowledge circulation networks supported through a vibrant knowledge sharing system that foster innovation and building of competencies and encouragement of free flow of ideas, knowledge and innovations. The various modes of multi-disciplinary and multi-sectoral cooperation people and institutions to make the most of opportunities to collaborate and connect people, resources, and institutions together in partnerships that work to generate new knowledge or transfer it from where it is to where it is needed.

Lessons from Kenyan Experiences

Sharing the Kenyan experience, the Hon. Minister reported that the emerging technologies are considered important for sustainable development and are considered in government policies as an opportunity to develop new technologies, create jobs and promote growth in the private sector. The Government of Kenya has initiated a number of policies, institutional and infrastructural reforms in science, technology and innovation that recognize emerging technologies as important drivers for sustainable development. The case in point is the Kenya constitution 2010 and Kenya Vision 2030, the country's long term governance and development blueprint, which, recognizes STI as a key foundation of economic, political and social growth pillars. STI support to these pillars will lead to the creation of new knowledge for wealth creation, social welfare and global economic competitiveness. STI will play a critical role in progressively making Kenya's economy a knowledge-based one. Research institutions will be critical drivers of innovation systems and the resultant developments in STI and application of knowledge especially in biotechnology, value-addition, manufacturing and Information and Communication Technologies (ICT). This will lead to industrial and

entrepreneurial development perspective. STI will be applied to provide solutions that will enhance poverty alleviation as well as resolving human animal conflicts and developing a sustainable tourism industry.

Kenya, through the Ministry of Higher Education, Science and Technology has also developed the STI policy and strategy along the same line to guide the entrenchment of STI into sustainable national development. Through the STI policy, capacity building, institutional and governance restructuring as well as emerging technologies are being supported as important tools for development. Kenya is one of the few African countries that have a biotechnology development policy and a functional National Biotechnology Authority to spearhead the safe application of biotechnology for sustainable national development.

The Hon. Minister reported that the Ministry of Higher Education, Science and Technology, has been actively involved in initiatives and activities that support gender mainstreaming in STI as stipulated in its policy documents and will continue to do so in order to achieve the required parity. Several programmes and projects supported by the Ministry have been spelt out for action. The Ministry is seeking collaboration with interested organizations such as ATPS and UNECA to move the programmes to a higher level of actualization.

In conclusion, the Hon. Minister noted that in order to move Africa's agenda for science, technology and innovation forward, African leaders should lay emphasis jointly and in individual countries to support the following:

- Improvement of infrastructure in the continent;
- Improvement of regional and continental cooperation;
- Creation of policies which facilitate sharing of resources and knowledge;
- Promotion of technological innovation; and
- Uplifting the continent's Gross Domestic Product.

These will provide a more proactive and practical actions in addressing poverty, hunger, energy access, energy security and safety, efficient and sustainable resource use and ecosystem management through sound policies and action plans that are supported by political will and effective collaborations with the developed world. The Hon. Finally wished delegates a fruitful engagement during the conference.

4. Conference Plenary Presentations

4.1 Institutional structures, policies & macro-economic environment in African countries: implications for social innovations and business competitiveness

Prof. Eric c. Eboh



Prof Eboh, started his presentation by noting how economic competitiveness is critical to national and regional growth potential, wealth creation and sustainable prosperity. In spite of the considerable improvements in macroeconomic and growth performances in the past decade, Africa has remained structurally weak, poorly competitive and among the world's poorest and least developed regions. The interplay of better macroeconomic policies, FDI gains, debt relief and favourable commodity prices helped stem the tide of the global economic and financial crisis of 2007-2009. But, growth continued to be stifled by institutional weaknesses, misaligned sector policies coupled with infrastructural shortages, regulatory failures and dysfunctional market mechanisms. He noted, while very few African countries (like Mauritius & South Africa) were making steady progress in the middle bracket of the global competitiveness march, most were lagging in distant bottom positions. Tackling the productivity and competitiveness lags of the continent required getting sector policies right (particularly for agriculture-industry linkages), reining in domestic resource mobilization and making regional and national institutions work to create the critical investments in technological and social innovations. There is a large scope to strike a deliberate balance between 'state and the market' based upon accountable democratic governance, transparent and efficient public spending and human capacity building for private sector development. In addition, there is a compelling case for Africa's paradigm shift in tapping her comparative advantages in agriculture and agro-based industries by effectively deploying regional cooperation/integration, domestic policies and technological, institutional and social innovations. Africa's current circumstances call for a new model of state-market synergy that will have cross-cutting macroeconomic and microeconomic impacts. The synergy would work to promote agriculture-industry linkages, market-oriented value chain development, infrastructure financing, export competitiveness, environmental sustainability and efficient public service delivery.

4.2 Achieving Food Security and Sustainability for 9 Billion

Professor Christopher J. Leaver CBE FRS, Emeritus Professor of Plant Science, University of Oxford



Prof. Leaver in his presentation enlightened the delegates present that during the last 50 years the world population had more than doubled to 7 billion and until recently that the relative abundance of food has kept pace with the poorest benefiting the most, yet more than 1 billion are malnourished and live below the poverty line. This dramatic increase in crop yields was due to a number of innovations which included: genetics and plant breeding (the so called 'Green Revolution'), mechanisation, irrigation, nitrogen fertilisers, and pesticides. Subsequently the developed world became complacent.

There has however been an environmental cost associated with modern high input agriculture and the world has lost 20% of its topsoil due to erosion, desertification and salinity, 20% of our agricultural land due to overgrazing and the generation of marginal land and 33% of our forests. In addition, he noted that we now face the challenges of climate change as a result of massive fossil fuel usage resulting in increased greenhouse gases and carbon dioxide levels, decreased water availability, environmental pollution, loss of biodiversity, urbanization and dietary upgrading (the 'nutritional transition' in China and India), obesity in the developed world and malnutrition and starvation in the developing world.

According to Prof. Lever, the major challenge for the future was to feed a predicted world population of 9 billion by 2050, 80% of whom will live in developing and transition countries with the majority living in an urban environment in mega-cities. Each hectare of land in 2050 will need to feed 5 people compared to just 2 people in 1960. To feed this number food production we will have to increase by at least 70 percent on essentially the same area of land with less available water. This required 'sustainable intensification - growing more from less' by using land and resources more efficiently, with the aim of meeting the current needs while improving the ability of future generations to meet their own needs. In addition we must conserve natural resources and preserve ecosystem function while minimizing adapting to and where possible, reversing the effects of climate changes.

Food security and the need for healthy staple food are no longer just the concerns of developing countries and they have become a global issue. Not even in Europe which is a net food importer. However, in order to address these challenges, the scientific community and colleagues in associated organizations need to be engaged increasingly in strengthening the capacity for research and development and also transferring the results for the benefit of smallholder farmers and their communities in developing countries.

During the last 25 years there has been a revolution in plant science and the skills of the plant breeders have been enhanced by two new technologies, marker assisted plant breeding and genetic modification (GM). These developments have depended on our increasingly detailed understanding of the information content of plant genomes and how cells and organisms function at the molecular, biochemical and physiological level, linked to our ability to use this information to select for, and modify, important agricultural and nutritional traits. He went further ahead to give examples of how it was being applied in the world of agriculture and what will be in the future. The application of these technologies must not only be applied to improving food production in major crops of the developed world but also it should be adapted to improving so called, orphan crops in the developing world in general and Africa in particular by public good plant breeding.

As with many new technologies, people are keen to embrace the benefits but are concerned about the potential risks. In Europe the manner of introduction of these new technologies coupled to a lack of coherent political policy led to loss of community confidence which has been exploited by global pressure groups and activists for their own political ends. This resulted in developing countries by being denied access to the science where it has the potential to contribute to the improvement of food security and help alleviate poverty. GM crops are not a 'silver bullet' and alone cannot solve the global challenges outlined above.

We must evaluate all available technologies and, subject to appropriate and realistic evidence-based, bio-safety regulations and in combination with conventional approaches, deploy those which are most effective and sustainable. This will include sustainable farming practices and appropriate use of agrochemical inputs, wherever possible moving from chemical to biological solutions.

In conclusion, he proposed that these technologies must not only be applied to improving food production in major world crops but also be adapted to improve orphan crops which can address food security and nutrition as well as providing economic benefits to farmers in the developing world. However we must invest now as time is not on our side. Science and its application is not a quick fix and cannot be switched on and off like a tap. While science can provide technological solutions, these have to be implemented in a responsible and fair way for them to have impact. And this is not the job of scientists but of politicians, policy makers, regulators and funding organizations. Now, and in the future, making sure everyone has enough to eat is more than ever about politics, socio-economics, communications and science – it is not just about ‘technology-fixes’ (see www.b4fa.org)

4.3 Is genetic modification to answer to Africa’s food insecurity? Lessons from India

Professor Anupam Varma Emeritus, Indian Agricultural Research Institute, New Delhi – 110012, INDIA



Prof. Varma presentation was on Agriculture which has been practiced in India for thousands of years. During the Indus Valley Civilization period (around 3000 BC) Indian dwarf wheat (*Triticum aestivum* sub-species *sphaerococcum*) was grown. Since that period and the time of independence in 1947, India developed capacity to produce about six million ton of wheat annually. It was not sufficient to meet the demand.

The country had to resort to large scale importation of wheat. For over a decade the country had a ‘ship-to-mouth existence’. Thanks to the visionary political and scientific leadership, agricultural research who were given the top priority for developing agricultural technologies supported by policies and investments in dams and irrigation, human resource development, improving rural infrastructure and services to transform Indian agriculture. The agricultural transformation in India can be best described in the words of Prime Minister, Manmohan Singh: “The country has achieved a new plateau in food-grain production, exceeding 250 million ton during 2011–2012, an all-time record for the country. The production of grain-legumes, which is the main source of proteins in Indian diet, has touched 18 million ton, crossing the barrier of 15 million ton. The country is producing today more milk, more fruits, more vegetables, more sugarcane, more oilseeds and more cotton than ever before.”

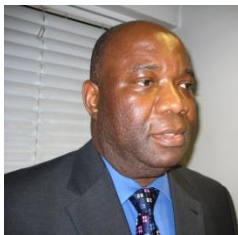
Prof. Varma further added that genetics played a key role in transforming the Indian Agriculture. Initial gains in improving agricultural production came from increase in area under cultivation and irrigation, but the introduction of High Yielding Varieties Programme (HYVP) in 1966 covering important crops like wheat, rice, maize, sorghum and pearl millet ushered the ‘Green Revolution’. Major gains were obtained in the production of wheat and rice. HYVP resulted in increasing production of wheat to nearly 17 million ton in 1968, and

there was no looking back, with wheat and rice production touching 86 and 104 million ton, respectively, in 2011. This remarkable achievement could be achieved through judicious integration of genetic improvement of crops by conventional breeding, improved agronomic practices, natural resource management and plant protection practices. India has also developed about 70 GM crops for resistance to biotic and abiotic stresses, and for improved nutritional value of crops. In 2011, India planted more cotton than any other country, covering 10.6 million hectares. Bt cotton helped in increasing cotton production from 13.6 million bales in 2002 to 35.5 million bales in 2011². However, so far, no food GM crop has been commercialized, as the country is actively debating the bio-safety issues.

While giving his closing remarks Prof. Varma emphasized that Africa's development challenges related to agriculture and food security are similar to those faced by India. Indian experience of integrated multidisciplinary approach supported by proactive policies and political will can help, not only in achieving sustained higher agricultural productivity but also in transforming the region into the world's bread basket.

4.4 Impact of Nanotechnology in Wealth Creation

Emmanuel O.Ezugwu M.sc, ph.D CEng FIET Fellow STYLE MNSE, Professor of Engineering Systems



At the beginning of Mr. Ezugwu's presentation, he gave a brief overview about the last few decades, on how new technology applications have become very central to the process of socioeconomic development of nations. Among them the recent scientific advances is nanotechnology which is attracting the attention of many researchers, investors, and marketers for its enormous potential. Basically, nanotechnology is the creation of functional materials, devices and systems through control of matter on the nanometer length scale (1-100 nanometers), and exploitation of novel phenomena and properties (physical, chemical, biological, mechanical, electrical) at that length scale to produce new structures, materials and devices. This technology promises scientific advancement for many sectors such as medicine, consumer products, energy, materials and manufacturing.

He further added that, nanotechnology commercialization is expected to become a powerful driver of innovation, job and wealth creation in the global economy in the coming decade. He estimated that in 2015, the market in nanotechnology will reach \$1trillion. Nanotech inventions can help fight tropical disease, produce an abundance of food, provide for cleaner water, make the transport of goods easier and cheaper to people in remote areas, and provide clean and cheap energy sources. Consequently, nanotechnology has the potential to dramatically improve the health of citizens and create wealth. Wealth creation involves more than just money: it encompass factors such as enhancement of knowledge, intellectual capital, effective exploitation of resources, preservation of the natural environment, and other factors that may contribute to raising the standard of living and quality of life. His presentation basically aimed at examining the impact of nanotechnology in wealth creation.

4.5 Building the critical mass in Science, Technology and Innovation (STI) capacity in response to emerging needs of Africa: The role of UNESCO

Peggy Oti-Boateng (PhD), Senior Programme Specialist in Science and Technology, UNESCO, Regional Office for Science in Africa, (ROSTA), Nairobi, Kenya



According to Peggy Oti-Boateng, the world's economies are undergoing a fundamental transformation to knowledge-based industries and the capacity of countries to compete in the global market depended more on their ability to innovate, harness their human capital and apply the relevant technology for socio-economic development. Africa has an enormous advantage which include; abundant unexploited natural resources and young population to play an essential role in knowledge-based global economic resurgence, but has not taken advantage of these attributes. The continent is challenged with sprawling urbanization, adverse climate change effects on water, food security, healthcare, limited access to efficient and clean energy and increased youth population in which many girls are denied access to basic education and unable to realize their full potential. These challenges, however, offer opportunities for industrial and socio-economic development of the continent if countries develop robust STI policies and strategies to take advantage of these problems.

She further alluded that the time is now for Africa to invest in her human capital the youth and ensure gender equity if the continent must be competitive. There is an urgent need to develop the critical mass in science, engineering, technology and innovation in response to emerging industrial and socio-economic needs. These include solutions to basic needs, environmental sustainability and harnessing the potential of the youth by empowering them through education and training, skills development and entrepreneurship. UNESCO in partnership with other development partners will facilitate in repositioning Africa in the global village by supporting capacity building in STI Policy in science and technology to enable Africa to innovatively exploit her natural and human capital for sustainable socio-economic development. African Governments on the other hand must create the platform for implementing appropriate policies to accelerate the process. In conclusion, African countries need to respond with policies, programmes, institutions and partnerships which maximize the participation of young people and enhance gender equity.

4.6 A strategic approach to strengthening the African Higher Education and Research Space (AHERS) through institutional national regional and continental collaboration

Alice Sena Lamptey, Senior Program Specialist, PMU –PAU, AUC, Ethiopia



Alice Lamptey informed the delegates during her presentation that, strengthening and sustaining the African higher education and research space is a primary goal of the African Union's strategy for harmonization of higher education, as envisaged in the AU's Plan of Action for the Second Decade of Education for Africa (2006-15) which aims to strengthen the capacity of African higher education institutions, through innovative forms of collaboration and improve quality through academic mobility across the continent. In preparation for the UNESCO 2009 World Conference on Higher

Education (WCHE+10) a Task Force constituted by UNESCO and ADEA identified several strategic orientations for higher education in Africa, one of which was the creation of an African Higher Education and Research Area (AHERS). The WCHE+10 Communiqué in its section on Higher Education in Africa affirmed the need for Africa to develop and strengthen its higher education and research area through institutional, national, regional and continental collaboration. The Steering Committee of the Working Group on Higher Education (WGHE) of the Association for the Development of Education in Africa (ADEA) consequently commissioned an analytical study to explore the concept in order to propose concrete actions to African higher education stakeholders. The higher education and research space in Africa at present suffers from several challenges including disparate systems inherited from Africa's colonial past (Anglophone, Francophone and Lusophone) with some Arab countries in North Africa having their own specific systems. This situation severely handicaps academic mobility of staff and students, particularly on the continent, notwithstanding the fact that African Heads of State, as far back as 18981, had promulgated the Arusha Convention. It is now more urgent than ever for Africa to take strategic steps to strengthen its higher education and research space.

The presentation identified key strategies which include; accelerating the implementation of the Arusha Convention and strategies for harmonization of degree structures to enhance academic mobility particularly within Africa, establishment of an African quality assurance rating mechanism and quality framework, intensifying research and postgraduate training through establishment of regional centre's of excellence, more effective use and integration of information and communication technologies, and promoting open and distance education and life-long learning.

4.7 Role of Science academies in development in Africa

Abegaz, B. M.¹ and B. A., Gyampo, African Academy of Sciences, Nairobi, Kenya



Benjamin Gyampo in his presentation noted that science; technology and innovation (STI) have played critical roles in development of the past and will be even more so in the future. Evidence of Africa's slack in developing its STI potential and strides made by other continents based on investments in STI clearly indicates that the future of development in Africa lies in the effective harnessing, development and use of knowledge in science, technology and innovation. African societies have always depended on their rich indigenous knowledge to cope with challenges they face. However, Higher education and research has not fully embraced this rich indigenous knowledge and has consequently failed to realize the benefits to society that would have accrued by doing so. It is often stated that Science Academies must be close enough to government to work with it but far enough not to lose its ability to think professionally and independently. In the face of competing demands for resources, it is important to recognize that only those investments in science and technology that are based on the best evidence yield the most optimum dividends. Academies must therefore take this challenge in order to position themselves as the most competent bodies to provide such advice. They need to likewise adopt trans-disciplinary approaches to problem solving. Current issues confronting Africa such as climate change and energy cuts across disciplines and African science academies need to bring together the diverse disciplines to bear on these issues. It is unlikely that most African nations will fully meet

Millennium Development Goals (MDGs) by 2015. Continuing the ‘Business as usual’ approach will only result in shifting the dates, resolute commitment with trans-disciplinary platforms are likely to move the continent in the direction of achieving these goals.

In conclusion, he noted that the Academia have important roles to play to mobilize the most talented minds, dialogue with leaders for the right enabling policies and also strive for development of scientifically enlightened community. As Africa develops a science, technology and innovation strategy for the next ten years, Science Academies must provide the needed support and guidance to make it successful

4.8 Youth and Women Empowerment for Sustainable Development In Africa

Prof. Obioma Nwaorgu, Global Health Awareness Research Foundation/ Dept of Parasitology /Entomology UNIZIK Awka



Prof. Nwaorgu narrated on what used to happen in the past forty years where global consciousness of and concern for sustainable development increased enormously in response to the environmental and social problems that have arisen worldwide. The primary objective of sustainable development is to reduce the absolute poverty of the world’s poorest of the poor through provision of lasting and secure livelihoods that minimize resource depletion, environmental degradation, cultural discrimination and social instability. No effort to advance sustainability will succeed if more than half of the world’s population comprising of youths and women are not taken into account. The vital role they both play in the three pillars of sustainable development- economic, social and environment must be acknowledged. There is therefore need for action to unlock their full potential.

She further noted that women who are small holder farmers constitute 70% of Agricultural labor force and provide 80% of food in sub-Saharan Africa, but they are not involve or consulted in policy decisions. Also they earn only 10% income and own 1% of property. Women on the average reinvest up to 90% of their income into their households compared to only 30% to 40% by men. On the other hand, 35% of African people are between ages of 15 to 35 years. This is the age for foundation laying for the future, building corners and planning for family. Many youths in Africa are faced with daunting challenges of achieving their legitimate life objectives. Empowerment of women and youths is therefore critical for sustainable development in Africa. Also to bring lasting peace and sustainable development in African continent, African youths must be empowered. Empowerment of youths and women is a core development objective fundamental for both human right realization and key to effective and sustainable development outcomes.

Empowerment for sustainable development could be accomplished through appropriate credit scheme, support for income generation activities, capacity building for women farmers groups in value added chains, leadership and entrepreneurship trainings, vocational and business services training, information technology and microfinance. Interventions to promote empowerment should also include imaginative and creative use of new technologies and innovations that hold great promise for improving human health and wellbeing. This includes science and technology tools such as internet and cell phones as well as low

technological innovations such as clean cook stoves. All are targeted at improving health, increasing productivity and reducing unpaid labour.

In conclusion, she emphasized that there is urgent need to elevate youth and women's leadership and participation in both economic, social and environmental policy processes and participation at all government levels. This is in view of the fact that these marginalized groups play vital role in the three pillars of sustainable development even though their experiences fail to reach decision makers tables for informed policy making. Investment in science, technology, engineering and mathematics (STEM) including environmental science should identify barriers and developing opportunities for women and youths through mentoring would help in advancing sustainable development.

Discussions

Comment: A delegate expressed worry that Africa is not a homogenous state and hence will not have a one size fits all approach. He noted that the problem with STI development is mainly on poor governance and leadership. He observed that there are existing capacity in-house though are not utilized effectively

Comment: A delegate called for the transformation of the National System of Innovation (NSI) into a global system of innovation because of the existence of numerous platforms and networks. But the challenge is on, who owns the intellectual property rights of innovations brought about by nationals of different countries?

Comment: because of the challenge of the growing population of African youths in the continent, a delegate called for governments to ‘reset’ their policy agenda towards promoting inclusive and sustainable growth strategies aimed at addressing the special needs of the youths.

Question/comment: How can innovation happen in the manufacturing sector? How can Africa encourage research led innovations?

Ans: Government must assist by creating enabling policies to enable manufacturing thrive. There is need for policies to suppress the takeover of Africa by foreign businesses as it does not encourage local innovation. There is also need for the integration of entrepreneurship education into the curriculum at the different educational levels. R&D should also be encouraged to take place in the manufacturing sector.

Ans: Improving governance of STI will lead to sustainable development in Africa. Such governance will produce policies that will support local manufacturing, knowledge and innovation.

Ans: Innovative companies that have thrived have close links with the local knowledge

5. Parallel Sessions

The parallel sessions comprised of presentations from delegates along the line of the subthemes of the conference. Submissions were received from delegates in response to the Call for Conference papers circulated by the ATPS earlier. These papers were peer reviewed and recommended for presentation at the conference thus forming the basis of the four parallel sessions for papers presented that included:

Session One: Comprised of papers on transition to low carbon development Pathways and the implications for sustainable development in Africa (subtheme 1)

Session Two: Comprised of papers on governance of Science, Technologies and Innovation including Genetics for Farming, Biotechnologies, Nanotechnologies and Indigenous Knowledge Systems (subtheme 2)

Session Three: Comprised of papers on Youth Gender and Empowerment for sustainable development in Africa. (Subtheme 3)

Session Four: Comprised of papers under the sub themes-Mainstreaming Trans-disciplinary in STI in Higher Education (subtheme 4) and Institutional structures and social Innovations for sustainable development in Africa (subtheme 5)

5.1 Parallel Session One

The session was chaired by Prof. Lynn Mytelka, a Professorial Fellow, UNU-MERIT, Maastricht and Distinguished Research Professor from Charlton University Ottawa, Canada. The session focused on subtheme 1 which dealt with the transition to low Carbon Development Pathways and the implications for sustainable development in Africa. The papers presented under this subtheme were presented as follows:

5.1.1 Pro-poor, low carbon development: Improving low carbon energy access and development benefits in IDCS

Dr. Robert Byrne, Research fellow, SPRU (Science and Technology Policy Research) and STEPS centre, University of Sussex



Dr Byrne underscored the importance of access to modern energy services to human development as a priority and which can be transformative to the livelihoods of poor people. A tension is sometimes perceived between increasing energy access *and pursuing low carbon development*. *High carbon, conventional energy options are often viewed as cheaper* and hence easier for poor countries to pursue. However, multiple synergies potentially exist between human and economic development priorities, and access to low carbon energy technologies. Renewable energy can facilitate access in areas where grid based access is prohibitively expensive and unreliable, energy efficient technologies can improve availability of energy services, such as lighting and heat, and a combination of the two can increase local and national energy security and economic resilience by reducing exposure to the price fluctuations and political constraints of fossil-based energy provision.

However, existing policy mechanisms that are intended to facilitate low carbon technology deployment in developing countries – such as the Clean Development Mechanism (CDM) – have had mixed results, and especially little impact in Africa. We argue that this low impact is in part due to a tendency to frame low carbon energy access in developing countries around the notion of low carbon technology transfer, where technology is understood in a narrow sense as hardware. This narrow understanding steer's policy towards financing the incremental costs of low carbon hardware, such as can be seen in the CDM. Whilst hardware is clearly important, these financing mechanisms have led to an uneven distribution of investment, both technologically and geographically, with the poorest nations benefiting least, if at all. The majority of support is concentrated towards rapidly emerging economies, where financing environments are already attractive. The technologies funded tend to be low risk or mature, and mostly relate to large project based initiatives that are less likely to attend to the needs of poorer communities.

Building insights from innovation studies and socio-technical analytical approaches, suggested that sustainable deployment of low carbon technologies will depend on policies and actions that foster both hardware and knowledge flows. Moreover, knowledge flows are central to building local innovation capabilities: the capabilities to adopt, adapt, develop, deploy and operate low carbon technologies effectively within specific contexts. But the existing innovation capabilities in any specific context also matter if technologies are to be successfully absorbed in the first place. Given this interdependent relationship, it is critical to the sustainable development of poorer countries that low carbon innovation systems are built along with the deployment of low carbon technologies.

He noted during his closing marks that emerging policy initiatives such as Climate Innovation Centers (CICs) offer the potential to implement such thinking, assuming they do not fall prey to the hardware-and-finance framing evident in the CDM.

5.1.2 Financing Access to Sustainable Energy for the poor in Nigeria: The Public Finance Option

Chidiebere Ibe, Institute for Public Policy Analysis and Management (IPPAM), Nigeria

According to The International Energy Agency (IAE), energy access is at three levels which include; access to basic human needs, productive uses, and modern society needs (Mainhardt-Gibbs et al, 2010). Electricity for lighting, health services, education, communication, and community services that require about 50-100KWh of electricity per person per year are the basic needs for the poor. In addition to the basic ones, the poor demands modern fuel technologies for cooking and heating, and this requires about 50-100Kg of modern fuel or advanced biomass stove. Arguably lack of access and inability of the poor to basic energy needs coerced the poor to look for destructive and unhealthy use of biomass which directly has an adverse impact on environment. Therefore, there should be options for the poor get access to basic and sustainable energy sources that include financing by government, private sector and the international development partners.

His presentation explored the public finance option for enhancing access of the poor to sustainable bio-mass energy technology in Nigeria in a manner that improved their livelihoods as well as reduce their carbon footprints. His presentation also attempted to answer the five key questions which include; What constraints do the poor have in accessing adequate energy? What roles can governments play in avoiding such barriers? What policies and strategies are required for effective government intervention? What mechanisms should be put in place to implement and manage government interventions and lastly, what measures are required to monitor the progress?

5.1.3 Transition to Low Carbon Pathways for Sustainable Agricultural Production Systems in Nigeria

*Francis E. Bisong, Professor of Conservation Biogeography & Environmental Management
Department of Geography and Environmental Science University of Calabar,*

Prof. Bisong examined the profile of carbon (soil and biomass) and the management regimes for major agricultural production systems across the broad ecological zones of Nigeria. Of particular focus was the investigation of the extent of soil, plant and animal carbon emissions resulting from land use change and management practices within a given agricultural production systems. The study placed due emphasis on the current agricultural transformation agenda of the federal government of Nigeria to determine their overall implications for carbon emission regimes and related management responses for crop and livestock production. This was in view to achieving a climate friendly agricultural system, without jeopardizing livelihoods sustainability, food security and efforts towards national socio-economic transformation. Various options for transformation to low carbon pathways in context of agricultural production and land management were also highlighted.

From his presentation, preliminary findings indicated that soil and biomass carbon profiles and management regimes for the major agricultural production systems across the agro-ecological zones of Nigeria are complex. The rainforest agro-ecological zone exhibited most variation showing that different management systems impact on the ability of the soil to sequester carbon. While conservation tillage practices reduced the loss of soil carbon stocks associated with land conversion.

In conclusion, he emphasized that the positive effect of conservation tillage is not comparable to the negative effect of land conversion, and may not result in significant accumulation of carbon in the region. In the drier Sudano-Sahelian region of the country, improved crop and pasture management are required to improve soil and biomass carbon storage. Lastly, he recommended there should be strategies to attend major cereals and livestock production.

5.1.4 Transitions to Low Carbon Development Pathways: Implications for Sustainable Development in Africa

Prof. Mark Swilling



Prof. Swilling presentation dealt on the emerging academic discussion about transition to more sustainable modes of development (or a 'low carbon' or 'green economy') that has been dominated to date by European writers largely concerned with a developed world context such as stable states, strong bureaucracies, substantial investments in innovation, mature financial systems, fairly well developed social democratic structures, strong private sectors. Writers interested in transition from rapidly growing developing country economies are few and far between. One reason for this may be due to lack of an adequate conceptual linkage among transition, development and growth. Indeed, for many who are interested in sustainability transitions, growth is regarded with suspicion. This sets up a problematic foundation for an inclusive discussion that engages the developing world.

He proposed that there should be a synthesis between the Multi-Level Perspective (MLP), the theory of industrial transitions and the theory of long-term development cycles. The resulting synthesis will make it possible to conceptualize the possible dynamics and modalities of the next long-term development cycle. Following long-term development cycles, it will be argued that the year 2009 marked the end of the *post-WWII* development cycle. What followed is a, more than likely quite a long, interregnum plagued by the consequences of what Edgar Morin called the "*polycrisis*" - a set of interlocked ecological and socio-economic crises. What is needed is a clear conceptual fusion of the deployment phase of the information age, the unfolding logic of the "*spring/summer*" phase of the next Kondratieff cycle and the dynamics of niche-level innovations. This provides will provide a critical framework for evaluating the key claims being made about the transition to a '*green economy*' as contained in UNEP's Green Economy Report and the 2011 UN World Social and Economic Survey.

He further recommended that this framework of thinking should be applied to develop a critical analysis of Africa's economic development policies and strategies. It will be argued that unless policy-makers in Africa recognize the deeper logics of transition underway, they will make decisions that will result in severe system failure in the relatively near future. By clearly demonstrating the linkages between transition, development and growth, it will be possible to conceptualize modes of African development that result in the decoupling of rates of economic growth from rates of resource use and negative environmental impacts such as carbon emissions.

5.1.5 Artisanal Rastrineobola Argenta light fishing on Lake Victoria, Kenya: Traditional kerosene lamps and PV-Battery Modern Lighting Systems, Markets, and Improving Safety and Supply Security.

M P McHenry¹, D Doepel², B O Onyango³, U L Opara¹ Murdoch University Post-doctoral research fellow, Perth, Western Australia, Chair of the ATPS Chapter in Australia, Community Resolve against Hunger, principal strategic advisor and project manager, Kenya Professor in Post-harvest Technology at Stellenbosch University

The presentation by McHenry, Doepel and Onyango investigated the use of modern lighting technology in the use of artisanal light fishing for omena/dagaa/mukene (Rastrineobola argenta) on Lake Victoria in Kenya. Technical system simulations, analysis of field data, economic modelling, and peer-research literatures indicated that there is a clear economic rationale for small-scale stand-alone photovoltaic-based battery charging for new Light Emitting Diode (LED) lighting technology to displace existing pressurized kerosene lamp technology, and implementation of even an unsubsidized custom light fishing system design can deliver a substantial reduction in fishing costs.

In addition, the research suggested that new lighting technology designs can efficiently attract targeted fish species and potentially reduce catch of endangered cichlid species. The initial research findings elucidated numerous external benefits of the new system: new LED lighting systems can be locally designed and assembled, creating a new local service industry; and cost-effective photovoltaic-battery-LED designs which may be used in the household during the day/evening in contrast to existing technology.

The proposed technology in the presentation would help to reduce other major costs of fishing such as traveling to obtain existing fuel/energy sources. The technology has zero emissions at point of use; it is healthier and safer to operate; it can eliminate environmental pollution due to kerosene use; increase local energy security, and enable fishers to own a fishing asset with lasting value and potentially for use as collateral for fishers to utilize credit services over time.

5.1.6 Climate Change Mitigation and Trade Competitiveness: An Assessment of the Clean Development Mechanism in East Africa

Jill Juma, Programme Officer and Trade Policy Expert at SEATINI, Kenya, and CIDR, Cameroon respectively,

Mr .Jill Juma in his presentation argued that while industrialized countries were progressively inclining towards reducing their combined (GHG) emissions, developing countries on the other hand seemed to be adopting policies and regulations aimed at broadening opportunities that promoted socio-economic growth and development. So that trade and environmental policy agendas seemed to be running on separate tracks. Countries in the developing South seem to be trapped in developing policy options that mitigation climate change impacts while balancing their stakes in terms of trade gains at global level. Clean Development Mechanism (CDM) is one such avenue that is currently being pursued because it does not only encourage sound environmental management but also industrialization through technology transfer, a prerequisite for greater market access and trade through trade competitiveness. In such setting CDM may appear to be an answered prayer for most developing countries in terms of

achieving their socio-economic development visions but there seemed to be apparent gaps, obstacles and limitations when we align the same trend to international trade, and in particular trade competitiveness.

He alluded that the reason for this trend is because the World Trade Organization (WTO) legal texts do not have clear cut guidelines between sustainable developments through climate change mitigation and free and fair trade through the gradual reduction of trade barriers. Therefore, adopting CDM fully in East Africa may have two pertinent implications within the purview of trade competitiveness: First, as a way of recovering certain costs associated with implementing CDM, the region may opt to impose taxes on goods or products penetrating into their market that do not comply with climate change mitigation procedures, a move that is not only highly likely to happen, but also capable to induce trade diversion. Second, the issue of having adequate structures and policies to buttress the region against imminent shocks arising from changes to a business environment that fully embraces sustainable development as envisaged in the Rio Declaration.

Mr. Juma assed the effectiveness of CDM in terms of trade competitiveness within the East African region. He begun by giving a brief introduction on CDM, and then proceeded to giving an account of CDM in the East African Partner States, specifically Kenya, Uganda and Tanzania, including the legal, policy and institutional barriers towards implementing the scheme.

In conclusion, he sought to answer whether the *status quo*; trade liberalization and competitiveness would still suffice. The subject matter of trade competitiveness in light of CDM should be introduced including possible considerations and their impact on trade in these countries.

5.1.7 Empowering the Health of Rural Farmers in Africa Through Telemedicine: Challenges and Prospects

Zelalem W. Mengistu, MCSE, MCTS, CCA, CEH Strayer University Virginia, USA (Graduate Student) Dept of Information Systems and Network Security

Zelalem Mengistu defined telemedicine and distance learning for health as related services which were wrongly perceived, assumed as luxury, and financially considered as the most expensive systems that cannot best fit for people in developing countries. However, the truth is rather contrary to what's perceived and assumed; it is a matter of contextualizing the services with respect to developing countries' existing reality especially in rural Africa.

The presentation focused on bringing the attention of stakeholders on how to implement and operationalize rural Telemedicine projects in the developing countries, emphasizing that projects should ensure rural people benefit. He cautioned stakeholders to examine first whether telemedicine projects are contextualized before fully entered into implementation phase or not. With proper design and effective implementation of telemedicine technologies served as a tool to improve the existing health and educational services allowing health practitioners to easily reach out rural people. Telemedicine also saves travel time and resource that would have been spent in search of such services.

He went further to inform the telemedicine technology suppliers, services providers and service beneficiaries to come together and figure out common challenge in order to maximize the benefit of Telemedicine service in rural areas. Cognizant of the role telemedicine played in rural areas he outlined the challenges and prospects of telemedicine in light of expanding health service coverage Telemedicine and Distance Learning for Health related services which were wrongly perceived, assumed as luxury, and financially considered as most expensive systems that cannot best fit for people in developing countries.

In his recommendation remarks, he emphasized for the implementation of a simple but reliable and affordable telemedicine technology services.

5.1.8 Pathways to Low Carbon Development: Alternative Energy Sources For Africa

Babettie A. Juwayeyi, Postgraduate student of the University of Malawi, Bunda College of Agriculture

Babettie Juwayeyi during the presentation informed the delegates that the economic growth and development of African countries is threatened by deficit and limited access to and use of energy. This is due to the inability of the Africans to use STI to manage the natural resources for their own benefit. This inability in the use of STI is evident in resource under-exploitation or exportation of unprocessed raw materials. Energy supplies available for local populations were largely insufficient. The rate of access to electricity in SSA is only 31% with 14% access rate in the rural areas. Energy consumption, 80%, is essentially reliant on traditional biomass. This over dependency on biomass has led to depletion of over 75% of forest cover resulting in exacerbated climate change impact and threatened biodiversity and sustainability of the energy source. That is why Africa is one of the most vulnerable places to climate change despite contributing only about 3.7% of total world energy-related carbon dioxide emissions. This necessitates the implementation of policies that can stimulate development of cleaner energy sources to enhance the adaptive capacity of households to climate change.

In addition, the move away from the use of traditional to the use of modern biomass energy or alternative renewable energy sources like wind, solar, hydro, and nuclear can potentially result to climate change mitigation outcomes which required the removal of barriers to energy access and use to reduce inefficiencies in the use of energy. This called for policies that provided incentives to clean energy production and use. These policies included, the reduction of energy use tariffs and production tax, time-differentiated electricity pricing.

In conclusion, Babettie recommended that there should be an integration of energy and climate change adaptation and mitigation policies, public investment and private sector involvement in STI and clean energy research and development, involvement of women in modern energy technology projects in rural areas, improvement of energy infrastructures to reduce waste during production and transportation.

5.1.9 Microalgae Cultivation and its use in the Production of Biofuel and Agricultural inputs in Lesotho

Mekbib S. B.¹, Thame T National University of Lesotho

Thame began the presentation by enlightening the delegates who participated in the conference that more than 85% of the energy source in the world is derived from burning of fossil fuels. In Lesotho, the residential energy demand coverage reached 88% in urban and 95% in rural areas from forest vegetation. Such practices of utilizing biomass by cutting shrubs and woods for fuel consumption has two basic impacts: increasing greenhouse gases effect and desertification, and endangered the diversity of indigenous and exotic tree species all together.

While securing basic energy requirements of the community, establishment of environmentally compatible technologies that supported and ensured future recycling application to reduce environmental and health impacts of fossil fuels and desertification are equally important. A variety of raw materials included agricultural wastes (plant residue and animal faeces, municipal solid wastes, market garbage, and wastewater from food and fermentation industries) are used in the anaerobic digester to produce methane in a small scale both at farm and village levels.

However, the scarce availability of these raw materials due to their use in agricultural farms as a primary source of humus, the use for methane production was very minimal. In some instances, where the production of methane from human faeces was practiced, it was found to be inconvenient due to its offensive odour and sanitation.

In conclusion, he recommended the use of microalgae as a feedstock for the production of bio-fuel is a viable biotechnological option to fossil fuels and forest vegetation. Bio-fuels derived from microalgae decomposition, besides their economic implications as energy and agricultural fertilizer reduce greenhouse gas emissions by 85% over reformulated gasoline and crops. The selection of suitable indigenous microalgae strains with less lignocellulotic property and the search for efficient cellulose degrading, acidifying and methanogenic microorganisms is an important task towards successful implementation of the technology for its economic advantage and sustainability.

5.1.10 Chrome-Aluminide Protective Coatings for Thermal Power Generation Applications

J.K.Kiplagat¹ and K. Kibicho¹Ministry of Industrialization

This presentation addressed the issue of Power plant systems and other utilities that use fossil fuel which are susceptible to degradation due to corrosion and wear. The expanding gas-steam or combustion gases through which energy is extracted from burning fuel create highly corrosive environments at high temperatures. To achieve higher efficiencies higher process temperatures are used, but this increases the rates of plant component degradation. Protective coatings applied to these components exposed to such environments like the steel tubes and vanes lead to prolonged life spans, improved performance and reduction of repair/replacement costs and downtime. In addition surface coatings enable the use of simpler, cheaper and more easily available substrate materials with substantial reduction in

costs, minimization of demands for strategic materials and improvement in fabricability and performance.

The development of advanced surface engineering treatments for optimization of corrosion and wear resistance in recent times have been of a more sophisticated nature compared to the traditional surface treatment technologies such as galvanizing, carburizing and Nitriding. These treatments essentially manipulate the properties of the material's interface to achieve superior properties.

Chromium and Aluminum, simultaneously deposited by diffusion into low alloy steel by the pack-cementation process provide enhanced protection against cyclic oxidation and cyclic hot corrosion. Diffusion takes place in a one-step halide activated thermo-chemical process to form a thin highly adhesive composite Cr-Al coating. The major controlling factor to achieve the desired coatings is the composition of the master alloy. Cyclic oxidation and hot corrosion tests carried out demonstrate the beneficial effects of the two element composite coating.

The presentation examined the unique beneficial properties of a chromium-rich aluminide coating and its application as effective barriers to high temperature degradation in thermal power generation plants.

5.1.11 An Emission Trading System as a Policy Tool for Low Carbon Development Pathway

Mr. Billy Katontoka, Managing Consultant at Clean Energy Solutions Consultants,

According to Mr. Katontoka, there has been much debate over recent decades about the need for a transition to a low carbon economy as well as the means to facilitate the transition and carbon emissions trading and carbon taxes which are commonly conceived as the most common policy instruments to facilitate this move since the main target of such policy intervention is to reduce emissions

Agriculture, forestry and fishing, mining and quarrying, and oil and natural gas are crucial contributors to the GDP of major African economies. These sectors are entirely dependent on natural resources and activities related to industries operating in these sectors, like deforestation in timber industries and large-scale drilling in mining which often lead to environmental degradation. Large portions of the African population, especially the rural population, are directly dependent on the natural resources for their sustenance and livelihoods. Thus the preservation of the continent's natural resources is of paramount importance to sustain the existence of these population segments. Africa's transition to low carbon development pathway thus has economic as well as social dimensions and implications.

Africa's transition to low carbon development demands involvement of unusual ways that would ensure achieving and sustaining the development processes through not only conceptually favourable but also feasible for implementation. Deciding alternative development pathways necessarily involves first appreciation of most African economies dependency on natural resources. Although, nations in Africa could opt to choose different approach on how to sustain their economic development adopting a low carbon development

model could be analysed based on three fronts which include; capitalizing on natural capital, embarking on green industrialization, and creating enabling policies and institutions.

5.1.12 Trends and Potentials of Renewable Energy Development in Ethiopia

Shirega Minuye, Independent Researcher/Consultant

Ms Shirega in her presentation attempted to describe, analyse trends, lessons, challenges and potentials of renewable energy development from the perspective of technical capacity, financial capacity, private investment role, market base and development partnership locally and through Foreign Direct Investment (FDI). The study focused on scientific data collection, validity and reliability testing methods to ensure robustness of the study results..

The case study was on Ethiopia as an agrarian economy where 85% of its population engaged in small scale agriculture and used biomass as an energy source in an attempt which directly affects agricultural land productivity due to nutrient depletion that would have been replenished through decayed of agricultural residues. Taking into account climate change, environmental vulnerability and depletion of natural resources, the Ethiopian government launched a strategic direction towards nurturing renewable energy resources. The Growth and Transformation Plan (GTP) which was launched two years ago in July 2010 and to be extended up to July 2015 set energy target of additional 8000 MW energy to be generated from renewable energy resources in order to meet both local demand and export market. The transformation plan introduced different but pragmatic implementation modalities to harness alternative energy technologies mainly to reduce deforestation and climate change induced effects. Ethiopia launched Climate Resilient Green Economy that highlights different adaptation and mitigation measures to help reduce emissions while ensuring sustainable development. Ethiopia strongly aspires to build green economy through proper utilization of alternative renewable energy sources such solar, wind, bio-fuels and geothermal among others.

5.1.13 Contribution of Animal Agriculture to Green House Gases Production in Swaziland: Implications for Mitigation Using Biotechnology

Dlamini A.M¹. Dube M.A¹ University of Swaziland, Department of Animal Science, University of Swaziland, Department of Agricultural Education and Extension,

The economy of Swaziland is heavily depended on agriculture. In 2006, it was reported that agriculture, forestry, and manufacturing contributed 42% of Swaziland's Gross Domestic Product (GDP). Besides economic importance, animal agriculture is important for food production and life sustenance. It is also viewed as a symbol of wealth and high social status particularly for the rural folks. Despite the merits of agricultural activities, agricultural production and particularly animal production have been incriminated for an accelerated emission of greenhouse gases. These gases are responsible for global warming and climate change.

The study by Dlamini and Dube was to determine the contribution of Animal agriculture to greenhouse gases production and to elicit adaptation strategies to climatic change and the role of modern technologies as mitigating measures. The major and minor greenhouse gases produced by farm animals were computed using the IPCC spread sheet for calculation of

greenhouse gases emissions. The major greenhouse gases produced by farm animals were CH₄, N₂O, and the minor gasses were NO_x and CO₂. The greenhouse gas that was emitted the most by farm animals was CH₄, 24 Gg or 600 CO₂e per annum. Ruminants were the major producers of methane. The producers of the least greenhouse gases emissions were non ruminants. Livestock produced 0.87 Gg of N₂O per annum, a global warming potential of 259 CO₂e.

The findings of the study revealed that feeding ammoniated straw and silage, inoculating with transgenic rumen bacteria, animal breeding, manure storage techniques, use of biogas digester with methane gas recovery and emphasizing non ruminant production are possible strategies that can be employed to reduce the greenhouse gases production by livestock.

In conclusion, the researchers recommended that feed preservation technologies, selection strategies, water harvesting, storage and recycling strategies and intensive livestock production systems could be used as adaptation strategies to climate change in livestock production.

5.2 Parallel Session Two

The session was chaired by Prof. Sir Brian Heap, Member, ATPS Board from the European Academies Science Advisory Council. The session comprised of papers on Governance of Science, Technology and Innovation including Genetics for Farming, Biotechnologies, Nanotechnologies and Indigenous Knowledge Systems (subtheme2).The papers presented were as follows:

5.2.1 Introduction to the Workshop

Volker ter Meulen, Chairman of EASAC-NASAC project “Planting the Future”



In his opening remarks, the Chair of the session Prof. Sir Brian Heap welcomed delegates to the session which looked at the governance of science, technology and innovation including genetics for farming, biotechnologies, nanotechnologies and indigenous knowledge systems. He noted that Africa has not embraced the opportunities inherent in emerging technologies such as the biotechnology and presented the occasion as important in shaping the discussion towards ways of engagement of Africa to action in this regards.

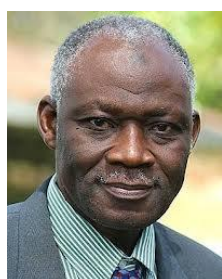
He welcomed the president of the German Academy of Sciences Leopoldina and Member of the European Academies Science Advisory Council (EASAC) Council, Prof. Volker ter Meulen to introduce the EASAC project on ‘Genetics for Farming’.

In his introduction to the Genetics for Farming project, Prof. Volker ter Meulen enumerated some global society challenges such as food insecurity and poverty that call for the need to embrace new technologies and innovation in agricultural technology and food production. He noted that it is only through innovations in agriculture that such challenges could be addressed to ensure adequate food security. He explained that one of EASAC’s roles is to promote the use of genetically modified organisms (GMOs) in ensuring food security as well as promote the numerous works/publications of members of the academies.

The academy established a network called “Planting the future: Opportunities and Challenges for Sustainable Crop Development”. He expressed joy on the opportunity given to them by the ATPS to organise the workshop together. He raised a question on whether the European Union has helped Africa on agricultural biotechnology. He went further to state that the main objective of the workshop is to share and analyse African country perspectives on the subject. He stated that the workshop will also try to explore this current situation as well as look into the future. In conclusion, Prof. Volker ter Meulen informed delegates that the outputs from the workshop will be brought to the attention of the EU policymakers who will contribute to the continuing debate and supporting action in Africa relating to genetics, biotechnology and nanotechnology

5.2.2 Current Situation in GM Research and Innovation in Ghana and The Sub-Region: Opportunities and Challenges

Walter S. Alhassan, FARA HQ, ACCRA, GHANA



Prof. Alhassan in his presentation reported that West Africa is a food insecure region. According to him, FAO (2012) estimates that 1 in 4 of the world's 840 million malnourished live in West Africa. Rising population and low agricultural productivity worsen the food situation. The 2012 Global Hunger Index (GHI) map shows that nearly all of West Africa is in the “serious” hunger classification with Niger and Sierra Leone classified as “alarming” while Ghana is the only country the sub-region classified as

“Moderate”.

He however noted that the solution to Africa's food insecurity situation lies on the application of known technology coupled with the introduction of modern biotechnology on a need basis. According to him, modern biotech covers a range of tools such as:

- Tissue culture
- DNA characterization of germ plasm,
- Marker assisted selection (use of DNA fragments as markers for the molecular identification of desirable genes)
- Genetic transformation (genetic engineering or genetic modification). Most potent of the biotechnology tools. Its use is governed by the application of legislative frameworks that guarantee acceptable levels of safety.

He enumerated the challenges confronting agriculture in the sub-region that could require GM application to include: intractable pests and diseases; declining soil fertility; climate change phenomena of drought and flooding; dwindling land areas; nutrient deficiencies; and danger of agro-chemical residues in food or water resources. In order to effectively develop and use the technology in addressing these challenges there is need for an enabling legislation for GM crops, infrastructural support services, markets and a core of well-trained and motivated scientists and informed farmers.

Describing the current status of GM crops in West Africa, Prof. Alhassan noted that Burkina Faso, Ghana, Senegal and Togo are the only countries in the sub-region that have bio safety legislation in place that can allow the handling of GM crops up to commercial release. While Nigeria has a cabinet approval for the handling of GM crops up to the confined field trial level, Burkina Faso is handling a GM crop (Bt cotton) at the commercial level since 2008. In Burkina Faso, cotton is the biggest export crop with production of up to 180,000 tons (2006/2007-2010/2011). About 250,000 of the 350,000 producers are small scale farmers. The area Under Bt cotton production is 250,000 ha. Bollgard II (Monsanto) is the variety used mainly for production. Insect damage to cotton is 50-70%. In order to combat this incidence, Pyrethroids have been used from 1998 though there seems to be a built up resistance thereby increasing the number of sprays from 4-5 to 6-8.

Bt cowpea is also receiving confined field trials (CFT) status in Burkina Faso (third largest producer in Africa). Maruca pod borer is the most devastating pest of the crop which genetic modification has been applied control.

In Nigeria, the national institutions that are actively engaged in GM bio-technology research at the CFT level are the Institute of Agricultural Research (IAR), Samaru, Zaria, Nigeria and the National Root Crops Research Institute (NRCRI), Umudike, Imo State. The GM crops under study at the field trial level are cassava, cowpea and sorghum. Biofortified Cassava (BC+) (GM cassava enriched in carotene and iron) has been selected for high resistance to African Cassava Mosaic Virus. The material on study was developed by the Danforth Plant Science Centre, St Louis, Mo, USA, while the original material tested is to be replaced by a locally developed cultivar preferred by farmers.

In Ghana, the state of legislation determines biotech products that can be handled and only GM requires special legislation. Capacity exists to varying degrees for work in conventional to GM biotechnology. Tissue culture tool is the most prevalent tool but considerable capacity exists in the area of genomics and very few have had training in transformation. The enabling laws available are the LI 1887 of 2007 and ACT 831 of 2011. The LI 1887 allowed handling GM crops up to CFT level as substantive legislation was being developed. LI was based on an existing legislation for research in the CSIR. On the other hand, Act 831 which is a comprehensive biosafety law covers the handling of GM products up to and including commercial release.

Prof. Alhassan concluded by stating that there is the need to accelerate bio-safety legislation across the sub region. He noted however that such legislation should not be restrictive. Again, there is need for an enabling environment for agriculture including input supplies, infrastructure support services, market, etc. Finally, there is urgent need for scientific human resource development in the critical areas such as plant breeding, animal breeding, crop protection, veterinary medicine, fermentation, molecular biology and bio-safety.

5.2.3 Current Status of GM Research and Innovation in Uganda

Dr. Andrew Kiggundu, National Agricultural research Laboratories, Kawanda

In his presentation, Dr. Kiggundu observed that increasing crop and animal productivity, improved human and animal health, industrialisation and a safe environment are important for improving food security, poverty eradication and national development in Uganda.

Investment in modern biotechnology is one of the options that can significantly contribute to this national development which is the new engine of economic transformation. Choice biotechnologies such as agricultural biotechnology, medical biotechnology, environmental biotechnology, industrial biotechnology, bio-safety and bio-policy can be developed and applied to realize this goal.

According to Dr. Kiggundu, traditional breeding has failed in some aspects to sustain food security and leads to the release of new varieties that may have high yield but not desired by farmers. GMOs of local crops will have resistance to disease, drought and also preferred by farmers. He noted that farmers have cultural attachments to their specific crops which make it difficult for them to accept new crops with different tastes. He narrated the need for agricultural biotechnology including subsistence production, conventional cross breeding, and noted that biotechnology offers leverage over the breeding constraints. He identified some challenges of adoption of GM tech in country including some production constraints such as pests and diseases and plant architecture. He remarked that biotech has the capacity to address the production constraints which the normal breeding cannot achieve.

According to stakeholders' analysis in Uganda, banana is the most important food crop and second most important cash crop. It is high yielding staple food (up to 60ton/ha/yr) and is least disturbed by season imperfectability thereby providing food and income for households all year round. Banana also has high industrial potential.

Efforts are being made in Uganda through the national agricultural research organizations (NARO) to support the regeneration of genetic materials and other progress on technology testing such as bacteria wilt testing and production of vitamin A enhanced bananas. The goal of biotechnology in banana production will therefore be to address key problems for which conventional breeding has not been successful. To do this, there is need to acquire capacity in biotechnology in terms of infrastructure and trained personnel. At NARO, Uganda, the key biotechnologies developed are; embryogenic cell suspensions and regeneration systems; transformation system; genes for key constraints; transgenic plants (in progress); evaluation of GM plants, bio-safety and de-regulation; distribution of clean planting materials and gene discovery from within the crops. Progress on technology testing has also been made in bacterial wilt resistance, banana weevil and nematode resistance, and improved micro-nutrients in banana. Other crops receiving attention at the research organization on genetic modification are; cassava, maize, cotton, rice, sweet potato, and groundnut.

He however enumerated some challenges to the biotechnology adoption in the country to include inadequate human capacity, poor utilities, inadequate laboratory supplies and procurement, poor capacity for laboratory equipment maintenance, inadequate public awareness, poor funding, inadequate policy and regulatory framework, amongst others. He identified future plans for biotechnology to thrive in the country to include:

- Advocate for quick enactment of the enabling law on biotechnology
- Continued capacity building
- Investment in demand-driven and impact oriented research (Nationwide R&D strategy highlighting specific projects underway)

- Strengthen public and private biotech linkages to fully exploit biotechnology public-private-partnerships (PPP)
- Integrate the use of biotech tools into research and training
- Promote and strengthen partnerships with the donor, research communities and regional networks e.g. USAID, NEPAD, ASARECA, BECA, COMESA
- Establish bio-safety competence for the safe commercial utilization of biotechnology
- Continued public awareness and education
- Networking amongst institutions involved in biotechnology

5.2.4 Preparedness of Tanzania to Utilize Genetically Modified Technology

Roshan Abdallah and G. Bamwenda, Agricultural Innovation Research Fondation (AIRF), Arusha, Tanzania

In her presentation, Dr. (Mrs) Roshan Abdallah noted that the application of biotechnology in Tanzania is considered in the context of the country's need for more food and the survival of its people. She recalled that worldwide, besides food, biotechnology has been applied in medicine, public health, industry and environment. She identified some crops where biotechnology has been applied in Tanzania to include maize, cassava, striga, and banana. She also noted that tissue culture techniques to address constraints of disease free planting materials and rapid improvement in crop production is now routinely applied in several institutions in Tanzania to crops such as pineapple, cashew nut, sweet potatoes, vanilla, and coconut. Some of the institutions that conduct tissue culture techniques are:

- Mikocheni Agricultural Research Institute (MARI) in Dar es Salaam,
- ARI Mlingano in Tanga,
- ARI Uyole, Mbeya
- Horti-Tengeru (Arusha)
- Kizimbani Agriculture Research Station (Zanzibar),
- Tropical Pesticides Research Institute, Arusha
- Sokoine University of Agriculture (SUA)
- Tanzania Coffee Research Institute (TACRI)

Some of the institutions also use DNA marker technology to identify genetic linkages for qualitative and quantitative traits, which simplifies the genetic improvement and disease diagnostics. SUA has established a state of the art Genome Science Centre, which supports research and postgraduate training in the area of functional genomics and bioinformatics. The Genome centre has facilities for; cDNA works, printing microarrays using a high throughput GENETIX microarrayer, 4-colour scanning of arrays, and facilities for cold storage.

She noted that the first GM research technology is conducted at ARI, Mikocheni and is on cassava in a contained environment. She further noted that the next GM research is on Water Efficient Maize (WEMA) and will be carried out in a confined field trial.

Some bio-safety legal framework that supports the development and use of GM technology in the country are; Biotechnology policy (2010); Environment Management Act, 2004; Plant Bio-safety Regulations (2009); Bio-safety Guidelines; and the Standard Operating Procedures. On the other hand some institutional framework supporting the GM technology in a value chain approach are; National Bio-safety Focal Point (NBFP); National Bio-safety Committee (NBC); National Biotechnology Advisory Committee; Ministerial Competent Authorities; Plant Bio-safety CoE; and the Institution Bio-safety Committees (IBC).

However, she reported that the Tanzanian public is not fully aware of the benefits, risks and risk management options of the GM technology. This has resulted in uncertainty in decision making processes by policy makers when it comes to adoption of GM technology. She stressed the need for the public to understand about the technology itself, its benefits, risks and what can be done to mitigate the risks. In order to achieve this, good political will, policies, functional legal and institutional framework must be in place. The public confusion about risks and benefits of GM technologies should be addressed by the government whom the people have trust in while farmers who are the backbone of food security must also be aware of the technology and create demand for it. The public must therefore be adequately mobilized through dialogues to participate in the national policy making processes regarding GM technology. Effective communication in local languages becomes imperative to the realization of public engagement.

The government is encouraged to continue providing effective leadership and allocate more funds to R&D in GM technology. They should support and facilitate regional harmonization and cooperation for the development of knowledge, skills and sharing of facilities and must ensure that the country is not left behind in the increasingly knowledge based global biotech economy. It is important the bio-safety legal and institutional frameworks are functional and practical if the ultimate goal of GM technology is to be realized. The partnership between the public and private sectors in the GM technology also needs to be adequately harnessed in order to ensure productivity and sustainability in the system. Dr. Abdallah concluded by stating that in order to ensure that Tanzania is in a position to harness the benefits of this powerful technology, debate should be about which policies need to be formulated, which regulations need to be in place, and what research should be performed for the growth of the Tanzania economy.

5.2.5 The Virca Project and Issues Arising

Dr. Douglas W. Miano, University of Nairobi, Kenya

Dr. Miano in his presentation emphasized the strategic importance of cassava as a staple food in Africa. He noted that the foliage, stem and roots are all useful in providing income and food for humans as well as livestock. According to him, cassava is a strategic crop for increasing food supply, reducing hunger and responding to food emergency crises. Irrespective of its importance cassava production in Africa is threatened by concurrent epidemics of cassava mosaic disease (CMD) and cassava brown streak disease (CBSD) which are expanding rapidly in range, incidence and severity. In East Africa alone, CMD and

CBSD are estimated to be causing losses in excess of US\$180 million annually. The major challenge to the management of the two diseases which are transmitted by the Whitefly is the continuous presence of the viruses and the vector throughout the year; the attachment of farmers to particular cultivars which are susceptible to the diseases; and the limited sources of resistance to viruses.

He stated that it was this situation that led to the current project on virus resistant cassava whose mission and vision is to enhance the livelihoods of smallholder farmers in East Africa by delivering farmer-preferred cassava varieties genetically enhanced to resist serious virus diseases; and reduce incidence of cassava virus diseases affecting the food security of 30 million Ugandans and Kenyans respectively. He noted that approvals have already been obtained from regulatory authorities in Kenya and Uganda to conduct confined field trials reporting that so far, a total of 9 field experiments have been conducted (7 in Uganda and 2 in Kenya). The parameters being assessed were disease severity, disease incidence, and virus incidence.

The first VIRCA Product, called Virus-Resistant TME204, is natural, has a robust resistance to CMD, popular for taste and yield, number one variety in farmer participatory trials, but highly susceptible to CBSD. It has no unintended effects on agronomic characteristics, taste, quality and its transformation with RNAi is resistant to UCBSV and CBSV. He concluded by stating that more efforts are being put in place to finalize VIRCA product development through event selection, assurance of appropriate regulatory measures and effective communication with relevant stakeholders including governments, farmers and researchers. He called for the supports of these stakeholders in ensuring that the mission and vision of VIRCA is accomplished.

5.2.6 Nanotechnology: Key to Meeting the Millennium Development Goals

Mr. J.K. Kiplagat, Ministry of Industrialization, Nairobi, Kenya

Mr. Kiplagat described nanotechnology as the study, design, creation, synthesis, manipulation, and application of functional materials, devices, and systems through control of matter at the nanometer scale. He enumerated the areas of application of nanotechnology to include in information technology, in energy, medicine and consumables. Under information technology, smaller, faster, more energy efficient and powerful computing and other IT-based systems have been developed. Under energy systems, more efficient and cost effective technologies for energy production including solar cells, fuel cells, batteries and bio fuels have also been developed. In medicine, nanotechnology have been used in cancer treatment, bone treatment, drug delivery, appetite control, drug development, medical tools, diagnostic tests, and imaging.

He pointed out that nanotechnology can be applied in meeting the eight millennium development goals of the United Nations. He particularly identified five MDGs where nanotechnology has already been applied as shown in Table 1. These areas include eradicate extreme poverty and hunger (MDG 1); reduce child mortality (MDG 4); improve maternal health (MDG 5); combat HIV/AIDS and other diseases (MDG 6); and ensure environmental sustainability (MDG 7).

Table 1: Nanotechnology applications that addresses five MDGs

S/N	Applications of Nanotechnology	Examples of Technologies	Target MDGs
1	Energy storage, production and conversion	<ul style="list-style-type: none"> • Photovoltaic cells and organic light-emitting devices • Carbon nanotubes 	VII
2	Agricultural productivity enhancement	<ul style="list-style-type: none"> • Nonporous zeolites for slow drug-release • Nanocapsules for herbicide delivery • Nanosensors for soil quality 	I, IV, V, VII
3	Water treatment and remediation	<ul style="list-style-type: none"> • Nanomembranes for water purification • Nonporous zeolites & atta clays for water purification 	I, IV, V, VII
4	Disease diagnosis and screening	<ul style="list-style-type: none"> • Nanosensor arrays based on carbon nanotubes • Quantum dots for disease diagnosis • Anti-body detrimers for diagnosis of HIV-1 and cancer 	IV, V, VII
5	Drug delivery systems	<ul style="list-style-type: none"> • Nanocapsules, dendrimers, nanobiomagnets and attapulgitic clays for slow drug release systems 	IV, V, VII
6	Food processing and storage	<ul style="list-style-type: none"> • Nanocomposites for use in food packaging • Antimicrobial nanoemulsions for food equipment 	I, IV, V
7	Air pollution and remediation	<ul style="list-style-type: none"> • Nanoparticle photocatalytic for self-cleaning systems • Nanocatalysts for more efficient catalytic converters. 	IV, V, VII
8	Construction	<ul style="list-style-type: none"> • Nanomolecular structures for asphalt and concrete. • Nanomaterials for durable housing surfaces. 	VII
9	Health monitoring	<ul style="list-style-type: none"> • Nano-tubes & -particles for glucose, CO₂, & cholesterol sensors for <i>insitu</i> homeostasis monitoring 	IV, V, VI
10	Vector and pest detection and control	<ul style="list-style-type: none"> • Nanosensors for pest detection • Nanoparticles for pesticides & insecticides 	IV, V, VI

Mr. Kiplagat concluded his presentation by noting that the applications of bio-and nano-technologies are potentially the key drivers for sustainable development but must overcome many roadblocks in their development, deployment and diffusion. He stressed the opportunity provided by nanotechnology in meeting five key MDG goals especially in food security, energy provision and access to water but noted that the health and environmental

impacts associated with exposure to many of the engineered nanomaterials are still uncertain hence the need for occupational health regulations must be in place.

5.2.7 Studies on Nanobiotechnology Control of Agricultural Pests and Pathogens for Food Security and Safety

Ms. Aruah Chinenye B. National Biotechnology Development Agency (NBDA), Southeast Zonal Centre, University of Nigeria, Nsukka, Nigeria

In her presentation, Ms. Aruah noted that nanotechnology, the science of working with smallest possible biological particles, raises hopes for future agriculture in Africa by breaking the barriers that cannot be addressed by conventional breeding technology. She recalled that much of the problems facing agricultural productivity and sustainability are both pre and postharvest losses usually due to pests and pathogens. These cause serious damage to crop thereby reducing their yield, quality, and their commercial values. According to her, pests appear to be economically more important than disease in relation to food security and safety because some pests are disease vectors while others create entrance for pathogens. Some pests are difficult to control with available technologies and large differences exist in the efficacy of pest control. The resistance of the causative agents of agricultural products coupled with potential health hazard on the environment gave birth to search for alternative to synthetic chemicals. The development of nanotechnology and biotechnology has significantly expanded the application domain of nanomaterials in the field of agriculture and other areas.

Nanotechnology has therefore been useful in the production of safe pesticides, insecticides, etc for the control of pests and pathogens. For example, it has been reported that Photocatalytic and microbiocidal nanoparticles (NPs) are employed for pesticide degradation, detection and in control food spoilage, respectively. Nanotechnology has the potential for efficient delivery of chemical and biological pesticides using nanosized preparations or nanomaterial based agrochemical formulations. The development of biopesticides stimulates modernization of agriculture and will, without doubt, gradually replace chemical pesticides. The benefits of nanomaterial based formulations are the improvement of efficacy due to higher surface area, higher solubility, higher mobility and lower toxicity. Materials such as nano-clays and layered double hydroxides possess good biocompatibility, low toxicity and potential for controlled release. Agrochemicals such as fertilizers (nitrate), plant growth promoters (α -naphtheleneacetate), and pesticides (4-(2,4-dichlorophenoxy) butyrate) are deployed using double layered hydroxides.

She also gave examples of nano formulations using plant extracts such as the essential oil from garlic loaded on polymer NPs (240 nm) and coated with polyethylene glycol (PEG) to evaluate their insecticidal activity against adult *Tribolium castaneum*. Silver nanoparticles (Ag NPs) are synthesized using aqueous leave extracts of *Euphorbia prostrata* and successfully used for controlling *Sitophilus oryzae* in rice. She also gave examples of nano formulations using microbes. Microbes and microbial products such as bacteria, viruses and fungi can function as biological control agents against insect pests.

She however noted that the future of nanotechnology is uncertain due to many reasons such as; lack of public awareness, negative reaction of the public towards nanoparticles, lack of many of the requisite skills in public agricultural research organizations, and ill-equipped and

somewhat hesitant regulatory structures to deal with these new technologies. In conclusion, she maintained that nanotechnology may have concrete solutions against many agriculture-related problems such as insect pest management; adverse effects of chemical pesticides; and development of improved crop varieties. However, nanotechnology has the potential to revolutionize the existing technologies used in various sectors including agriculture in the near future. Its products can be used in a number of ways to reduce disease levels and prevent the development and spread of pathogen, thus preserving yield and quality.

5.2.8 Practical Application of Modern Biotechnology Tools to Musa Breeding in Nigeria: Potentials for Increased Production

Oselebe, H. O.¹, Obi, I. U.², Uguru, M. I. Ebonyi State University, University of Nigeria, Nsukka

The breeding of plantains (*Musa* species, AAB) in Nigeria had been approached through 4x – 2x breeding scheme to generate triploid hybrids. In this process, several factors were observed to impede rapid progress, including variations in genome size and structure within and across generations which reduces the accuracy of predicting progeny value from parental performance. The objectives of the study were to: a) assess the potential of early screening of 4x (AAAB) – 2x (AA) *Musa* breeding populations for discriminating ploidy and genome classes based on Flow Cytometry and genome-specific RAPD analysis, b) study the relationship between parents and offspring from 4x-2x families using amplified fragment length polymorphism (AFLP), c) evaluate the agronomic performance of progenies of reciprocal (4x – 2x versus 2x – 4x) crosses in *Musa* to understand how gender or ploidy affect the inheritance of quantitative traits, d) assess the potentials of use of biotechnology tools to enhance plantain and banana production in Nigeria.

The study was carried out at the High Rainfall Station of the International Institute of Tropical Agriculture in Onne (4° 43' N, 7° 01' E, 10 m above sea level). Results indicated that progenies of 4x-2x crosses produced predominantly 3x progenies (94.1%). RAPD analysis identified seven genomic classes, dominated by AAA and AAB configurations segregating 1:1 ($\chi^2 = 0.21$, $P = 0.05$). Five AFLP +3 primer pairs produced 2158 polymorphic bands among the hybrids and parental lines with segregation distortion occurring in the population. The marker similarity index between hybrids in different families ranged from 33.0 to 90.0%, while the genetic distance (GD) ranged from 10% to 67%. The mean contributions of the 4x and 2x parents to their progenies were 0.9: 1.2, respectively. Diploid progenies predominantly produced from 2x – 4x crosses were shorter plants, took shorter time to flower and produced smaller bunches compared to 3x progenies from 4x – 2x crosses. The differences in reciprocal breeding outcomes were attributed to complex microsporogenesis in parents of higher ploidy level. However, the use of biotechnology tools for increased plantain and banana production was highlighted.

5.2.9 Animal Genetic Resources, Intellectual Property Rights and Traditional Knowledge: Quo Vadis?

Eliamani Laitaika Tanzania Intellectual Property Rights Network (TIP-NET), Tanzania

Ms. Laitaika described genetic resources (GR) as part of animal, plant or human body containing functional units of heredity. She categorized genetic resources into three namely: human genetic resources; GR for food and agriculture (encompassing animal genetic resources and plant genetic resources; GR in the context of biodiversity narrowly defined to exclude human GRs and GRs for food and agriculture. She however explained that her discussion focused on the animal genetic resources.

One of the issues of concern in dealing with genetic resources is the intellectual property (IP). This is the property emanating from creation of the human intellect or mind (WIPO, 1998). Intellectual Property Rights (IPR) is a legal instrument used by governmental authorities to protect IP. This can be in the form of Copyright, Patent and Trademark. All IPRs are territorial in nature. She went further to explain that IP differs from other forms of property as they are *non rivalrous* (i.e. one use does not preclude another); *non-excludable* (i.e. possession does not control access); and *inexhaustible* (i.e. ideas are in infinite supply) (de Beer 2005:14).

On the other hand, traditional Knowledge (TK) is a non conventional knowledge held collectively by communities and transmitted through oral tradition. She explained that TK and Indigenous Knowledge (IK) differ in the sense that TK is broader and not confined to “indigenous people” while IK is a traditional knowledge system. Studies on TK and negotiations within the World Intellectual Property Organization (WIPO) have led to distinction between TK *stricto sensu* and traditional cultural expressions TCEs also referred to as expressions of folklore EoF. While TK *stricto sensu* means the “technical” aspects of TK such as traditional medicinal knowledge, animal husbandry, etc, the TCEs/EoF is the “artistic” part of traditional knowledge such as songs, clothing, riddles, etc.

Giving illustrations on how the conventional IP and TK works, Ms. Laitaika remarked that if Mr. ‘A’ goes to Village ‘Z’ and records a song and goes back to country B” and makes an album, “A” is the copyright holder of the copyright. Similarly if Ms. “C” goes to Village “D” learns of the use of plant “E” for treating ailment “F” takes such genetic resources and develops drug “G” and obtain a patent, “C” holds the patent right. A patent is a legal right to control exploitation of one’s invention granted by governmental authorities in exchange for technical information which later becomes a part of public domain. The criteria for patenting is that such an invention has to be novel, inventive, not anticipated by prior art, and not expressly prohibited by law e.g. for morality. Nevertheless, the World Trade Organization’s Agreement on Trade Related Aspects of Intellectual Property (TRIPS Agreement) of 1995 allows member countries to exclude plants and animals from patentability. However, there is an obligation to create “sui generis” systems for plants but there is no such obligation for animals. She identified some international legal instruments that may be relevant for the understanding and application of animal genetic resources. These include; Convention on Biological Diversity (CBD) 1992; The Cartagena Protocol on Biosafety, 2000; The WTO Agreement on Agriculture, 1994; The WTO Agreement on the Application of Sanitary and Phytosanitary Measures.

She recommended that a comprehensive intellectual property strategy is needed in order to balance between “embracing technology” and protecting indigenous breeds which play a vital role for food security among local communities. She called for the Farmers’ Rights in Plant Genetic Resources

Discussions

How do we ensure that the GM on confined field trials (CFT) is not accessed until the regulations approve of it?

Ans: All researches on CFT are conducted in a safe, well protected environment that will prevent outsiders from accessing the plots.

How much will the small holder farmers gain from research and use of GM seed/product?

Ans: In Burkina Faso, 70% royalty are given to farmers while 30% goes to Monsanto.

Comment: There is need to adapt field tried crops in temperate region for tropical crops

Comment: If STI is taken to the next level, it could lead to social innovation and cultural change. However, the question is “is Africa ready for the high technologies”?

Comment: There is a general consensus that African lacks the requisite capacity to effectively carry out research and development on GM technology, hence the need for capacity building and strengthening across various levels including scientists, policymakers, private sector actors, etc.

Comment: Labeling is so important for GM technology and there is need to agree on what should be or not labeled. However, some critics believe that it will be unwise to talk about labeling when the technology in Africa is yet not developed.

Comment: Increasing public private partnership in the agricultural sector could help to support the development of the GM technology.

Comment: The role of extension service at public and private levels is important in making new technologies such as GM to easily be accepted by farmers

Comment: There is need to strengthen linkages between researchers and policymakers. Capacity in GM is required at all levels including development, regulatory, implementation, bio-safety, etc. Capacity requires knowledge and information.

Comment: Crops from GM have added values when compared to the traditional crops.

Comment: There is need for the continuity of programmes and its implementation with governance structures strengthened to support new technology development and use

Comment: There is need to understand that Africa is heterogeneous and hence such uniqueness need to be taken into consideration in technology transfers. Such heterogeneity may play out in culture, religion, traditions, norms, etc.

Key Observation and Recommendations on Subtheme 2: Governance of STI including Genetics for Farming, Biotechnologies, Nanotechnologies and Indigenous Knowledge Systems

Observation:

Delegates on the subtheme 2 observed that the emerging technologies provide significant potentials to improve agricultural productivity and food self-sufficiency.

Recommendations

Based on the forgoing observation, delegates recommended that there is need for:

- Capacity building and strengthening including increased investment and financial support to research and development in Agriculture and Emerging technologies. Capacity at all levels and in critical sectors. The 1% investment in R&D and 10% budgetary allocation to agriculture as agreed by the AU needs to be fully implemented.
- Regulatory frameworks and enabling biosafety policies. Where in existent, they need to be revised to meet current needs. Harmonization of these regulations across regional blocs is necessary
- Public awareness, education, training and extension services. The academies of sciences working with organisations such as ATPS have the role to create awareness and clarify issues on emerging technologies based on evidence.
- Network of stakeholders including policymakers, scientists, private sector actors, etc working together (collaboration) to develop, disseminate and use new technologies and innovations necessary for sustainable development. Strengthening the linkage between and amongst these stakeholders is necessary
- Partnership on the new/emerging technologies on equal basis with the developed economies is key
- Need for centres' of excellence in the areas of new technology to encourage the state of the art research and development including dissemination and use of the new technologies
- Up scaling new technologies based on need
- Harnessing the skills and expertise of Africans in Diaspora. Demolishing of boundaries that hinder exchange and adoption of new ideas across the continent.
- Infrastructural development to enable emerging technologies is necessary

5.3 Parallel Session Three

The session was chaired by Prof. Indira Nath, ATPS Board Member from The Institute of Pathology (ICMR) India. The session comprised of papers under Institutional Structures and Social Innovations for Sustainable Development in Africa. Papers presented were as follows:

5.3.1 Fostering Social Innovation for Sustainable Development within an African Context

Ernest N. Acheampong African Technology Policy Studies Network (ATPS)



Mr. Acheampong introduced the Social Innovation (SI) project currently executed by ATPS under the auspices of Rockefeller Foundation. His presentation focused on three key issues: understanding the current state of knowledge on social innovation in Africa, its relationships with on-going research and policy processes within the mainstream Science, technology and innovation policy research and policy development in Africa; identify the barriers to and opportunities for mainstreaming the concept of social innovation in STI policy research and research and development funding in Africa; and identifying the types of platforms and key stakeholders needed to facilitate cross-sector collaborative social innovation in Africa.

The presentation was based on the premise that, society underlies almost all considered economic and technological activity, making it imperative for innovations to respond appropriately to social needs. The presentation raised a number of salient questions which included how emerging ideas may respond to social needs, and how social needs may create new ideas, and how these new ideas may provide solutions to societal problems at the same time build interactions among society. He pointed out that, social innovation is increasingly being recognized globally as an integral part of development- addressing some of the world's emerging issues for example, fair trade, distance learning, hospice and waste reduction to restorative justice and zero-carbon housing. This development has come in the wake of the global economic and financial market crisis in 2008, making creativity and innovation in general and social innovation in particular essential factors for fostering sustainable growth, securing jobs and increasing competitive abilities.

Mr. Acheampong explained social innovations as new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and creates new social relationships. Social needs ranges from working conditions, education to community development and health to strengthening civil society. He further explained that social innovations are elements of social change that create new social facts, changing beliefs of individual people or groups, highlighting the desire for collaboration and enhancing society's capacity to act. Social innovation transcends sectors, levels of analysis, and methods to discover the processes – the strategies and tactics producing lasting impact. It may involve finding and training more social entrepreneurs, supporting the organizations and enterprises it creates, however, it will certainly require understanding and fostering the conditions that produce solutions to social problems

He was of the view that's although social innovation is happening all around us in Africa, very little was known about it. He indicated that, social innovations are becoming norms

amongst African youths particularly in the area of information, communication and technology. He presented several examples of current social innovation programs and activities, eg. Ushahidi, M-PESA, M-Shamba, Farmerline, Tech in Education, AfroVumbua, etc, which are driving social change and economic development from the grassroots, and adding an extra capital dimension to sustain the African social fabric which is viewed as engine for growth, and as fundamental source of value.

He advocated that whilst Africa's emerging economies continue to invest in the public, large industrial enterprise, it was equally important to also invest adequately in social innovations such as social enterprises which are becoming an integral part of the economy, mimicking the true African society – a focus on communities, the people, and social structures as measures of prosperity. Ignoring these elements that drive the social fabric of society in favour of only new technologies poses significant challenges including low adoption and sustainability rates, deepening economic woes, social unrest (e.g. the Arab spring) and unsustainability of investments in new technologies.

In his concluding remarks, Mr. Acheampong observed that by encouraging social innovation, policy-makers strive to pursue a triple triumph: a triumph for society and individuals by providing services that are of high quality, beneficial and affordable to users and add value to their daily lives; a triumph for governments by making the provision of those services more sustainable in the long term; and a triumph for industry by creating new business opportunities

5.3.2 Social Innovations, Inclusive Green Growth and Sustainable Development: Global Imperatives and African realities

Prof. Kevin Urama, Executive Director, ATPS



Prof. Urama presented excerpts from a policy paper on “social innovation creates a prosperous society” submitted to the Stanford Social Innovation Review as part of a special supplement to celebrate Rockefeller Foundation’s 100th anniversary in 2013. He described a prosperous society as the one with several elements that make up for a “flourishing condition in human societies”, including such indicators as peace and happiness, economic and financial well-being, individual freedoms and liberties, etc. In other words, a prosperous society consists of economic prosperity and social prosperity which require coexistence and cooperation of peoples, nations and regions. Creating a prosperous society is the goal which emerges from social interaction. He indicated that estimate that 50-80% of economic growth emerges innovation and new knowledge according to economists. Financial instability and economic crisis have reinforced the call for creative and innovative solutions for fostering sustainable growth, securing jobs and increasing competitive abilities. There is need for a fundamental transformation of social, economic and even cultural arrangements, which the old paradigm of government aid is simply inadequate to tackle in the 21st century

Prof. Urama was of the view that African economies are highly informal, emerging from social innovation, as are technological innovations. There is need to tap into the innovation history of African countries and to make these explicit so that they can be distributed. He reflected on the possibility of reverse engineering social innovation just as technological innovation has been reverse engineered in India, using the case example of electronic tablets

such as iPad, and stressing that this was not simply reverse engineering but a great deal of innovation was required. This kind of action is both technological and social innovation. The ‘good decade’ has emerged from improved governance, skills, and importantly restlessness among youth who do not want to accept the old ways. Youth are innovating in ways that were not seen in the past to address social problems particularly with technology. Questioning the capacity of current generation to harness the restlessness among youth and women to drive development, Prof. Urama highlighted that technological innovations may requires money and this is always in short supply, however social innovation is disaggregated and responsive at the local level, may not require advanced education, and may be a new model. Terms such as inclusive green growth, green economy, and decoupling economic growth from social and environmental impacts have become regular parlance in mainstream economics and global institutions such as the World Bank and United Nations Agencies, as emerging paradigms to push the sustainable development agenda. Moving this forward requires new forms of public policy shaped by new models of innovation that address social needs, creating networks for formalizing the informal economy, and strengthening democracy.

5.3.3 The Land Potential Knowledge System (Landpks) Increasing Land Productivity and Resilience

Dr. Jeffrey Herrick, United States Department of Agriculture, New Mexico, USA



Dr Herrick’s presentation focused on how land potential knowledge generated from research could foster agricultural productivity. He opined that for Africa to meet the needs of its growing population there must be significant intensification and expansion of current agricultural production. The success of both strategies requires understanding the land’s potential productivity, and its resilience: its ability to resist or recover from degradation. An understanding of land potential is therefore needed by governments for land use planning and climate change adaptation, and for negotiating land contracts that will ensure that a nation’s productive capacity is maintained. It is needed by national extension and international development organizations to target their investments as well as need by individual farmers to determine how to best feed their children today, while ensuring that future generations will also be able to feed themselves.

Dr Herrick indicated that much of the necessary information and knowledge to understand land potential already exists in the scientific literature and as local knowledge, but is often not accessible or easily integrated and shared. Where the information and knowledge are accessible, the types of land to which they are relevant are often unclear. In some cases, the most similar soil and climate conditions (and therefore the best places to look for successful management strategies) may exist within a country, while in others the closest analogy may be on a different continent. He posed the question on how we can use social innovation to drive knowledge in land potential and resilience. Addressing this question, he revealed that the United States Department of Agriculture (USDA) and African Technology Policy Studies Network (ATPS) have established partnership between to develop a Land-Potential

Knowledge System (LandPKS) with initial support from USAID, following on an ongoing ATPS social innovation project supported by the Rockefeller Foundation.

Through the application of mobile phone technologies and web-based knowledge engine, the LandPKS will allow policymakers and land managers to share and access the most current information and knowledge for their specific type of land. A secondary function of this system will be to directly connect farmers, including women, with nearby farmers who have developed innovative strategies that they have tested on the same type of land. It will also increase the value and efficiency of existing agricultural extension workers by providing them with the tools and information necessary to communicate more specific and timely recommendations to particular groups of farmers (e.g., providing information on drought management specifically to those farmers with soils that are the most sensitive to drought).

The LandPKS will be piloted in Kenya and Namibia in 2014 following the development of the knowledge engine and mobile phone applications in 2013. These countries were selected because they include a broad range of biophysical conditions (soils and climate), large areas that are currently undergoing different types of land use change, a diversity of land ownership systems (communal, private and public), and very different levels of local knowledge, and management objectives, including both agricultural production and biodiversity conservation. It is expected that LandPKS following successful pilot implementation will be made available globally.

In his concluding remarks, Dr Herrick stated that like many other social innovations, the development and implementation process of the LandPKS will rely strongly on partnerships as the benefits of participating in the system are expected to vastly exceed adoption costs for both individuals and organizations.

5.3.4 Economic Growth's Secret Weapon: Innovation & Entrepreneurship

Mr. Denis C. Fourie, The Trusted Advisor, South Africa

As a highly successful entrepreneur, Mr Fourie asserted that Africa is one of the world's most appealing continents and home to Innovation, Vision, Entrepreneurship, Passion, and Determination, yet its potential and market remains untapped and underrated. The question then raised is: with all these attributes, why is Africa dealing much poverty, unemployment and so? He was of the view that African economies are not growing fast enough and African governments do not invest enough into these skills, raising a further question of how Africa can grow its economy to the point of alleviating poverty and unemployment and what governments should be doing differently. He noted that whilst there may be several answers, mostly theoretical, from experts across the globe, the answer is simple: "Start treating African countries as a business, utilizing and nourishing their strengths to eliminate their weaknesses whilst exploring the existing opportunities thereby reducing threats". This he believed can be achieved through promoting entrepreneurship and innovation in Africa!

Moving forward toward achieving, African countries need to not only provide our younger generation with the skills needed to become entrepreneurs, but also to promote and invest in existing entrepreneurs. He indicated that less than 1% of African entrepreneurs have access to funding locally to start their ventures, with most African entrepreneurs source funding abroad, which often results in those businesses moving abroad and as a result contributing

towards the American, European or Asian economies. Whilst most governments will argue they provide funding for entrepreneurs, their processes and requirements are often unrealistic and unobtainable due to the fact that such investments in entrepreneurs are managed by politicians and not by business people. Furthermore, most governments are now focused on a new buzz word, called social entrepreneurship which is not new, and existed for a long time however its definition within Africa context has been hazy.

Social enterprise is not non-profit organizations unless such non-profit organizations are generating income from its activities (provision of products and/or services. Social entrepreneurs unlike NGOs, are not dependent on philanthropy, voluntarism or government subsidies, but are self-sufficient and sustainable. It is for good reason that governments are focusing on social entrepreneurship as it shares the responsibility of addressing the challenges of society with the social entrepreneur. Government no longer needs to fund such through their own social development funds, but rather relies on businesses to improve the lives of their citizens and help grow the economy. The problem with this strategy is that it is not sustainable given the rate of increased poverty and unemployment in Africa. Governments therefore need to focus on investing in entrepreneurs, social and business entrepreneurs in order to grow their economies. Economic growth, employment and equality will only be achieved by promoting and investing in the innovative ideas African entrepreneurs have to offer

5.3.5 Social Innovation and Economic Growth: Experiences of the Global Knowledge Initiative

Mr. Andrew Gerard, Program Officer, The Global Knowledge Initiative, USA

Mr. Gerard defined innovation as a new way of doing things in a place or by people where they have not been done before. He asserted that innovations have been driving to economic and technological growth in many countries over the years. Drawing from some statistics from the Department for Business, Innovation and Skills (BIS) report, he explained that there is a strong correlation between investment in technology and labor productivity and that there is almost a universal correlation between investment in innovation and sales from innovation products. He demonstrated that private and public returns to research and development (R&D) are between 10-30% and 20-50% respectively. Investment in information and communication technologies (ICTs) can spur economic growth, e.g. 10% increase in mobile phone usage predicts 0.8% increase in economic growth (World Bank).

Scientists, technologists, and development practitioners operate in a time and context in which challenges are more complex which call for more interdisciplinary approaches than ever before. While challenges are increasingly thorny, a greater number of resources and potential solutions now exist to solve them than at any time in history. Against this complex backdrop, one salient question emerges: will existing resources-scientific, technological, institutional, and knowledge-based be utilized, or will they languish in academic, geographic, or sectoral silos? Going beyond this general question, will available resources reach those who need them to solve the scientific, social, and economic development challenges most important to developing and Least Developed Countries?

Mr. Gerard was of the view that the answer lies in the collaboration innovation to solve challenges which has been established in numerous studies. Despite its importance, however, structures that optimize the collaborative effort and resources of participants do not often spring forth organically. Rather, forging, optimizing and sustaining “purpose-driven networks” requires intent, tools, commitment, and trust. Where these ingredients mix we see the effects of collaborative innovation: knowledge creation, transfer of ideas from where they are to where they need to be, and the potential to find sustainable solutions to tough challenges.

Illustrating the power and promise of collaborative innovation, Mr Gerard shared the experience of the Global Knowledge Initiative (GKI) as a case study in how collaborative efforts in science, technology, and innovation can solve development challenges and produce economic growth. Since its formation three years ago, the Global Knowledge Initiative has confronted difficult questions about the nature of innovation and how best to produce sustainable development solutions. Drawing on examples of best practice in forming, optimizing, and sustaining international collaborative innovation partnerships using the Learning and Innovation Network for Knowledge & Solutions model (LINK) in Rwanda, the GKI built purpose-driven networks by partnering with National Universities to tackle STI-pertinent development challenges coffee estates whilst increasing farmers income by 6 folds and decreasing production coffee loss to Antestia by 30%. In his concluding remarks, he stated that the cost of failing to collaborate is rising; knowing how to structure collaboration, and the type of collaboration works best to increase the rate of innovation, is essential.

5.3.6 Constraints and Opportunities of Promoting Public-Private Partnerships in Irrigated Agriculture Financing and Management in Nigeria

Ebele C. Amaechina, Eboh E. C., and Nwagbo E.C. University of Nigeria, Nsukka, Nigeria

Dr. Amaechina’s presentation focused on the importance of boosting agriculture productivity for improved economic growth- enhanced income for farmers, reduction of poverty and hunger, and reduction in the burden of food import by fostering public-private partnerships in irrigated agriculture financing and management in Nigeria. With variability of rainfall due to climate change, and rising food demand from increasing population, the need for irrigated agriculture becomes more paramount. He emphasized that irrigated agriculture is potentially key to national food security as well as individual and community livelihoods at the local level. The application and management of water use is critical to raising productivity of agriculture and ensuring predictability in outputs.

In Nigeria, the performance and productivity of many irrigation and drainage systems is generally below potential due to a variety of shortcomings: Organizational issues such as unsuitable legal frameworks, incompatible actor interests, or inadequate economic incentives have all hampered the performance of the sector. At the irrigation project level, insufficient cost recovery and lack of direct linkages between revenue and expenditure, and between the client and the service agency are the root of the problems resulting to lower performance.

Dr. Amaechina indicated that the irrigation sector in Nigeria is highly monopolised and social sensitivity nature of the sector has fostered extensive government intervention that has not always been financially sustainable. While such arrangements are important, some questions

arise about these concepts: would it work in situations where the physical infrastructure is dilapidated; what should be the cost-sharing approaches in financing irrigated agriculture; what is the essential set of rights, responsibilities and powers to be included in irrigation management transfer? How can new institutions or regulations be introduced while matching past or traditional ones.

The presentation attempted to address these concerns by recommending that the improvement of the delivery of services, operation and management of the irrigation sector by tapping the expertise and efficiency of the private sector. Private sector engagement and capital mobilization is necessary for the delivery of infrastructure and services in the irrigation sector. Whilst engaging the private sector, multi-stakeholders dialogues are very crucial to develop a broader consensus on water valuation and self-ownership. At the farm level, farmers should improve productivity to enable them pay for irrigation service supply. At the governmental level, supportive investment and policy environment is essential for investors to reduce risks in the irrigation sector.

5.3.7 Mainstreaming M-health Innovations with Loosely Coupled Policy Interventions in Africa

Eng. Okuonzi John, Lecturer Kyambogo University, Uganda; ATPS National Coordinator, Uganda Chapter

Eng. Okuonzi's presentation assessed the capacity of mobile technology backed by policies to contribute toward the efficient and effective delivery of health services in Africa. Providing a background to this emerging paradigm, Eng. Okuonzi indicated that healthcare continues to pose challenges of affordability, complexity and access in Africa. As a result, 24% of the global disease burden is born by Africa with only 3% access to healthcare service providers. A new area of innovation to addressing the healthcare needs of Africa is the application Mobile health or m-Health which is the use of mobile communication and devices for providing healthcare services or achieving health outcomes. Though the field of m-Health is evolving in Africa, it is clear that there are few e-Government, e-Health, and Health Information Systems (HIS) synced policies that take into account the increasing access to mobile telecom infrastructure and availability of m-Health panaceas. He was of the view that innovations mostly thrive in enabling policy environment, funding and regulations at national and institutional levels. Therefore, mobile health policies are necessary for leveraging innovations and creating safe environment for health care service provision.

The presentation examined the current a set of policy issues related to m-Health and a set of leveraging strategies to improve m-health in the healthcare sector. He noted several challenges existing challenges which impeded the operationalization of the m-health in Africa: these included the rather weak ties between policy making and practice on one hand and implementation on the other hand. Secondly, the various actors (quadruple helix) in healthcare provision in Africa are often organised in a segments but loosely coupled way where separate and semi-autonomous work units specialize in different areas of care delivery. Thirdly, while it can be assumed that all African countries have the same aspirations for improved health care provision, the fact that each country is at different levels of

development means that not all policy issues are viewed in the same way. Hence there is a need for loosely coupled policy frameworks.

In his concluding remarks, Engr. Okuonzi stated that, the massive utilization of mobile phone technology present the health sector with a great opportunity to harness the benefits of m-health which is emerging as suitable alternatives to effective health care delivery. He encouraged the development of policies that promote user autonomy, which in turn drive m-Health adoption and hence innovations. He also advised that, responsible authorities should initiated reimbursement schemes that reward positive health outcomes and support the adoption of innovations such as the mobile health.

5.3.8 Determinants of Micro-Enterprises Growth and Revenue in the Niger Delta, Nigeria: Microfinance The Way Forward

Dr. Anselm A. Enete and Miebi Theophilus Gbigbi, University of Nigeria and Ministry of Agriculture and Natural Resources, Nigeria

Dr Enete's presentation drawing from a study that was conducted in the Niger Delta in Nigeria established micro-enterprises as important agents of economic and social transformation that deeply affect the lives of people through employment generation, contribution to GDP and reduction of poverty. The contribution of micro-enterprises often seem small at the individual level individually but collectively monumental and very significant to the overall national economy. In the Niger Delta region of Nigeria, the development and promotion of micro-enterprises are crucial to job creation toward curbing the high youth unemployment rate causing restlessness among the youth in the region. The objective of the presentation was to outline socio-economic and institutional factors that influence the growth and revenue generation by micro-entrepreneurs.

Over the years, the performance of micro-enterprises in Nigeria has been unsuccessful in making the desired impact due to some constraints confronting the sector. Micro enterprises are faced with inadequate financing making these enterprises very prone to liquidity issues. The study results revealed that, out of the 120 micro-entrepreneurs that were interviewed majority of the entrepreneurs were ageing, dominated by female operators. Micro-enterprises are relatively young in the area and majority of the businesses are small and cannot enjoy reasonable economy of large scale. The study identified age of entrepreneur, number of employees, length of experience in business, education, income level of entrepreneurs, asset holdings, access to market, and access to electricity supply, access to cold-rooms, amount of loan received and loan usage as key determinants to sustainability of micro-enterprises in the study area. The study identified the cost of renting stores and loan disbursement hindering the operation and sustainability of micro-enterprises. Other constraints are high cost of raw material, access to credit, lack of infrastructural facilities, size of loan received, weak purchasing power, working premise/location, lack of awareness, availability of raw material and marketing problem.

In moving forward the study calls for policies aimed at encouraging agro-based micro-enterprises development by improving the revenue of the entrepreneurs through micro-financing by government and non-governmental organizations to expand market infrastructures and boost agricultural intensification. It is recommended that government and

corporate bodies should take this matter with almost importance to encourage rural and urban industrialization to improve the standard of living of entrepreneurs.

5.3.9 Examining Institutional Linkages In Climate Change Adaptation And Mitigation: Implications For Sustainable Food Security And Environmental Quality In Nigeria

Taofeeq Ade Amusa and Dr. Anselm A. Enete, Department of Agricultural Economics, University of Nigeria

The focus of Dr Enete's presentation was to examine the existing challenges in institutional linkages for Climate Change Adaptation and Mitigation whilst assessing a framework for effective institutional linkages (formal and informal institutions) and expected roles of the major actors. He was of the view that effect of climate change is expected to be most severe in Nigeria where current institutional framework for effective climate change resilience is not effective, where funding to agricultural research has been comparatively low, the current spread of agricultural information and training are poorest, technological changes have been the slowest and where domestic economies depend heavily on rain-fed agriculture.

In Nigeria, although structural adjustment policies entailed substantial institutional change and modifications, the attention to Climate Change issues was virtually non-existent for a long time. Both government and the private sector who are in a better position to drive the agricultural sector through consistent policies, robust funding and infrastructure development have failed to accord climate change resilience the priority it deserves most especially from the perspective of sustainable institutional framework

Dr. Enete pointed out that adequately addressing these challenges call for proactive institutional framework that ensures effective forward and backward linkages between the actors in the formal and informal sectors toward sustainable climate change resilience in Nigeria. Substantial investments in social and human capital, particularly regarding formal and informal institutions are needed for institutions of sustainability to evolve. Institutional co-operation between formal and informal institutions on climate change therefore becomes the optimal approach to sustainable agricultural development in Nigeria.

5.3.10 Appropriate Innovation Structure For Sustainable Development

Ameha Mulugeta ,Addis Ababa Institute of Technology, Ethiopia

Mr Mulugeta's presentation analyzed current innovations and structures that promote or constrain innovation in Ethiopia and recommend structure and policy directions that prepares Ethiopia for the dynamic and innovative future. He pointed out that Science and Technology policy green paper 2010 for Ethiopia over the past year has failed to promote development through science, technology and innovations. The policy failed to influence a clearly defined and weak national system of innovation that contributed to the low ranking (108th) of Ethiopia in the innovation for Development Report, 2010. In a bid to address that the flaws in the policy, Ethiopia currently reformulated its STI policy which was ratified by the House of Representatives in 2012. However, the policy is more focused on technology transfer and represents a clear and unbiased vision for innovation development is missing.

Mr Mulugeta remarked that a nation's innovation system performance is dependent on spheres of expertise and the effective interaction that exist among institutions that are engaged in Science, technology and innovation. He there recommended the establishment of innovation centers which will provide the needed impetus to harness the innovative ability of available professions, experts, researchers and also bridge the current gap that exist among research institutions, universities and other institutions fostering innovation in Ethiopia.

5.3.11 Assessment Of Innovative Institutional Arrangements: The Case Of Integrated Tamale Fruit Company (ITFC) In Ghana

Mr. Francis Kizito Yaw Amevenku, CSIR Water Research Institute, Accra, Ghana

Mr Kizito presented an assessment of opportunities, challenges and potential for further investments in water management based contract farming systems dwelling on the experience of the Integrated Tamale Fruit Company (ITFC), a limited liability entity which produces and processes certified organic mangoes for local and export markets, located in Northern Ghana. He pointed out that contract farming (out grower scheme) though still in its infancy in the country, offers a suitable model to enhance smallholders' access to water and markets.

Mr Kizito indicated that there are currently no clear cut national policies in terms of contract farming mechanisms over the years. At best the establishment of out grower schemes were mentioned as components for achieving objectives of some projects. The ITFC model depicts the only water management based contract farming experience currently in the country which produces organic mango on a nucleus farm in conjunction with produce by its contracted farmers through the provision of an interest free loan.

The out grower model offered opportunities to increase incomes and reduce risks. Each party derives mutual benefits as producers earn long term sustainable incomes and the buyer get large volumes of organic mango for processing and export. The principal stakeholders involved in the contract namely, company, leadership of the out growers association, and individual farmers overwhelmingly expressed satisfaction about the terms guiding the contract. However, when examined against a set of criteria for successful solutions, the outcomes of the scheme were mixed: in contributing to smallholders' livelihoods the model is unlikely to reach the poorest farmers unless special measures are taken to ensure their participation; on Gender and equity consideration, the model shows that women farmers can successfully participate, particularly when they have been targeted by donors or receive support from NGOs; on out scalability, the model depends on largely on high value export crops limited to areas with good connections to export markets but poorest farmers often found in remotest areas; on the ease of implementation, with large agri-businesses showing interest and donors supporting such out grower schemes water infrastructure will be shared by smallholders, companies etc., but donor investments also. On resource sustainability, the model addresses existing and potential environmental issues through reforestation and the use of natural fertilizers.

Mr. Kizito presented some major challenges confronting the implementation of the model/scheme which included the difficulty in establishing mutual trust between

stakeholders, information asymmetries and the high transaction costs. But with modifications, the ITFC model holds promise for out scaling in Northern Ghana and possibly in other regions of the country. The model can offer additional livelihood options for subsistence farmers in a region characterised by a high incidence of poverty and food insecurity but with abundant land and water resources. More generally, the trust developed among ITFC the contract farmers and its commitment to broader corporate social and environmental responsibility initiatives are important features of this model and its success.

The potential roles for investors included the provision of legal and institutional frameworks to enhance transparency and to clarify privileges and responsibilities, support farmer organizations in out grower schemes to ensure farmers' voices were heard and their interest served in the long run, ensuring poor farmers participation by provision of affordable credit and repayment terms that coincided with farming income cycles, safety nets etc., ensuring women farmers participation by setting realistic conditions for financial support and the provision of incentives for companies to invest in poor smallholder farmers.

5.3.12 Treatise and Praxis Linking Social Ingenuity And Institutional Innovations In Sustainable Development: A Case Research In Afar And Boran

Costantinos BT Costantinos, Professor of Public Policy, School of Graduate Studies, College of Management, Information and Economic Sciences,

Common sense would exact an urgent need to bring into equilibrium to scale the destructive magnitude of industry, untenable demographic dynamics and frantic misuse of resources on the one hand and development pastoral sustainable livelihoods on the other. Beyond platitudes and empty pledges, global covenants for a sustainable world have borne little fruit. The Rio+20 jamboree manifestly projected the mercerization of well-meaning global survival concerns by financially dominant and compelling transnational companies and client states which successfully coerced a dramatic barter of the human environment and life on the planet with admirable succinctness and brazen verve.

The knowledge gap addressed in the research is the link on how local social innovations can be transformed into institutional praxis in sustainable development at the national level. Hence, the research questions underpin (1) what social innovations do exist in communities? (2) What are the environmental challenges to these innovations posed by vectors of vulnerability and (3) how would technology off set this and what measures are being taken to institutionalize these innovations into production practices? These call for a requisite need to look for innovations, which promote appropriate sustainable development administration. Hence, the key objective of this inter-disciplinary research is to analyze critically the discourse on people-driven institutional and social innovations in sustainable development management and elevate this to a higher paradigm of linking the innovations at grassroots level to national policies and praxis.

Methodologically, the research uses both quantitative and qualitative methods to collect, collate and analyse the praxis in the link between societal and institutional innovations, employing four major techniques of participatory action research user-friendly and people-based research, critical recovery of history, valuing and using popular culture, production and

diffusion of new knowledge. Two communities in the Afar and Boran areas in Ethiopia, which possess many of the multiple innovation features, have been chosen to participate in the study. The survival of the pastoral production system in both societies is a function of their adaptability to the social and physical environment and strategies that are employed to meet each new challenge maintain the resilience of the system and help minimise unforeseen risks. The study concludes by proposing public policies strands informed by trans-disciplinary systems studies that need to be set in motion in Africa so that those strategies can be transformed into becoming the basis for sustainable livelihoods based on social entrepreneurship and that further innovation capacity development.

5.3.13 Institutional Challenges Of Current Structural Changes In West African Agriculture: An Analysis From The Benin Case

Dr. Roch L. Mongbo, Abomey-Calavi University, Benin

Dr Mongbo presented an assessment of the major structural and institutional changes with that have occurred in the agricultural sector using the case of Benin. He further examined the actual framework of actors, organizations and institutions in charge of agriculture and how these organizations reproduce their functioning modes of the 1960s and 70s, despite the multiple reforms that took place over the past 20 years.

Describing the current state agricultural sector in most (francophone) West African countries as “old palm wine in a new pot”, Dr Mongo indicated that staff capacity and the operational modes in non-public agricultural research, training and extension organizations, and professional associations lag more than a decade behind the structural changes underway in the agricultural sector. He emphasized on four key structural changes that are taking place in the agricultural sector. These include: (1) diversification of farm enterprises ranging from smallholder and medium size family farms of half literate male, female or young farmers with differential time allocation schemes (occasional, part and full time farmers), to medium and large agri-business of natives, or to very large agri-business with foreign financial shares; (2) Scattered mechanization (tractor-ploughing, water-pump and irrigation for horticulture and rice cultivation) limited to a few farming operations along the value-chains and therefore constrained by the pace of the non-mechanized operations; (3) Emergence of few industrial agro-food processing enterprises that contract out to smallholder farmers part of their supply in agricultural raw material; and (4) New structures of local and foreign markets for farm and agro-industrial products, following a rapid transformation of the food consumption patterns of increasing urban populations dumped with food imports, while new regulations make it hard to African agriculture to hold any substantial share on western markets.

Working on value chains and innovation platforms at local, regional and national levels; linking stakeholders at the various levels and lobbying for enabling environment for technology development and diffusion are necessary to effect changes in the structural and institutional set up of the agricultural sector.

5.3.14 Enabling Rural Innovations For Sustainable Development In Malawi

Mr. Tennyson Magombo, Executive Director, Arise and Shine International, Malawi



Mr Magombo presented an on-going program which was an outcome of a research he undertook under the sponsorship of ATPS. The overarching objective of the program is to build smallholder farmers' adaptive capacity or resilience against climate change impacts for their improved and sustainable livelihoods, while ensuring economic

Prosperity, social inclusion and protection of the natural resource base in the targeted communities.

The action research program is based on the hypothesis that utilization of farmers' indigenous knowledge and innovations and improved farmers access to markets of their produce would encourage farmer's investments into the natural resource base, conserve biodiversity, hence enabling farmers to mitigate and adapt to climate change impacts for their livelihood security, and ensure sustainable development of their communities and the nation at large.

Mr Magombo emphasized that the program is very unique and complements the Malawi government's efforts of eradicating poverty and hunger since it emphasizes in putting farmers first (i.e. taking farmers as partners) in development projects through use of private public partnerships (PPPs) in the context of inclusive or pro poor value chain development approach and building up the capacity of farmers to use their indigenous knowledge for sustainability of their agro enterprises and hence sustainable development of the communities involved and Malawi at large.

5.3.15 The Impact of Regulation On The Adoption And Diffusion Of Point-Of-Sale Technology In Nigeria

Ngozi, IhuomaIbeji, United Kingdom

Ms Ngozi's presentation examined the potential impact of existing regulations on the adoption and diffusion of Point-of-Sale (POS) technology in Nigeria. The cashless policy initiated by the Central Bank of Nigeria (CBN) resulted in the introduction of several technology innovations in payments including the Point-of-Sale (POS) technology which are aimed at reducing Nigeria's heavy dependency on cash transactions, supported by. For merchants and traders alike, the POS technology provides a more efficient and convenient payment channel to facilitate business transactions.

Ms Ngozi indicated that the contribution of a new technology to economic growth can only be realised if the technology is well adopted and widely used. However, current adoption rate of the POS technology in Nigeria is at 0.013% of the potential adopters (merchants) very low compared to other African countries such as Uganda (0.45%) or South Africa with more than one POS per merchant and far from the projected minimum of 3 POS per merchant by 2015. This outcome can be attributed to the fact that current regulatory structure appears to undermine the learning and persuasion stages of the adoption and diffusion dynamic process,

thereby limiting the ability of merchants to acquire and use POS terminals. Moreover, the fees structure for POS providers operates outside the standard two-sided market framework, thereby creating imbalances and distortions in the current Nigerian model. Again there is evidence of duplication of processes and functions, which increase costs to end-users of POS terminals, and ultimately adoption and usage.

Ms Ngozi was of the view that imposing an operational technology through regulatory mandates is unlikely to be effective in an industry characterised by network externalities. It was therefore important that the fee structure facing merchants balances the two sides of the payment market, avoiding undesirable distortions to ensure smooth functioning of the payment infrastructure in Nigeria (e.g. POS deployment, maintenance, training, and support). This may increase costs on the adoption side of the market. Therefore, policies and procedures promoting the POS technology in payment should grow naturally from incentives provision associated with its adoption and usage.

5.4 Parallel Session Four

This session covered two sub-themes that delved into youth and gender for sustainable development in Africa and mainstreaming trans-disciplinarity in STI in higher education. The session was co-chaired by Ms. Alice Lamptey, a senior programme specialist with the Pan African University, African Union Commission in Addis Ababa, Ethiopia and Prof. Malachy Okwueze, Deputy Vice Chancellor, Administration, University of Nigeria, Nsukka. The papers submitted under these sub-themes were presented as follows:

5.4.1 Youth and Gender Empowerment For Sustainable Development In Africa: The Role Of The African Youth Forum On Science And Technology (AYFST).

Mr. Victor Emeka Ngwoke, Chair, AYFST, Nigeria and Mr. Abdelaziz Lewani, Vice Chair, AYFST, Benin



Mr. Emeka and Mr. Lewani's presentation focused on the situation of the youth in Africa and the role of AYFST in empowering the youth to take charge of their lives and contribute to their countries' development. They began by clarifying that for purposes of their presentation, youth represented persons between 18-24 years

of age. In other situations the term 'youth' could also represent state of mind, status or experiences. The youth formed 18% of the global population, 87% of which lived in developing countries and comprised the majority in African countries. However, the youth were faced with numerous problems such as unemployment, semi-literacy and illiteracy, poverty and hopelessness. Most governments designed and implemented development policies that isolated them, leading to their marginalization in spite of their high numbers. Therefore, there was need for the youth to participate, engage and be integrated in the development agenda of Africa.

The AYFST programme is the youth arm of the ATPS which seeks to elevate the status of the youth in Africa by encouraging their participation in STI and empowering them to take bold steps towards improving their lot. AYFST empowers the youth through capacity building, imparting of skills such as entrepreneurship, knowledge sharing, and mentoring. In 2009, the Y I Can (Youth Innovation Challenge) was launched to promote and support innovations in various fields (e.g. environment, agriculture, health and sanitation) through challenge awards such as the climate change innovation challenge. In conclusion, the presenters stressed that AYFST was the voice of the youth on STI and sustainable development in Africa and its activities were geared towards making a difference on the continent.

5.4.2 Successful Youth Initiatives In Africa: Lessons And Way Forward For Attaining Sustainable Development

Ms. Constancia Akola Amukhobe, TNS RMS, Nairobi, Kenya

Ms. Amukhobe began by quoting Ban Ki Moon the Secretary General of the United Nations, who stated that “The world’s young people are a major human resource for development. to achieve the Millennium Development Goals, including the overarching goal of cutting poverty and hunger in half by 2015....” Ms. Amukhobe enumerated some youth initiatives in Africa that were championing sustainable development. The main initiatives were: the Education for Sustainable Development (ESD) initiative by UNESCO on technical and vocational education and training (TIVET) Program in Eastern and Southern Africa, Youth participation in development (YPD), African Youth Bio-Entrepreneurship fund Program, Africa Youth Initiative on Climate Change (AYICC), and the DuPont and 4-H Youth Development Initiative for Rural Africa.

She said that youth initiatives in Africa had achieved significant successes but had also faced barriers. The key successes were increased awareness about sustainable development, participation in platforms that enhanced training and capacity building, acquisition of team work skills, support for innovations by government and other stakeholders, and promotion of the culture of self-help and discipline. She outlined the hindrances faced by youth initiatives as lack of sustainability or continuity of initiatives once funds ran out, lack of cooperation and support at national level, lack of a clear understanding of the scope and context of sustainable development, low quality output due to poor qualifications and inadequate training, and marginalization in mainstream development.

In conclusion, Ms. Amukhobe recommended that there was need to reorient curricula taught in schools to include sustainable development, to involve stakeholders in ensuring that skills taught matched job market demands, to continuously strengthen institutions dealing with youth to boost their capacities, to involve the youth in all spheres of national development, and to sensitize the public to perceive the youth as change agents rather than trouble makers.

5.4.3 Empowering Women for Sustainable Development Through STI: The Key Challenges

Ngozi Uche Onyejeli, Doctoral researcher based in Scotland, United Kingdom

Ms. Ngozi's study examined the key challenges faced by women in Africa and how they lithe effect on their participation in STI. She noted that the challenges facing women in Africa were interlinked, mutually reinforcing and multi-dimensional capability deprivations, harmful culture, little or no education, poverty and ill health. Cultural practices such as female genital mutilation, boy child preference, and child marriage were said to contribute to low female enrolment and retention in school. Ms. Ngozi noted that curricula taught in some countries were gender biased and did not encourage women's participation in STI. Further, some governments did not have adequate policies and programmes to bridge the gender divide. Any meaningful attempt at engaging African women in STI capacity building for sustainable development had to begin with a thorough understanding of the core enablers of constraints to women's engagement.

Ms. Ngozi concluded by stating that it was necessary for African governments to design policies and legislation with a marriageable age limit to enable women attain basic education of at least twelve years, to adopt and implement the UN convention on the right to child education as well as the African Union protocol on the rights of women, to reorient curriculum to emphasize science and technology, and to provide efficient knowledge delivery infrastructure in rural and urban areas.

5.4.4 Innovative and Entrepreneur Skills For Employment: A Challenge For The Youth In Africa

Luckson Muganyu Kaino, College of Education, University of South Africa (UNISA)

Mr. Luckson's presentation dwelt on the education system in South Africa and examined three main forms of education, namely general education (prepares the learner for life in a general sense and for higher education too) vocationally oriented (produces someone who is not immediately ready for the job market but is well versed in the specific context and environment of an occupation), vocational education (produces someone who is equipped to join the job market immediately). Education was defined as a means of preparing for occupational fields and for effective participation in the world of work and development. His objective was to identify opportunities and challenges presented by these systems and the impact on youth employment or entrepreneurship. He observed that in some cases, education offered in schools and tertiary institutions was did not meet market demands, resulting in unemployment. Unemployment among the youth led to social vices such as loitering, pick pocketing, robbery, and prostitution.

Many educational authorities in different countries had realized the need to prepare learners for white collar jobs, manual jobs and self-employment. In Africa examples of institutions where students were trained in different fields to obtain employable skills included: the Swaneng Hill in Botswana (established in 1962), the Village Polytechnic in Kenya (established in 1971), the Emalatini Development Centre in Swaziland (established in 1972), Tanzanian's Polytechnic Educations Support Programme (PESP) (established in 1977). However, there still existed a gap between what was studied in these institutions and what was needed by employers. The South African school system's shortcomings had necessitated

a new curriculum that provided a number of subjects which mixed theoretical knowledge and acquired or contextual knowledge. These subjects included agricultural management practices, agricultural technology, dance studies, design, visual arts, accounting, civil technology, electrical technology, mechanical technology, engineering graphics and design, computer applications technology, consumer studies, hospitality studies, and tourism. While hailing the new curriculum for allowing learners to choose their career fields, Mr. Luckson took exception with the fact those schools no longer provided guidance and counselling in career choice, leaving this important role to peers and parents. In spite of the new curriculum, unemployment was still rife especially among the youth. He drew lessons from school systems in Australia, Germany, Switzerland, and South Korea that South Africa could emulate to limit unemployment and enhance entrepreneurship among its young people. In his concluding remarks, he emphasized that South Africa needed to reorient its curricula to match market demands. Curriculum development needed to put into consideration students' needs and aspirations as well as remain diverse and relevant. Adequate funding and deployment of competent teachers and staff to learning institutions was critical, as was collaboration between government, industry and the community.

5.4.5 Bamboo Bicycle and Car: Green Solution To Nigeria's Transport Problem

Ukoba, O. Kingsley, Federal University of Technology, Akure, Nigeria

In his presentation, Mr. Ukoba noted that in recent years, the need for eco-friendly transportation had become apparent thus stimulating an interest in green design approaches. He interrogated the possibility of a green solution to Nigeria's transport problems through the development of eco-friendly bicycles and cars made from bamboo. The objective of his research was to make a bamboo fixed gear bicycle that was strong and durable, low cost and comfortable to ride. The bicycle was made from eco-friendly material, thereby contributing to climate change mitigation through reduction of carbon emissions into the atmosphere. Carbon emissions contributed to ozone layer depletion leading to global warming and climate change. Literature showed that bamboo was an environmentally friendly plant, producing 35% more oxygen than wood and with high capacity to sequester carbon. To justify his study, he observed that bamboo was very fast growing, cheap, and was the closest to carbon fibre reinforced plastic used to make bicycle frames. Demand for bicycles as a mode of transport was high and bamboo bicycles provided a cheaper option in comparison with imported steel bicycles. Bamboo was readily available and its production was labour intensive, thus had potential to provide jobs to the youth and generate national income too.

Mr. Ukoba outlined the selling points of a bamboo bicycle as: its functionality, amazing ride quality (i.e. it had four times the vibration dampening of carbon fibre), similar stiffness/weight ratio of steel, and its uniqueness. In addition he felt that bamboo bicycles would appeal to people supporting the "green revolution" through the use of natural and environmentally friendly materials. He informed the audience that he was in the process of conceptualizing and designing a bamboo car and would communicate his findings soon. He indicated that further research was necessary to design bamboo motor cycles, tractors, airplanes and eventually have a bamboo transport system. Finally, he encouraged third world countries to embrace locally available materials as green solutions to everyday problems and potential job creators.

5.4.6 Youth Development And Engagement In Science, Technology And Innovations In Tanzania

Basili S. A. Liheta¹, Deogratias B. Aikaruwa¹, Gerald Absanto^{1,1} Moshi University College of Cooperative and Business Studies, Moshi, Tanzania

According to a report by World Bank, 2010 Nearly 50% of the developing world population is youth and children and there are about 1.2 billion 15 to 24 year olds youth population in the world and one billion live in the developing countries (UN, 2008). Mr. Gerald Absanto noted that this youth bulge represents both a challenge and an opportunity for development. In developing countries, Tanzania in specific, the youths face challenges derived from limited access to resources, education, training, employment, and broader economic development opportunities and therefore becoming the most vulnerable group in the country.

As part of the solution to the challenges, Tanzania needs a development approach that ensures full participation of young for creative change especially in Science, Technology and Innovation (STI). But reactive change requires resource commitment to get it on one hand and tailored made skill training on the other. In return resource commitment and tailor made training would strength youth gain required skills to meet subsistence needs through properly utilization of resources, promote youth awareness participation in STI, and involve the youth in social development networks and foster inclusive approach to reduce adverse impacts that might be caused by the youth.

The Tanzania national development vision (2025) is a long term desire of the type of society a nation wants to build over a given time frame. It has a number of objectives and strategies in which all focus at developing the country to a middle-income country with much higher levels of human development. A deeper analysis of the vision, poses critical challenges in terms of contribution of youth in national development and STI. In scrutinizing the youth involvement in the development process, STI are therefore imperative. Taking into account youth inclusion.

The presentation examined the intervention of strategies that considered the full and effective participation of youth in the STI development process which included: encouraging and promoting youth-led organizations and the important role they play in supporting youth in capacity-building and providing non-formal education through skills and entrepreneurship development; financial and technical support and promotion of their activities, and providing young people who are disconnected or socially and economically excluded with opportunities to participate in science, technology and innovations. This will be achieved through creating effective and efficient channels of cooperation and information exchange among young people, their national Governments and other decision makers.

Such information will serve as a knowledge asset for both practitioners and policy makers to foster activities on youth development through science, technology and innovations.

5.4.7 Networking And Empowering Youth In Science, Technology, And Innovation (STI): A New Model For Youth Engagement

Kiprono Caleb Metto, YADSTI, Kenya

In his presentation, Mr. Kiprono defined youth as the “transition from adolescence to adulthood, from dependence to independence, and from being recipients of society’s services to becoming contributors to national, economic, political and cultural life.” The youth comprised approximately 20% of Africa’s population and 60% of the unemployed. Majority of the youth, unemployed or not lived on less than 2 dollars a day and Africa needed to generate at least 10-15 million jobs annually to cater for its unemployed or underemployed youth. Citing the case of Kenya, he observed that youth unemployment was at 21% and the job market was unable to absorb all fresh graduates. Ensuring that the youth were integrated into the economy and gainfully employed would enhance Kenya’s competitiveness in the global arena as well as improve investment and growth. He stressed that all stakeholders (private sector, government, civil society, academia, and international partners) had to be involved to draw up strategies and solutions to youth unemployment.

Mr. Kiprono drew experiences from YADSTI (Youth Agency for Development of Science, Technology and Innovations), an agency whose objective is to empower the youth in STI through capacity building, networking and entrepreneurship. YADSTI was intent on finding solutions to development challenges through practical solutions such as employment creation for the youth. He outlined various government led youth initiatives such as the youth enterprise development fund and kazi kwa vijana (work for the youth) as programmes that his organization would add value to. YADSTI endeavoured to create a networked STI hub that built capacity and energy for entrepreneurial pursuits by youth in higher learning institutions, preferably universities. Although university graduates made up only 1.4% of Kenya’s unemployed, they were more likely to grow the economy as “opportunity entrepreneurs” than “necessity entrepreneurs.” The network of STI hubs would initially focus on seven thematic areas critical to Kenya’s development i.e. agriculture, information and communication technology, health and life sciences, engineering, energy, environment and natural resource management, statistics and applied sciences. The key activities of the network hub would be creating a dynamic network, training of trainers and students, providing professional mentoring and seed funding.

In conclusion, Mr. Kiprono said that YADSTI had teamed up with the government under the auspices of the ministry of science and technology to develop a purpose driven network to achieve this vision. The network was representative of national, continental and international stakeholders cutting across different geographical zones, disciplines, and institutions. Several partners had already agreed to support the new initiative and he invited those interested to join the network and contribute to change.

5.4.8 Science for Women: Supporting Women’s Development and Livelihood Activities Through Science Technology and Innovation

Ezeibe, A.B.C., University of Nigeria, Nsukka, Centre for entrepreneurship and development research

Ms. Ezeibe’s presentation looked into the importance of making STI policies gender responsive by encouraging women’s participation. She observed that many national STI

policy making and implementation initiatives did not fully consider the centrality of gender equity and women's empowerment. She underscored the importance of gender equity in STI programmes and stressed that these programmes would not be effective and sustainable if concerns and aspirations of both men and women were not taken into consideration. Women in Africa were marginalized in the mainstream development agenda yet their contribution to development was significant. In agriculture, women provided about 43% of the labour force and were reported to be almost 20% more productive than men given similar access to land and inputs. Women comprised two thirds of the world's population that lacked access to safe drinking water and were also exposed to unclean energy sources at the household level. They also had less access and ownership of modes of transport such as wheel barrows, bicycles, motorcycles, or cars. As well, there were few women in management and leadership positions in medium and large enterprises. These inequalities played out in science, technology and innovations (STI) related initiatives. STI could play several roles in supporting women's development and livelihood activities in agriculture, energy, water and sanitation, energy and conservation of biodiversity. However, women's participation in STI was limited by poor access to resources such as land, credit, technology, information, training and education.

Ms. Ezeibe recommended that in order to achieve sustainable development and meet millennium development goals, governments and stakeholders needed to find the right mix of policies and programmes that addressed gender inequalities in development as well as in STI. Enhancing women's role in STI and developing and implementing STI approaches which benefited women (science for women) was critical. This would be achieved through consultation and working with women in the choice, development and application of technologies, providing them access to resources, ensuring their contribution to and benefit from STI, as well as recognizing and supporting their local knowledge and innovative practices. At national level, STI policies needed to be gender responsive and linked to spheres of development such as agriculture, environment and energy.

5.4.9 Youth and ICT for Development: Digital Divide?

Irene Magara, Mbarara University of Science and Technology, Uganda

Ms. Magara's paper focused on access to information and communication technology in Uganda and explored ways in which the digital divide could be narrowed. She stated that access to ICT was influenced by numerous factors among them employment rates, urbanization, poverty, literacy levels, and migration. The challenge of bridging the digital divide did not necessarily lie in access to ICTs but in other factors such as the quality of the connection, affordability, relevance of content, legal and regulatory frameworks, effective use, and socio-cultural factors. She noted that efforts towards closing the gap required changing the public's mindsets about ICTs, robust education systems, gender mainstreaming, and promotion of local content.

Although the digital gap had not been closed, efforts had been made towards achieving this goal. They included programmes and activities such as infrastructure development, creation of business opportunities, consumer education and awareness programmes, and setting up policies and strategies. With regard to telecommunication, five key players dominated the mobile phone sector and accounted for 84% of the market. These players were MTN, Airtel, UTL, Warid and Orange. The Uganda Communication Commission's main objectives and roles in closing the digital divide were promoting national coverage of communication

services and products, developing and improving rural communication services, and encouraging the participation of the private sector in the development of the telecommunications sector. By December 2011, mobile subscriptions had gone up by 14% from the previous year. Other ICT related initiatives that bore fruits included the Kasiisi project in partnership with One Laptop per Child (OLPC), ICT training programmes for the youth, and the rural communications development fund (RCDF). In particular, the RCDF was a government led initiative that leveraged communications access to the hard-to-reach areas such as rural areas which were not covered by major communications players due to their remoteness. Other government efforts were the draft national ICT policy framework, addressing gender related inequalities through inbuilt mechanisms, and encouraging liberalization and privatization of the telecommunications sector.

In conclusion, Ms. Magara identified some of the barriers to bridging the digital divide as the mismatch between political leadership versus the benefits of an efficient telecommunications sector, weak regional groupings such as the East African Community as well as the government's role versus privatization. She lauded the telecommunications sector for the significant progress it had made towards bridging the digital gap in Uganda and ended with a quote from Carly Fiorina, a renowned American business executive: "Many people see technology as the problem behind the so-called digital divide. Others see it as the solution. Technology is neither. It must operate in conjunction with business, economic, political and social systems."

5.4.10 The Link Between Maternal Employment And Child Wellbeing: Evidence From West Africa

Ikenwilo Divine, United Kingdom

Mr. Ikenwilo's study investigated the effect of maternal employment on child wellbeing. He observed that a mother being in employment could mean one or two things which include; a higher disposable income for the family which could be invested in the wellbeing of the children, or time spent away from the child, which could diminish its wellbeing.

Empirical studies had revealed that there were links between maternal employment and breast feeding, obesity, dietary or physical activities, and cognitive development. He however noted that there were other variables that affected child health such as socio-economic factors. The Nigerian demographic and health survey of 2008 found that maternal employment had an effect on the frequency of breast feeding and food choice. Only slight differences were observed in preference for breast feeding among working mothers (55.4%) and non-working mothers (59.8%). The same trend was reported for frequency of breast feeding, with both working and non-working mother's breast feeding their babies four times during the night. Interestingly, during the day, both categories of mother's breast fed breast fed approximately nine times. The study however did not elaborate the circumstances under which working mothers were able to attend work and breast feed at the same time. With regards to food choice, working mothers invested more into different food groups in comparison to non-working mothers. Nevertheless, the study did not provide information about the nutritional quality of these food groups or factors that led employed mothers to prefer them.

The author concluded by noting that the study was ongoing and more analysis was required to develop concrete results that could inform policy and decision making. He promised to avail the final results once the study was completed.

5.4.11 Raphia Palm (*Raphia Hookeri*) Wine Production: A Goal Mine In Nigeria

Okorji, E.C. and Okon, U., Department of Agricultural Economics, University of Nigeria, Nsukka, Nigeria

Mr. Okorji began his presentation by providing an overview of the agricultural sector in Nigeria and went on to give a case study of Raphia palm wine production and its potential to generate income and create jobs. He remarked that despite the interest Nigeria's petroleum industry had generated over the last forty years, agriculture remained the mainstay of its economy and contributed 40% of the gross domestic product (GDP) compared with the petroleum and gas sector which contributed 25% of the GDP. With an expanding population of 165 million, there was need to create employment and generate national income to spur development. The Raphia palm was a genera of palm that was indigenous to Nigeria and whose potential remained largely untapped. The research specifically assessed the socio-economic characteristics of the Raphia palm wine tappers, estimated the profitability of Raphia wine production, and identified major constraints to Raphia wine production in Akwa Ibom state. The results showed that Raphia palm wine was a major economic activity for older men in their mid and late forties. Profitability analysis revealed that the enterprise was viable and profitable, with wine tappers making considerable amounts of money. However, there were constraints to production which included high labor costs and lack of credit.

He ended his presentation by recommending that Raphia palm should be included as a key crop in the government's list of value crops. Additionally, adoption of mechanization would help reduce the high labour costs and increase output. Facilitating access to credit and improved varieties of Raphia palm would also boost productivity and profits. Lastly, there was need to encourage the youth to take up wine tapping as a source of livelihood.

5.4.12 Leveraging Talent for African Development

Velaphi Msimang, the Mapungubwe Institute for Strategic Reflection, South Africa

Dr. Msimang's paper underscored the need to invest in the youth and to tap Africa's talented minds in science, technology and innovations (STI). He reported that South Africa had come a long way since the era of apartheid and posted economic growth over the last two decades. The statistics showed that by 2011, more South Africans had access to electricity, safe drinking water and disposable income. In spite of these improvements, unemployment rates were still high especially among black South Africans. The average income per household was lower for black South Africans in comparison with white South Africans. Inequality had increased over the years and there was need for huge investments in the youth and in talented citizens too. Investment in education among the youth, infrastructure, clean energy and poverty alleviation would enable the country meet its development objectives. He cited the case of three young girls whose plight was highlighted by a local newspaper as that of the desperate poverty faced by some young South Africans especially in rural areas and in informal settlements. The three girls sat outside in the night and used light from firewood to prepare for their matrix exams. The irony was that they were studying to attain a brighter future but the pollutants from the firewood were ruining their eyes and health denying them the bright future they were working so hard to achieve.

In conclusion Dr. Msimang stressed that Africa's hope for development did not lie in its mineral resources but in its people. Africa could not compete with the rest of the world without a critical mass of talented scientists, engineers, technologists, and technicians. It took many years to develop human capital and the sooner Africa began doing so and retaining it, the sooner it would reap benefits. He added that Africa's youth could either be a risk or an opportunity and governments that invested in the youth in form of science, technology and innovations invested in development and in the future too.

5.4.13 Maternal Education And Child Health In Nigeria: Implication For Science, Technology And Innovation

Azubike Achike, Department of Economics, University of Nigeria, Nsukka

Mr. Azubike's study focused on the effect of maternal education on child health and the subsequent impacts on STI. He noted that children's health and their development provided the foundation for adult health and achievement. Education was believed to have the potential to facilitate care giving behavior in women

Specifically, the study analyzed the effect of maternal education on height-for-age of child in urban and rural areas; socio-economic, demographic and environmental factors that affected child health in rural and urban areas; and determinants of child mortality. The research revealed that maternal education mitigated health risk factors in children through child specific behaviour based on knowledge acquired in school. Additionally, safe drinking water, maternal education, the asset index, place of residence, age of child, sex of household head, and mother's occupation all contributed to reduction in health risks in children, leading to an increase in height-for-age of child. Moreover, mothers who were educated were more likely to have their children vaccinated compared to uneducated mothers. Generally, educated mothers took better care of their children through access and use of healthcare information. Incomes earned through employment enabled mothers invest in technological appliances that saved time, thus enabling more attention to children.

In summary, Mr. Azubike's research showed that there was a strong positive relationship between maternal education and child health using height-for-age of child as the indicator for health. Education also helped to facilitate treatment whenever the child was sick and enhanced good sanitation thereby reducing health risks. Besides, child health could be improved by educating women and giving paid jobs to educated mothers. He recommended that the government took measures to enforce female literacy programmes and correct the imbalance in access to education by females in comparison to men. He also encouraged investment in science and technology as a way to boost child health since STI boosted the role of women as care givers or health workers.

5.4.14 Science, Technology and Innovation Policy Research in Africa's Higher Education: Challenges, Prospects and Opportunities

Chux Daniels, School of Business Management and Economics, the Freeman Centre, University of Sussex, United Kingdom

Mr. Daniel's presentation explored how science, technology and innovation research and policy could be integrated in Africa's institutions of higher learning. He observed that some of the challenges and tensions of STI research and policy were related to: the interdisciplinary

nature of research and policy, definition of STI research and policy within the African context, the STI research agenda for Africa, aspirations of STI versus capabilities for STI research, collaboration and linkages, decision making and foresight activities, declining funding, poor infrastructure and inappropriate methodologies. He gave an example of the University of Edinburgh in the United Kingdom whose institute of STI was highly regarded in the UK and abroad due to its multi-disciplinary approach to STI research and policy. He however stated that the case of the University of Edinburgh was a unique one and that many institutions were not very successful in conducting multi-disciplinary STI research.

With regards to capabilities for STI research and policy, he distinguished between organizational capabilities (processes, routines) and individual capabilities (skills) and stressed that both types were necessary for STI research and policy making. Short term capacity building workshops focused on skills development had not worked since the 1970s and there was a need to adequately address the organizational capabilities into which individuals (experts and policy makers) returned and functioned in after the workshops. For successful realization of STI research and policy goals, institutional and human capacities had to be invested in. Opportunities for successful STI research and policy lay in a strong and productive research base, commercialization, increased research collaboration, highly skilled workforce, STI capabilities in higher education, government and industry, foreign direct investments, competitiveness, economic growth and sustainable development.

In his concluding remarks, Mr. Daniels urged governments to set up STI policy research institutes in selected higher learning institutions across Africa to increase the role and importance of organisational capabilities, to have stronger university-industry-government linkages and collaborations, to address gaps in national innovation systems, to enhance cooperation with developed countries, and to increase the role of STI research output in government decision making. He emphasised that Africa could borrow aspects of western STI policy and research models that worked well and try to implement them. In addition, he observed that strong, highly robust and world-class universities (higher education) equipped with STI policy and research capabilities were critical towards achieving Africa's sustainable development goals.

5.4.15 Education Implosion In Africa: Mainstreaming Appropriate Education Technology And Trans-disciplinarity As A Way Out

O.C. Eneh, Enugu Campus, University of Nigeria

Mr. Eneh's presentation delved into education systems in Africa and the need to reorient them to current market demands and realities of development. He started by enumerating the importance of education by quoting Georges Danton [1759-1794] who said that "education is the second need of people, after bread." He reported that over the last five decades, Nigeria had undergone a significant expansion in the number of learning institutions, the number of subjects taught and enrolment rates. For instance, between 2001 and 2005, the number of secondary schools rose by 173% and between 2001 and 2004, the number of university students rose by 102.8%. Student population rose by 740% per annum for a period of 52 years in one of the universities. In spite of this progress, graduates remained largely unemployed and lacked the necessary drive and skills required by the market. Outdated and irrelevant curricula, under funding, infrastructural decay, and brain drain were some of the reasons for the sorry state of affairs. Unemployment rates were said to be high because

learners were half baked and did not have practical skills required by the job market or entrepreneurial capacities. Due to unemployment, the school and university dropout rates had increased, while teachers and lecturers reduced due to internal and external brain drain. School drop outs became street traders, porters, barrow pushers, house girls/boys, and child marriage or prostitution victims. The chase for certificates in most cases led to examination malpractices, with Nigeria being ranked first globally in examination malpractices index. The poor performance of government programmes in addressing unemployment was associated with their remedial rather than preventive approach to unemployment.

Mr. Eneh emphasized that education was not only about acquiring certificates but functionality and utility. Viable education produced agents of change and development. Appropriate education technology and trans-disciplinarity were promoted as possible solutions to the current education implosion in Nigeria. Appropriate education technology is defined as “a teaching tool that uses the rich environment as a source of teaching/learning materials to impart on learners the knowledge, skills and attitudes of the world around them through personal contact and experience. It does not place emphasis on the study of books and charts and/or passing examinations, but on acquisition and application of science knowledge, skills and attitudes for the purpose of improving the environment and the learners’ living conditions. It emphasizes on the ability to explain, show, grow, demonstrate, name, think, and describe among learners. It promotes activity-based teaching through learner investigation, experimentation, exploration and demonstration. It aims at the brand of teaching that changes student attitude and behavior – and not accumulation of ‘head knowledge’.”

In conclusion, Mr. Eneh pointed out that African countries needed to shift from their education systems devoid of functionality and marketability and added that mainstreaming appropriate education technology and trans-disciplinarity would empower learners, build confidence and encourage entrepreneurial mind sets

5.4.16 Integrating Humanities Approaches To Shaping African Technological Development: The Case For An Indigenous Futures Component In The Science, Technology And Innovation Agenda In Africa

Oluwafunmilore Adebola, Department of Mechanical Engineering, Obafemi Awolowo University, Nigeria

Mr. Adebola began his presentation by calling for the need for synergy between STI and other facets of development such as knowledge systems, research and development, millennium development goals, and sustainable development. He introduced futures study/futurology/strategic foresight and said that there existed not only one future but many probable and possible futures. He defined futures studies as “a way of examining the possible futures of a human community. The goal of such studies is not to predict the future, but rather to help to build a future that will meet the community’s aspirations, and to assist in making better decisions that will have a greater chance of resulting in the desired future. This is a difficult undertaking, and the method chosen to guide this effort is crucial.” “In the broadest sense, futurists hope to inform people’s expectations of the future and to help make their efforts to shape the future to their worthy values and purposes more effective. In some sense, futures studies help us to “prepare for the unpredictable.” (Bell 2003). Futures studies apply methods from a wide range of already established fields such as philosophy, sociology,

history, psychology, engineering, mathematics, physics, biology, astronomy and tourism. Popular techniques include back casting, causal layer analysis and scenario creation. Mr. Adebola reported that futures studies was not new to Africa but very little research has been done and the only post graduate course on the continent was offered in South Africa at the University of Stellenbosch. The primary reasons why futures studies were not common in Africa included: political tensions over resources, institutionalization of research systems, lack of research capacity and poor funding, economic lure of other STI fields, and negative bias towards futures studies.

In his concluding remarks, Mr. Adebola advanced the need for policy makers to introduce futures studies as a policy issue, to sensitize the public in order to correct bias and encourage interest, to train undergraduate and post graduate students in futures studies, organize futures workshops and seminars, disseminate information using the print and electronic media as well as consider investing in an African futures university that apes the African virtual university model.

5.4.17 Information Systems Education In Sub-Saharan Africa: The Case Of Kenyan University Business Students Specialization Choice Trends

Prof. Atieno Ndede-Amadi, Kenya Kountry Business Incubator (KEKOBI), Nairobi, Kenya



The primary objective of Prof. Amadi's research was to investigate the relationship between Information Systems (IS) awareness among Kenyan university business students and the choice of IS as a field of specialization. She hypothesized that the choice of a field of specialization was dependent upon a student's awareness of its existence, its utilization in the real world, its career opportunities, and its strategic importance to the country's economic development. She defined IS as a technology driven system that is a set of interrelated components that collect, retrieve, process, store and distribute information to support decision making in an organization. In addition to supporting decision-making, IS help managers and other workers analyse complex problems, develop new products, and integrate various modules both within and across departments.

Prof. Amadi noted that although tertiary institutions in Kenya trained computer scientists, majority of them did not offer IS as a career choice and it was only taught in few private universities or as a course within disciplines such as commerce. Due to the high demand for system analysts globally, the few who were locally trained quickly joined the international market which remunerated highly. IS as an academic discipline remained largely unknown and unavailable to high school students preparing to join the university and as such, the level of IS education was low, resulting in a deficiency of skills. The study found that majority (71%) of the business students who had been exposed to IS concepts found it very interesting. Most students (72%) who had been exposed to IS concepts reported that given a chance, they would switch to IS specialization and 66% of this group said they would do so out of interest, while 33% indicated they would switch due to perceived career opportunities. 88% of the students interviewed said they felt that the university ought to offer a bachelor's degree in IS. IS awareness levels were high among students who had taken IS concepts classes and low among those who had not. IS awareness as a field of specialization among Kenyan business students was both low and late, negatively impacting its choice as a field of specialization.

The study concluded that awareness of IS was low since majority of the respondents did not know of the existence of the specialization, its utilization in the real world, and its strategic importance to the country's economic development until they took the IS concepts course. The fact that the *IS Concepts* course made such a major impression on the students revealed the need to provide more and better career choice information to students during and before they left high school. It also pointed to the importance of expanding both discipline and specialization choices, that included IS. She ended her presentation by proposing future comparisons of IS awareness and education statuses between countries to identify differences and similarities with a view to informing decision making and planning.

Questions, Answers and Comments

After all the presentations were made, the group addressed various questions and observations emanating from each presentation as follows:

Questions	Answers or Comments
How can continuity of youth programmes be guaranteed?	✓ Through strong institutions and good leadership to facilitate smooth transitions
Are the youth responsible enough to be entrusted with leadership?	✓ The perception that the youth are trouble makers is unfair since majority of them are responsible. The youth should be given a chance to prove their worth.
What is the economic advantage of a bamboo bicycle over a steel one?	✓ A bamboo bicycle is cheaper and environmental friendly
Should we be advocating for gender equality or equity?	✓ Equity is what should be promoted to ensure fairness in access to and utilization of resources by both men and women
How can STI institutional capabilities be enhanced?	✓ Through funding, partnerships, knowledge sharing, proper coordination, capacity building, and change of attitudes/mindsets
How is system analysis different from computer science?	✓ Systems analysis answers research problems in a focused manner by analyzing all the constructs using available tools
How long ago did futures studies begin?	✓ There is documented research showing that they started around the early 1960s
How can we ensure that research is responsive to current development realities?	✓ By ensuring research is market driven and solution oriented ✓ Identification of research problems

	<p>through cooperation with industry stakeholders</p> <ul style="list-style-type: none"> ✓ Research recommendations should be practical
How can we make our curricula robust and focused on emerging issues?	<ul style="list-style-type: none"> ✓ By developing state of the art curricula that is holistic ✓ Through creation of centers of excellence for specific capacities ✓ Promotion of modern technology ✓ Change of attitudes and mindsets among learners and instructors ✓ Through practical capacity building ✓ Developing market responsive curricula ✓ Collaboration and partnership with industry, government, civil society, media and policy makers ✓ Increased funding and infrastructural development ✓ Encouraging and teaching innovativeness and entrepreneurship ✓ Gender responsiveness and inclusion of the youth
How can we address the problem of brain drain in Africa?	<ul style="list-style-type: none"> ✓ Creating an enabling environment (e.g. through ICTs, better remuneration, change of attitudes and work ethics) to attract Africans in the Diaspora
How can capacity building in STI be achieved?	<ul style="list-style-type: none"> ✓ Internships for students ✓ Training ✓ Workshops and seminars ✓ Incubation centers ✓ Centers of excellence ✓ Mentorship

6. Conclusion & Policy Recommendations

The 2012 ATPS Annual Conference and Workshop which was held from 19-21 November in Addis Ababa, Ethiopia was designed to engage relevant stakeholders to deliberate on *emerging paradigms, technologies and innovations for sustainable development: global imperatives and African realities* in a post Rio+20 world. The conference engaged a dynamic mix of researchers, policy-makers, science journalists, private-sector actors, the civil society, students and policy research advisors in stimulating debates to address the emerging paradigms, technologies and innovations for sustainable development. Lessons from successful cases of good partnership and linkages amongst the stakeholders in Africa and beyond were drawn so as to enhance experiential learning from a trans-disciplinary perspective. The Delegates were drawn from Africa, Australia, Europe, United States of America and India.

The conference which was which was hosted by the Africa Union Commission at its headquarters in Addis Ababa, Ethiopia recognized that only the mastery and unremitting application of science and technology can guarantee human welfare, human happiness and the achievement of sustainable development goals on the continent. The conference also emphasized on the important role of science, technology and innovation, how it is recognized by African Heads of States in their various declarations including the Lagos Plan of Action and the AU/NEPAD Consolidated Plan of Action (CPA). The delegates congratulated The African Union for their support to its development partners which has enhanced steady progress mounting to programs and initiatives for the implementation of the CPA; these commendable efforts need to be strengthened and sustained through targeted investments in STI policy institutions and networks on the continent including the ATPS. Whereas African economies have recorded improvements in Gross Development Product (GDP) growth and in the application of STI including the mobile telephony and telecommunications, and space technology during the past decade, the continent has not fully reaped the benefits afforded by science, technology and innovation for inclusive sustainable development. STI led development requires strong leadership commitment and concerted investments in endogenous capacities at all levels: education, institutions, governance, technology development and transfer, deployment, diffusion and regulation.

Delegates at the conference/workshop noted that Africa has a comparative advantage for transitioning to a low carbon development pathway that is inclusive, sustainable and resource efficient; if supported by endogenous research and capacity building, some emerging technologies and existing sustainable development practices on the African continent can help to improve productivity and resource efficiency for inclusive development in Africa. Social innovations provide opportunities for enhancing economic growth and social prosperity through youth employment, entrepreneurship and value creation. In addition, African Universities stand to benefit from the mainstreaming trans-disciplinary research and teaching to overcome the weak collaboration and coordination that exist between disciplines, universities, industry, the public sector and civil society in Africa. In conclusion, African countries are not effectively harnessing the untapped potential of the continent's bulging youth and women population for development. Africa's development must focus on industrialization, wealth creation and diversification of energy sources to include renewable energy options.

Based on the conclusions derived above, delegates proffered the following policy recommendations:

- Africa needs to lead its own dialogue on low carbon development and green growth; and proactively invest in the required capacities to ensure African ownership of the inevitable transitioning processes that are unfolding globally.
- There is a need for a shift towards trans-disciplinary teaching and research approaches to encourage collaboration and networking across disciplines and between universities, the productive sectors and civil society, with special reference to innovation-driven value addition, employment creation and inclusive development strategies.
- In order to harness the resource potential for productivity improvements in Africa, urgent and significant investments is required in STI education and research to build endogenous capacities for appropriate technology development, diffusion, deployment and regulation.
- Harnessing the opportunities for social innovations will require a favourable policy environment, incentive structures, innovation incubation, training and mentorship In entrepreneurship.
- Proactive measures to harness the potentials of the youth and women in STI Policymaking and implementation are necessary pre-requisites for achieving the Sustainable Development Goals (SDGs) in Africa

Addressing these policy recommendations is critical to fostering self-ownership and democratic governance of STI which are the imperatives for sustainable development. This is urgently needed to ensure that Africa can effectively engage in the rapidly unfolding green growth paradigm which is likely to constitute the *'third industrial revolution'*.

Lastly, the delegates expressed appreciation to the African Union Commission for its assurances of continued support for ATPS as a continental think tank and resource to be harnessed for further development and implementation of STI policies. Delegates further expressed appreciation to ATPS Development Partners for their continued support.

Appendix 1

Programme for the 2012 ATPS Annual Conference and Workshop from 11-22 November in Addis Ababa Ethiopia

DAY 1 – Monday, 19 November 2012			
Time	Topic/Presentations		
08:30 – 09:00 am	Registration & Accreditation	<i>Facilitators:</i> 1) Mr. Murimi Muriuki, ATPS 2) Ms. Sarah Wakasa, ATPS 3) Mr. Nelson Akenga, ATPS	
PLENARY SESSION 1: OPENING SESSION <i>Rapporteur: Dr. Nicholas Ozor, Senior Research Officer, ATPS</i>			
Time	Topic/Presentations	Presenters	Session Chair
09:00 – 09:05 am	Welcoming Remarks by the ATPS Ethiopia Chapter	Mr. Wondwossen Belete National Coordinator ATPS-Ethiopia	Dr. Mohamed Khalil Timamy Head, Environment Division Department of Rural Economy and Agriculture, AUC, Ethiopia
09: 05 – 09:15 am	Welcoming Remarks by the AUC	H.E. Professor Jean-Pierre Ezin Commissioner for Human Resources, Science & Technology, AUC, Ethiopia	
09:15 – 09:25 am	Welcoming Remarks by the ATPS Secretariat/Objectives of Conference	Prof. Kevin C. Urama Executive Director, ATPS	
09:25 – 09:35 am	Welcoming Remarks by the Chair of ATPS Board	Prof. Shaukat A. Abdulrazak Executive Secretary, National Council for S&T, Republic of Kenya / Chair, ATPS Board	
09:35 – 09:40 am	Remarks by a Representative of ATPS Consortium of Development Partners	Dutch Ministry of Foreign Affairs/Rockefeller Foundation/ Open Society Foundation/Nigerian Ministry of S&T, etc.,	
09:40 – 10:00 am	<i>Opening Remarks: Emerging Paradigms, Technologies and Innovations for Sustainable Development: Lessons from Ethiopia’s Green Growth Strategy</i>	His Excellency Mr. Dessie Dalike , Honourable Minister for Science and Technology Ethiopia	
10:00 – 10:20 am	Opening Keynote Address: <i>Emerging Paradigms, Technologies and Innovations for Sustainable Development: Global Imperatives and African Realities</i>	Prof. Osita Ogbu Former Economic Advisor to the President of the Federal Republic of Nigeria Executive Director, African Development Solutions International (ADSI), Nigeria	
10:20 – 10:40am	<i>Emerging Paradigms, Technologies and Innovations for Sustainable Development in East African Countries</i>	Prof. Margaret Kamar Hon. Minister for Higher Education, Science & Technology, Republic of Kenya	

10:40 – 11:00 am	<i>Emerging Paradigms, Technologies and Innovations for Sustainable Development: in West African Countries</i>	Hon. Prof. Ita Okon Bassey Ewa , Hon. Minsiter for S&T Ministry of S&T Federal Republic of Nigeria	
11:00 – 11:15 am	PHOTO SESSION & TEA/COFFEE & HEALTH BREAK		
PLENARY SESSION 2: KEYNOTE PAPERS <i>Rapporteur: Dr. Nicholas Ozor, Senior Research Officer, ATPS</i>			
	Keynote Presentations	Presenters	Session Chair
11:15- 11:35 am	Green Growth and Poverty Reduction: Framing the Issues for Developing Countries	Mr. Angel Gurria Secretary General, OECD, <i>Represented by</i> Mr. Serge Tomasi Deputy Director of the Development Co-operation Directorate, OECD, France	Prof. Turner Isoun , <i>Former Minister for S&T, Fed. Republic of Nigeria & Vice Chair, ATPS Board</i>
11:35 - 11:55 am	Energy Transitions, Innovations & Development: Global Imperatives and African realities	Professor Lynn K. Mytelka Professorial Fellow UNU-MERIT (Maastricht) Distinguished Research Professor Carleton University (Ottawa)	
11:55 – 12:15 pm	Social Innovations & Sustainable Development in the Global South: - implications for achieving sustainable development goals in the global south	Prof. Caroline Wagner Milton & Roslyn Wolf Chair in International Affairs, Ohio State University, USA Columbus Ohio	
12:15 – 12:35 pm	Institutional Structures, Policies & Macro Economic Environment in African Countries: implications for Social Innovations and business competitiveness	Professor Eric Eboh Policy & Institutions Economist, University of Nigeria, Nsukka / President, Agricultural Policy Research Network (APRNet), Nigeria	
12:35 – 01:00 pm	Q&A Facilitated Discussion Session		
01:00 - 02:00 pm	LUNCH BREAK		
PLENARY SESSION 3: KEYNOTE PAPERS <i>Rapporteur: Dr. Mark McHenry, Murdoch University, Western Australia</i>			
	Keynote Paper Presentations	Proposed Presenters	Session Chair
02:00 – 02:30 pm	Achieving Food Security and Sustainability for 9 Billion	Professor Chris Leaver Emeritus professor of Plant Science, fellow of St. John’s College, Oxford University, UK	Sir, Brian Heap (ATPS Board Member) President, European Academies Science Advisory Council
02:30 – 02:50 pm	Is Genetic Modification to Answer to Africa’s food insecurity? Lessons from India	Dr. Anupam Varma , Adjunct Professor, Indian Agricultural Research Institute, India	
02:50 – 03:10 pm	Nanotechnologies and Implications for Achieving Sustainable Development Goals in Africa	Prof. Emmanuel Ezugwu , Provost, Air Force institute of Technology, AFIT, Kaduna, Nigeria.	

03:10 – 03:30 pm	Building the critical mass in STI capacity in response to the emerging needs of Africa	Dr. Peggy Oti-Boateng Senior Program Specialist for Science and Technology UNESCO, Nairobi Office and Coordinator, African Network of Scientific and Technological Institutions (ANSTI), Nairobi, Kenya	
03:30 – 03:45 pm	Facilitated Discussion Session		
03:45 – 04:00 pm	TEA/COFFEE & HEALTH BREAK		
04:00 – 04:15 pm	A Strategic Approach to Strengthening the African Higher Education and Research Space (AHERS) Through Institutional National Regional and Continental Collaboration	Ms. Alice Lamptey Senior Program Specialist, PMU –PAU, AUC Ethiopia	Prof. Mark Swilling ATPS-South Africa National Chapter Coordinator Sustainability Institute, University of Stellenbosch, South Africa
04:15 – 04:30 pm	African Science and the Science of Sustainability in the 21 st century? Perspectives from the African Academy of Sciences	Dr. Benjamin Apraku Gyampoh Programme Officer Africa Academy of Sciences (AAS), Kenya	
04:30 – 04:45 pm	Gender equity and youth empowerment in Africa: implications for achieving Sustainable Development Goals in Africa.	Prof. Agnes Mwang’ombe Principal, College of Agriculture and Vetrinary Medicine, University of Nairobi, Kenya & Prof. Obioma Nwaorgu , Global Health Awareness research Foundation, USA	
04:45 – 05:50 pm	Facilitated Participatory Dialogue		
05:50 – 06:10 pm	Launch of ATPS-Australia Chapter		Prof. David Doepel Africa Research Group, Murdoch University, Perth, Western Australia
END OF DAY ONE			
07:00 – 09:30 pm	High Level Strategic Planning Dinner hosted for ATPS Development Partners and Key Stakeholders (By Invitation Only)		
DAY 2 - Tuesday, 20 November 2012			
PARALLEL SESSIONS (D2:P1 – P4)			
See Annex 1 – 4 for specific break-out rooms for the parallel sessions: P1 – P4			
Time	Topic/ Presentations	Proposed Presenters	Session Chair/Lead Discussants
09:00 – 11:00 am	Parallel Session (D2-P1): Sub-Theme I Transitions to Low Carbon Development Pathways: Implication Sustainable Development in Africa	All delegates that submitted papers under this subtheme (see Annex 1 for full program and venue)	Chair: Prof. Lynn Mytelka , Professorial Fellow UNU-MERIT (Maastricht) Distinguished Research Professor, Carleton University (Ottawa) Rapporteur: Dr. Mark McHenry , Murdoch

			University, Western Australia
09:00 – 11:00 am	Parallel Session (D2-P2): Sub-Theme II Governance of Science, Technologies and Innovation including Genetics for Farming, Biotechnologies, Nanotechnologies and Indigenous Knowledge Systems	All delegates that submitted papers under this subtheme (see Annex 2 for full program and venue)	Prof. Sir Brian Heap Member, ATPS Board; EASAC; The Royal Society of London & Honorary Fellow, St. Edmunds College Rapporteur: Dr. Nicholas Ozor , Senior Research Officer, ATPS
09:00 – 11:00 am	Parallel Session (D2-P3): Sub-Theme III Institutional Structures and Social Innovations for Sustainable Development in Africa	All delegates that submitted papers under this subtheme (Annex 3 for full program and venue)	Chair: Prof. Indira Nath (ATPS Board Member) Institute of Pathology (ICMR), India Rapporteur: Mr. Ernest Acheampong , Research Officer, ATPS
09:00 – 11:00 am	Parallel Session (D2-P4): Sub-themes IV and V Sub-Theme IV - Youth and Gender Empowerment for Sustainable Development in Africa Sub-Theme V - Mainstreaming Trans-disciplinarity in STI in Higher Education	All delegates that submitted papers under this subtheme (Annex 4 for full program and venue)	Chairs: Mr. Tennyson Magombo , (Out-going Chair, AYFST), Executive Director, Arise and Shine International, Malawi Rapporteur: Dr. Edith Gathoni , Post-Doctoral Research Officer, ATPS
11:00 – 11:30 am	TEA/COFFEE & HEALTH BREAK		
11:30 – 01:00 pm	PARALLEL SESSIONS (D2:P1 – P4) CONTINUE (cf : Annexes 1 – 4 for time allocations and respective venue)		
01:00 – 02:00 pm	LUNCH		
02:00 – 03:30 pm	PARALLEL SESSIONS (D2:P1 – P4) CONTINUE (cf : Annexes 1 – 4 for time allocations and respective venue)		
03:30 – 04:00 pm	TEA/COFFEE & HEALTH BREAK		
04:00 – 05:00 pm	PARALLEL SESSIONS (D2:P1 – P4) CONTINUE (cf : Annexes 1 – 4 for time allocations and respective venue)		
06:00 – 09:00 pm	Conference Group Dinner hosted by ATPS (Details TBC)		
END OF DAY TWO			

DAY 3 - Wednesday, 21 November 2012

PLENARY SESSION – International Roundtable, Recommendations and Conclusions
Rapporteurs: TBC

Time	Topic/ Presentations	Proposed Presenters	Session Chair/Lead Discussants
08:30 – 09:30 am	Recap from the Parallel Sessions	<p>Dr. Mark McHenry, Murdoch University, Western Australia (D2:P1) – Low Carbon Development Pathways: Implications for Sustainable Development in Africa</p> <p>Dr. Nicholas Ozor, Senior Research Officer, ATPS (D2: P2) – Governance of STI- Genetics for Farming, Biotechnologies, Nanotechnologies and Indigenous Knowledge Systems</p> <p>Mr. Ernest Acheampong, Research Officer, ATPS (D2:P3) – Institutional Structures and Social Innovations for Sustainable Development in Africa</p> <p>Dr. Edith Gathoni, Post Doc. Research Officer, ATPS (D2:P4 - Sub-theme IV) - Youth & Gender Empowerment for Sustainable Development in Africa; and (D2:P4 - Sub-theme V) - Trans-disciplinarity in Higher Education</p>	<p>Dr. Peggy Oti-Boateng Senior Program Specialist for Science and Technology UNESCO, Nairobi Office and Coordinator, African Network of Scientific and Technological Institutions (ANSTI), Nairobi, Kenya</p>

09:30 – 10:45 am	<p>International Roundtable and Recommendations on Emerging Paradigms, Technologies and Innovations for Sustainable Development: Global Imperatives and African Realities (Panellists to make about 4-minute remarks on take home messages and strategic actions for Africa)</p> <p><u>Panellists:</u></p> <ol style="list-style-type: none"> 1) H.E. Professor Jean-Pierre Ezin (AUC), Commissiner for Human Resources, Science & Technology, AUC, Ethiopia 2) Prof. Shaukat A. Abdulrazak, Executive Secretary, National Council for S&T, Republic of Kenya / Chair, ATPS Board 3) Prof. Osita Ogbu, Former Economic Advisor to the President of the Federal Republic of Nigeria/ Executive Director, African Development Solutions International (ADSI), Nigeria 4) H. E. Mr. Dessie Dalike, Hon. Minister for Science and Technology, Federal Republic of Ethiopia 5) Hon. Prof. Margaret Kamar Hon. Minister for Higher Education, Science and Technology, Republic of Kenya 6) Hon. Prof. Ita Okon Bassey Ewa, Hon. Minsiter for Science and Technology, Federal Republic of Nigeria 7) Professor Lynn K. Mytelka Professorial Fellow, UNU-MERIT, Maastricht and Distinguished Research Professor, Carleton University, Ottawa, Canada 8) Prof. Caroline Wagner, Milton & Roslyn Wolf Chair in International Affairs, Ohio State University, USA 9) Professor Chris Leaver Oxford University, UK 10) Dr. Peggy Oti-Boateng Senior Program Specialist for S&T, UNESCO, Nairobi Office and Coordinator, ANSTI, Nairobi, Kenya 11) Dr. Benjamin Apraku Gyampoh Programme Officer, Africa Academy of Sciences (AAS), Kenya 12) Dr. Mohamed Khalil Timamy, Head, Environment Division Department of Rural Economy and Agriculture, AUC, Ethiopia 13) Professor Turner Isoun, Former Minsiter for S&T, Fed. Republic of Nigeria / Deputy Chair ATPS Board 14) Dr Agnes Soucat Director, Human Development OSHD, AfDB 15) Dr. Boukary Savadogo, Higher Education Division, AfDB 16) Mr. Ahlin Byll-Cataria, Executive Secretary, ADEA-AfDB 17) Dr. A. I. Mayaki, Executive Secretary, NEPAD 	<p>Chair: Dr. Mahama Ouedraogo, Head of Division, Science and Technology-AUC Addis Ababa, Ethiopia</p>
10:45 – 11:00 am	TEA/COFFEE & HEALTH BREAK	
11:00 – 12:30 pm	Recommendations and way forward - <i>A Communiqué to be produced recommendations from the parallel group discussions and recommendations from the international roundtable</i>	Facilitator: Dr. Nicholas Ozor, Senior Research Officer, ATPS
12:30 – 01:00 pm	Conclusion and closing remarks	Prof. Kevin Urama , Executive Director, ATPS Prof. Shaukat A. Abdulrazak , Chair - ATPS Board
01:00 – 02:00 pm	LUNCH	
02:00 – 05:00 pm	Plenary Session: ATPS Annual General Meeting (For registered members only)	Prof. Shaukat A. Abdulrazak , Chair ATPS Board
END OF DAY THREE		
CONFERENCE DELEGATES DEPART		
DAY 4 - Thursday, 22 November 2012		

ATPS BUSINESS – ATPS MANAGEMENT AND BOARD MEETINGS			
VENUE: DREAMLINER HOTEL, ADDIS ABABA, ETHIOPIA			
Time	Topic/Presentations	Participants	Session Chair
09:00 – 13:00 pm	ATPS National Chapter Coordinator’s and Secretariat Staff Meeting & Training on Transformational Leadership	<ul style="list-style-type: none">• ATPS Board Members• ATPS Regional Council Members• ATPS National Chapter Coordinators• ATPS Secretariat Management Committee Members• AWFST Executives• AYFST Executives	<p>Chair: Prof. Shaukat A. Abdulrazak</p> <p><i>Facilitators:</i> Prof. Vincent Anigbogu DG, Institute for National Transformation USA</p> <p>Prof. Chris Garforth Professor of Agric. Extension and Rural Development, School of Agriculture, Policy and Development, University of Reading, UK</p>
11:00 – 11: 30 a.m.	TEA/COFFEE & HEALTH BREAK		
01:00 – 02:00 p.m.	LUNCH		
02:00 – 06:30 p.m.	22 nd ATPS Board Meeting	ATPS Board Members only	Prof. Shaukat A. Abdulrazak , Chair, ATPS Board
03:30 – 04:00 a.m.	TEA/COFFEE & HEALTH BREAK		
END OF DAY FOUR			

Annex 1: Programme for Parallel Session 1 (Covering Sub-Theme I) - (D2-P1)

Tuesday, 20 TH November 2012 D2-P1: (SUB-THEME I) TRANSITIONS TO LOW CARBON DEVELOPMENT PATHWAYS: IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT IN AFRICA <i>Rapporteurs: Dr. Mark McHenry</i> , Murdoch University, Western Australia			
Time	Topic/Presentations	Presenter	Session Chair
08:30 – 09:00am	Registration		
09:00 – 09:25am	Pro-poor, low carbon development: Improving low carbon energy access and development benefits in LDCs	Dr. Robert Byrne Research Fellow, SPRU (Science & Technology Policy Research) and STEPS Centre, University of Sussex, UK	Professor Lynn Mytelka Professorial Fellow, UNU-MERIT, Maastricht and Distinguished Research Professor, Charlton University, Ottawa, Canada
09:25 – 09:50 am	Low Carbon Growth Pathways for Africa: The case of geothermal energy potential	Dr. Mohamed Khalil Timamy Head, Environment Division Department of Rural Economy and Agriculture, AUC, Ethiopia	
09:50 – 10:15am	Inclusive Green Growth, Renewable Energy Potentials and the Mitigation of Climate Change Impacts- Implications for SDGs in Africa	Dr. Fatima Denton Director, African Climate Policy Centre (ACPC)-United Nations Economic Commission for Africa	

		(UNECA), Addis Ababa, Ethiopia	
10:15 – 10:50am	Facilitated Discussion		
10:50 – 11:10am	TEA/COFFEE & HEALTH BREAK		
11:10 – 11:25am	Financing Access to Sustainable Energy for the Poor in Nigeria: The Public Finance Option	Mr. Chidiebere Ibe Institute for Public Policy Analysis and Management, Abuja, Nigeria	Prof. Francis M. Mutua University of Nairobi Coordinator Stochastic Modeling Component FRIEND Nile Project, University of Nairobi, Kenya
11:25 – 11:40am	Transition to Low Carbon Pathways for Sustainable Agricultural Systems in Nigeria	Prof. Francis E. Bisong Professor, Department of Geography & Environmental Science, University of Calabar Nigeria	
11:40 – 11:55am	Transitions to Low Carbon Development Pathways: Implications for Sustainable Development in Africa	Prof. Mark Swilling Sustainability Institute, Stellenbosch University South Africa	
11:55 – 12:10pm	Artisanal Rastrineobola argenta light fishing on Lake Victoria, Kenya: traditional kerosene lamps and PV-battery modern lighting systems, markets, and improving safety and supply security	Prof. David Doepel Africa Research Group, Murdoch University, Perth, Western Australia	
12:10 – 12:25pm	Climate Change Mitigation and Trade Competitiveness: An Assessment of the Clean Development Mechanism in East Africa	Jill Juma SEATINI, Kenya and Trade Policy Expert, Kenya	
12:25 – 01:00pm	Facilitated Q & A Discussion		
01:00 – 02:00pm	LUNCH		
02:00 – 02:15pm	Pathways to Low Carbon Development: Alternative Energy Sources for Africa	Babettie A. Juwayeyi Bunda College of Agriculture, Malawi	Prof. Mark Swilling ATPS-South Africa National Chapter Coordinator Sustainability Institute, University of Stellenbosch, South Africa
02:15 – 02:30pm	Microalgae cultivation and its use in the production of biofuel and agricultural inputs in Lesotho	Sissay B. Mekbib National University of Lesotho, Roma, Lesotho	
02:30 – 02:45pm	Chrome-Aluminide Protective Coatings for Thermal Power Generations	J.K. Kiplagat Ministry of Industrialization Kenya	
02:45 – 03:00pm	Emission Trading System as a policy tool for Low carbon development pathway	Billy Katontoka Africa Carbon Credit Exchange, Zambia	
03:00 – 03:15pm	Trends and Potentials of Renewable Energy Development in Ethiopia	Shirega Minuye Ethiopia	
03:15 – 03:30pm	Contribution of animal agriculture to greenhouse gases production in Swaziland; implications for mitigation using biotechnology	Dlamini, A.M. & Dube, M. A University of Swaziland	
03:30 – 03:45pm	Empowering the Health of Rural Farmers in Africa through Telemedicine: Challenges and Prospects	Zelalem W. Mengistu Ethiopia	

03:45 – 04:00pm	Facilitated Q & A Discussion	
04:00 – 04:20pm	TEA/COFFEE & HEALTH BREAK	
04:20 – 05:00pm	<p>Plenary Panel Discussion:</p> <p><i>Do Renewable Energy Options provide a Sustainable Development pathway for Africa? - Insights from the IPCC Sustainable & Renewable Energy Report, 2011, and the Global Energy Assessment, 2011</i></p> <p><u>Panellists:</u></p> <ol style="list-style-type: none"> 1) Prof. Lynn Mytelka, UNU-MERIT, Maastricht and Charlton University, Ottawa, Canada 2) Prof. Mark Swilling, Stellenbosch University, South Africa 3) Dr. Billy Katontoka, Africa Carbon Credit Exchange, Zambia 4) Dr. Rob Byrne, University of Sussex, UK 5) Prof. Turner Isoun, Former Minister for S&T, Fed. Republic of Nigeria & Vice Chair, ATPS Board 6) Prof. Francis Mutua, University of Nairobi, Kenya 7) Dr. Fatima Denton, ACPC, Ethiopia 	<p>Dr. Mohamed Khalil Timamy Head, Environment Division, Department of Rural Economy and Agriculture, AUC, Ethiopia</p>

Annex 2: Programme for Parallel Session 2 (Covering Sub-Theme II) - (D2-P2)

Tuesday, 20TH November 2012 D2-P2: (SUB-THEME II) GOVERNANCE OF SCIENCE, TECHNOLOGIES AND INNOVATION INCLUDING GENETICS FOR FARMING, BIOTECHNOLOGIES, NANOTECHNOLOGIES AND INDIGENOUS KNOWLEDGE SYSTEMS			
<i>Rapporteur: Dr. Nicholas Ozor, Senior Research Officer, ATPS</i>			
Time	Topic/Presentations	Presenter	Session Chair
08:30 – 09:00am	Registration		
09:00 – 09:20am	Welcome and introduction to project	Prof. Volker ter Meulen President of the German Academy of Sciences Leopoldina, Member of the EASAC Council. Email: Volker.terMeulen@mail.uni-wuerzburg.de	Prof. Sir Brian Heap Member, ATPS Board European Academies Science Advisory Council, The Royal Society of London SW1Y 5AG, and Honorary Fellow, St Edmund's College
09:20 – 09:40am	Genetics for Farming and Food Security in Africa: Lessons from Nigeria	Prof. M. I. Uguru Dept. of Crop Science University of Nigeria Nsukka Nigeria	
09:40 – 10:00am	Current Situation on GM research and innovation in Ghana and the region (opportunities and challenges)	Professor Walter Alhassan Forum for Agricultural Research in Africa (FARA), Ghana	
10:00 – 10:20am	Current Situation on GM research and innovation in Uganda	Dr. Andrew Kiggundu Kawanda Agriculture Research Institute (KARI) Uganda	
10:20 – 10:40am	Water Efficient Maize for Africa (WEMA) Project and focus on implications for African science of the liability clause in biosafety	Dr Roshan Abdallah (Mrs) Tanzania Tropical Pesticides Research Institute (TPRI) in Arusha, Tanzania	
10:40 – 11:00am	Virus Resistant Cassava (VICRA) project and issues arising	Dr. Douglas W. Miano VIRCA - Kenya Agricultural Research Institute (KARI) Biotechnology Centre Kenya	
11:00 – 11:30am	Facilitated Q&A discussion		
11:30 – 11:50am	COFFEE/TEA BREAK		
11:50 – 12:10am	Nanotechnology: Key to meeting the Millennium Development Goals	J.K.Kiplagat Ministry of Industrialization Kenya	Dr. David Bennett Project Co-Leader Biosciences for Farming in Africa
12:10 – 12:30pm	Studies on Nano biotechnology Control of Agricultural Pests and Pathogens for Food Security and Safety	B. Chinenye Aruah National Biotechnology Development Agency, Nigeria	

12:30 - 01:00pm	Facilitated Q&A discussion		
01:00 – 02:00pm	LUNCH		
02:00 – 02:15pm	Practical Application of Modern Biotechnology Tools to Musa Breeding in Nigeria: Potentials for Increased Production	Oselebe, H.O., Obi, I.U. and Uguru, M.I. University of Nigeria, Nsukka Nigeria	Dr. Anupam Varma Indian Agriculture Research Institute, India
02:15 – 02:30pm	Animal Genetic Resources, Intellectual Property Rights and Traditional Knowledge: Quo Vadis?	Eliamani Laltaika Tanzania Intellectual Property Rights Network (TIP-Net) Tanzania	
02:30 -03:00pm	Facilitated Discussion		
03:00 – 04:00pm	Two Break out groups to discuss questions circulated to all academies and chapters beforehand: (i) <i>The current situation in using biotechnology in agriculture</i> (ii) <i>Looking to the future</i>		EASAC Working Group Members
04.00 – 04.15pm	TEA/COFFEE & HEALTH BREAK		
04:15 – 05.15pm	<p>Report back (10 minutes each) from chairs of Break out groups (EASAC Working Group Members with assistance from Claudia Canales and Robin Fears)</p> <p>Panel and General Discussion and concluding remarks</p> <p><u>Panelists:</u></p> <ul style="list-style-type: none"> • Prof. Volker ter Meulen, EASAC, Germany • Prof. Emmanuel O. Ezugwu, AFIT, Nigeria • Dr. Anupam Varma, India • Prof. M. I. Uguru, Nigeria • Prof. Norah Olembo, Kenya • Prof. Sir Brian Heap, UK 		<p>Professor Chris Leaver (UK) Emeritus Professor of Plant Sciences, University of Oxford. Senior Scientific Adviser Biosciences for Farming in Africa, John Templeton Foundation</p>
05:15 – 06:00pm	Launch of booklet on Regulation of GM Technology	Dr. Jan-Hendrik Groenewald Executive Manager Biosafety South Africa	Prof Roseanne Diab Executive Officer Academy of Science of South Africa (ASSAf)

Annex 3: Programme for Parallel Session 3 (Covering Sub-Theme III) - (D2-P3)

Tuesday, 20 TH November 2012			
D2-P3: (SUB-THEME III) INSTITUTIONAL STRUCTURES AND SOCIAL INNOVATIONS FOR SUSTAINABLE DEVELOPMENT IN AFRICA			
Rapporteurs: Mr. Ernest Acheampong, Research Officer, ATPS			
Time	Topic/Presentations	Presenter	Session Chair
08:30 – 09:00am	Registration		
09:00 – 09:10am	Welcome and introduction to project on Understanding and Fostering Social Innovation in Africa	Ernest Acheampong Research Officer, ATPS	Prof. Indira Nath (ATPS Board Member) Institute of Pathology (ICMR), India
09:10 – 09:30am	Building National Systems of Innovation for Sustainable Development in Africa: Experiences from the Fed. Republic of Nigeria	Mrs R. S. Jimetta Permanent Secretary, Ministry of S&T, Fed. Rep. Of Nigeria	
09:30 – 09:50am	Social Innovations, Inclusive Green Growth and Sustainable Development : Global Imperatives and African realities	Prof. Kevin Urama Executive Director, ATPS/ Mr. Ernest Acheampong , Research Officer, ATPS	
09:50 – 10:10am	The Land Potential Knowledge System (LandPKS) Increasing Land Productivity and Resilience	Dr. Jeffrey Herrick United States Department of Agriculture, New Mexico, USA	
10:10 – 10:30am	Facilitated Q&A Discussion		
10:30 – 10:50a.m.	TEA/COFFEE & HEALTH BREAK		
10:50 – 11:10am	Economic Growth's Secret Weapon: Entrepreneurship & Innovation	Mr. Denis C. Fourie Chairman, The Lobbyist Group, South Africa	
11:10 – 11:30am	Social Innovations: Lessons from the mPedigree Technology	Mr. Bright B. Simons Director of Development Research and the Coordinator of the mPedigree Network IMANI Center for Policy Education, Ghana	Prof. S. Chidebelu Department of Agricultural Economics University of Nigeria
11:30 – 11:50am	Social Innovations and Economic Growth: Experiences of the Global Knowledge Initiative (GKI)	Mr. Andrew Gerard Program Officer The Global Knowledge Initiative, USA	
11:50 – 12:05pm	Constraints and Opportunities of Promoting Public-Private Partnerships in Irrigated Agriculture Financing and Management in Nigeria.	Ebele C. Amaechina , Eboh E. C., & Nwagbo E.C. University of Nigeria Nsukka, Nigeria	

12:05 – 12:20pm	Mainstreaming M-Health Innovations With Loosely Coupled Policy Interventions in Africa	Eng. John Okuonzi Kyambogo University, Faculty of Engineering, Uganda	
12:20 – 01:00pm	Facilitated Q&A Discussion		
01:00 – 02:00pm	LUNCH		
02:00 – 02:15pm	Determinants of Micro-Enterprises Growth and Revenue in the Niger Delta, Nigeria: Microfinance the Way Forward	Miebi Theophilus Gbigbi Ministry of Agriculture and Natural Resources, Nigeria & Dr. Anselm A. Enete University of Nigeria	Mrs. R. S. Jimeta Permanent Secretary Ministry of S&T, Nigeria
02:15 – 02:30pm	Mapping Institutional Linkages in Climate Change Adaptation and Mitigation: Implications for Sustainable Food Security and Environmental Quality in Nigeria	Taofeeq Ade Amusa & Dr. Anselm A. Enete Department of Agricultural Economics, University of Nigeria	
02:30 – 02:45pm	Appropriate Innovation Structure for Sustainable Development	Ameha Mulugeta Addis Ababa Institute of Technology, Ethiopia	
02:45 – 03:00pm	Assessment of Innovative Institutional Arrangements: The Case of Integrated Tamale Fruit Company (ITFC) in Ghana	Mr. Francis Kizito Yaw Amevenku CSIR Water Research Institute, Accra, Ghana	
03:00 – 03:15pm	Treatise and Praxis Linking Social Ingenuity and Institutional Innovations in Sustainable Development (SD):A case research in Afar and Boran:	Costantinos BT Costantinos School of Graduate Studies, College of Management, Informatics and Economic Sciences, Addis Ababa University, Ethiopia	
03:15 – 03:30pm	Institutional challenges of current structural changes in West African agriculture : an analysis from the Benin case	Dr. Roch L. Mongbo Abomey-Calavi University Benin	
03:30 – 03:45pm	Enabling Rural Innovations for Sustainable Development in Malawi	Mr. Tennyson Magombo, Executive Director, Arise and Shine International, Malawi Malawi	
03:45 – 04:00pm	The impact of regulation on the adoption and diffusion of Point-of-Sale technology in Nigeria	Ngozi, Ihuoma Ibeji United Kingdom	
04:30 – 04:15pm	Facilitated Q&A Discussion		
04:15 – 04:30pm	TEA/COFFEE & HEALTH BREAK		
04:30 – 05:30pm	Panel Discussion, Summary and concluding remarks <u>Panellists:</u> 1) Dr. Caroline Wagner,Ohio State University, USA	Mr. C. D. Glin Associate Director Rockefeller Foundation, Nairobi, Kenya	

	2) Prof. Kevin Urama, ATPS , Kenya 3) Prof. Eric Eboh, APRNet, Nigeria 4) Prof. Sand Chidebelu, UNN, Nigeria 5) Dr. Jeff Herrick, USDA, USA 6) Mr. Denic C. Fourie, The Lobbyist Group, South Africa 7) Mr. John Buchi Ekere, Nigeria 8) Mrs. R. S. Jimeta, FMST, Nigeria 9) Mr. Bright Simons, IMANI, Ghana	
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Appendix 2

List of Delegates that attended the 2012 ATPS Annual Conference and Workshops

Australia

1. Prof. David Doepel
Chair, Africa Research Group
Murdoch University
Tel (+61)418912287
Email: d.doepel@murdoch.edu.au

Benin

2. Dr. McHenry Mark
Murdoch University
Email: mpmchenry@gmail.com

3. Prof. Roch L.Mongbo
ATPS Chapter Coordinator
LADYD, Abomey-Calavi University
Tel: (+229)95966446
Email: Rochl_mongbo@yahoo.fr

4. Mr. Lawani Abdelaziz.
Vice Chair, African Youth Forum for
Science and Technology (AYFST)
Email: abdelawani@gmail.com

Burkina Faso

5. Dr. Kabore Benoit
ATPS Chapter Coordinator
Universite' de Ouagadougou
Tel: (+226)70403013/78812008/75980731
Email: benkabor2003@yahoo.fr

Cameroon

6. Sylvester Ndeso Atanga
ATPS Chapter Coordinator
Faculty of health sciences,
University of Buea
Tel: (+237)99841433
Email: silawrence2011@gmail.com

7. Prof Vincent P. K Titanji
Editor in chief, journal of CAS
Cameroon Academy of Sciences
Tel: (+237) 77756389
Email: vpk.titanji@yahoo.com

Cote d'Ivoire

8. Dr. Arsène Konan Kouadio
ATPS Côte d'Ivoire Chapter Coordinator,
Email: arsenekk@yahoo.fr

Egypt

9. Ahmed Abdelwahed
ATPS Egypt Chapter Member
Tel : (+20)14-5192921
Email: ahmed_alhamid@aidme.org

Ethiopia

10. Mr Shirega Minuye
Independent Consultant and Researcher
P.O. Box 24369 code 1000
Email: mmshirega@gmail.com

11. Mr Ameha Gewe Mulugeta
Lecturer, Addis Ababa Institute of
Technology
Tel (+251) 911 948014
Email: amehamulu@gmail.com

12. Mr. Wondwossen Belete
ATPS Ethiopia Chapter Coordinator
Tel : (+251)911886709
Email: wondwossenbel@yahoo.com

13. Mr Berhanu Adelo
Director General, Ethiopian Intellectual
Property Office
Email: ba4552@gmail.com

14. Mr. Hailemariam Teklewold
Assistant to the State Minister of Science
and Technology
Tel (+251) 911 162274
Email: hailem143@yahoo.com

15. Mr Eyasu Dessalegne
A/Director, STI Policy Research
Ministry of Science and Technology
Tel (+251) 913 624305

Email: eyasu_dess@yahoo.com

16. Mr Tadesse Hailu
Intellectual Property Advisor,
Addis Ababa
Email: tadutigie@gmail.com

17. H.E Mr Dessie Dalike
State Minister
Ministry of Science and Technology

18. Mr. Moges Bekele
Ministry of Science and Technology
Tel : (+251)912044405
Email: moges.bekele@yahoo.com

19. Dr. Fatima Denton
Director, African Climate Policy Center
(ACPC)

20. Ms. Bethlehem Tilahun Alemu
Co-founder and Managing Director
Sole Rebels (Bostex PLC)
Email: Bethlehem@solerebelsfootwear.com

21. Prof. Endashaw Bekele
Professor and Director of the Centre for
Human Genetic Diversity
Addis Ababa University and Ethiopian
Academy of Sciences (EAS)
P. O. Box 3434
Tel: (+251) 911 842649
Email: endashawbw@gmail.com

22. Ms Seble Geberegsorges Baraki
Legal Researcher
Federal Justice and Legal Systems
Research Institution
Tel: (+251) 911612197
Email: sleventike@yahoo.com;
seblebaraki1@gmail.com

23. Ms Alice Sena. Lamptey
African Union Commission (AUC)
Email: LampteyA@africa-union.org

24. H.E Prof Jean-Pierre EZIN
Commissioner for Human Resources,
Science & Technology
African Union Commission
Email: EzinJP@africa-union.org

25. Dr. Elwaer Abdul-Hakim
Director Human Resources, Science and
Technology African Union Commission

26. Dr. Mahama Ouedraogo
Head of Science and Technology Division
African Union Commission
Tel: (+251) 920 159516
Email: OuedraogoM@africa-union.org

27. Ms Kedijja Seid
Administrator African Union
Commission
Email: KedijaS@africa-union.org

28. Tesfaye Tegegne
Cameramen, papa film production
Email: Haileyesustion@gmail.com

29. Mesafint Haileyesus
Camera man
Email: papafilmproduction@gmail.com

30. Habtamu Addis
Light Man
Email: papafilmproduction@gmail.com

31. Tadesse Woldesenbet
Sound Man
Email: papafilmproduction@gmail.com

32. Eyob Mulungeta
Video camera man
Email: papafilmproduction@gmail.com

33. Eskindir Alamirew
Video cameramen
Email: papafilmproduction@gmail.com

34. Seifemichael Dagnachew

Video cameramen

Email: papafilmproduction@gmail.com

35. Mulugeta Nurilign

Video Cameramen

Email: papafilmproduction@gmail.com

36. Almaz Tegegne

Coordinator

Email: tegalmaz@gmail.com

37. Wassie Engida

African Union Commission

Tel : (251) 911629967

38. Mr Hambani Masheleni

Senior Policy Officer

African Union Commission

Tel : (+ 251) 911 998430

Email: hambanim@africa-union.org

39. Mr Hailu Geletu

Environmental Specialist

Ministry of Water and Energy

Tel : (+251) 911 166621

40. Bekele Tefesa Wakie

IP Lawyer and Consultant

Tel: (+251) 911 154943

Email: beketw@gmail.com

41. Wlamanuel Yisfalique

Agricultural Projects Followsman Expert

Society for Technology Studies

Tel: (+251) 913 33 98 67

Email: w-yisfalique@yahoo.com

France

42. Prof. Lynn Mytelka

Professorial Fellow,

UNU-MERIT (Maastricht)

Email: lmytelka@gmail.com

43. Prof Michel Delseny

Academia Europaea

Email: delseny@univ-perp.fr

Germany

44. Prof. Volker ter Meulen

Chairman, EASAC

Email: Volker.termeulen@mail.uni-wuerzburg.de

45. Dr. Robin Fears

EASAC Biosciences Programme

EASAC Secretariat

46. Dr Christiane Diehl

Executive Director, EASAC Secretariat

Email: christiane.diehl@leopoldina.org

Ghana

47. Francis Kizito Yaw Amevenku,

Research Scientist

CSIR Water Research Institute

Tel: (+233) 244 573418

Email: fykamevenku@yahoo.com

48. Dr. Frederick Kodwo Amu-Mensah

ATPS Ghana National Chapter

Coordinator

Senior Research Scientist

CSIR Water Research Institute

Tel: (+233) 24 474 8197

Email: assabil@aim.com

obeyie@gmail.com

49. Prof Walter Sandow Alhassan

SABIMA Biotech Project

Coordinator, FARA

Tel : (+233) 20 8146668

Email: walhassan@fara-africa.org

50. Mr Selorm Branttie

mPedigree Network

Email: iselorm@gmail.com

India

51. Prof Indira Nath

ATPS Board Member

National Institute of Pathology (ICMR),

Tel : (+91)9717104448

Email: indiranath@gmail.com

52. Dr. Anupam Varma
Adjunct professor
Indian Agriculture Research Institute
Email: av.acpv@gmail.com

Italy

53. Guy van den Eede
European Commission
Joint Research Centre, Institute for
Health and Consumer Protection
Email: Guy.VAN-DEN-EDE@ec.europa.eu

Kenya

54. Prof. Kevin Chika Urama
African Technology Policy Studies
Network (ATPS)
Tel +254202714092
Email: executivedirector@atpsnet.org

55. Dr. Kelali Adhana Tekle
Post-Doctoral Research Officer
African Technology Policy Studies
Network (ATPS)
Tel: +254202714092
Email: ktekle@atpsnet.org

56. Dr Nicholas Ozor
Senior Research Officer
African Technology Policy Studies
Network (ATPS)
Tel: +254202714092
Email: nozor@atpsnet.org

57. Mr. Richard Murimi Muriuki
Finance & Administration Manager
African Technology Policy Studies
Network (ATPS)
Tel: +254202714092
Email: rmuriuki@atpsnet.org

58. Ms Caroline W. Thuku
Snr. Secretary/Program Administrative
Assistant
African Technology Policy Studies
Network (ATPS)
Tel: 254202714092

Email: cthuku@atpsnet.org

59. Mr. Nelson A. Akenga
IT Assistant, (ATPS)
Tel: +254202714092
Email: nakenga@atpsnet.org

60. Ms Sarah Wakasa
Communications & Outreach Officer
African Technology Policy Studies Network
(ATPS)
Tel: +254202714092
Email: swakasa@atpsnet.com

61. Dr, Edith Gathoni Kirumba
Post Doctoral Research Officer, (ATPS)
Tel: +254202714092
Email: gathoni_edith@yahoo.com

62. Mr. Ernest Nti Acheampong
Research Officer (ATPS)
Tel: +254202714092
Email: eacheampong@atpsnet.org

63. Ms. Constancia Amukhobe Akola
Research Executive TNS RMS
Email: connieakola@yahoo.com

64. Prof. Atieno Ndede Amadi
Founder/Chief Executive Officer
Kenya Kountry Business Incubator
(KEKOB)I
Email: anamadi@kekobi.or.ke

65. Ms Jill Atieno Juma
Programme Officer
SEATINI, Kenya and Trade Policy
Expert,
Tel: (+254) 703 567470
Email: juma.jill2@gmail.com

66. Mr. Joseph Kipkemoi
Inspector, Ministry of Industrialization
Tel: (+254) 722 357318
Email: jkkiplagat@yahoo.co.uk

67. Mr. Kiprono Caleb Metto
Executive Director (YADSTI)
Email: calebkiprono@yadsti.org

68. Prof Shaukat Ali Abdulrazak
Chair, ATPS Board, CEO
National Council for Science and
Technology (NCST)
Tel : (+254)202242175;
(+254)721107867
Email: sabdulrazak@yahoo.com;
secretary@ncst.go.ke

69. Mr. Kenneth W. O Aduda
ATPS Kenya National Chapter
Coordinator
Principal Research Scientist (KIRDI)
Tel : (+254)721466444
Email: adudakenwo@gmail.com

70. Dr. Benjamin Apraku Gyampoh
Programme Officer, The African
Academy of Sciences (AAS)
Tel: + 254 (20) 806 0674
Fax: +254 (20) 806 0675
Email: b.gyampoh@aasciences.org

71. Dr. Douglas Miano
Kenya National Academy of Sciences
(KNAS)
Email: dwatuku@yahoo.com

72. Ms. Jacqueline Olang,
Network of African Science Academies
(NASAC)
Email: J.olang@aasciences.org

73. Hon. Prof Margaret Kamar
Minister for Higher Education Science
and Technology
Email: info@scienceandtechnology.go.ke

74. Prof Francis M. Mutua
Chair, Hydrology and Water Resources
University of Nairobi
Tel: (+254-20)-4441045

Email: fmmutua@gmail.com
fmuetua@uonbi.ac.ke

75. Dr. Peggy Efua Oti-Boateng
Senior Programme Specialist Science
and Technology
Coordinator, (ANSTI)
Tel : (+254) 700 506595
Email: p.oti-boateng@unesco.org

76. Prof Norah Olembo
Patron, (AWFST)
77. Ms Brenda Mariah Sudi
Protocol Cadet, Ministry of Foreign
Affairs and International Cooperation
Tel (+254) 722 866 758
Email: brendasudi@yahoo.com

78. Mr. George Achia
Science Journalist, Science Africa
Email: georgeachia2011@yahoo.com

79. Prof Vassey Mwaja
Chairman National Council for Science
and Technology (NCST)
Tel : (+254) 734 600870
Email: vsmwaja5@gmail.com

80. Prof James HP Kahindi
Council Member National Council for
Science and Technology (NCST)
Tel: +254) 722 705015 fax +254) 20
3606100
Email: jkahindi@gmail.com

81. Dr. Stephen Kibiru Karimi
ATPS-Kenya Executive Committee Member
National Council for Science and
Technology (NCST)
Tel: (+254) 727 923357
Email: karimisteve@gmail.com

82. Mr. Willis Okoth
Science Secretary, National Council for
Science and Technology (NCST)
P. O. Box 30623 – 00100

Tel (+254) 723 700669
Email: willokoth@gmail.com

Lesotho

83. Dr. Sissay Berele Mekbib
Lecturer Department of Biology,
National University of Leshoto
Tel : (+266) 63242329
Email: sbmekbib7@gmail.com;
sbmekbib@nul.ls

Liberia

84. Dr Wollor Emmanuel Topor
ATPS Liberia Chapter Coordinator
Dean, College of Science and
Technology
University of Liberia, Monrovia
Tel : (231) 886 875 802

Malawi

85. Ms Babettie Abigail Juwayeyi
Postgraduate Student, Bunda College of
Agriculture
P. O. Box 219, Lilongwe Malawi
Tel : (+265) 888 600 353
Email: babejuaei@yahoo.co.uk or
bjwayeyi@gmail.com

86. Mr. Tennyson M Magombo
Executive Director Arise and Shine
International
P. O. Box 30351, Lilongwe 3 Malawi
Tel: (+265) 5111736355;
+265 992 714625
Email: tennysonmagombo@yahoo.co.uk

87. Dr Henrie M. Njoloma
ATPS Malawi Chapter Member,
Irrigation Expert
Tel: 265(0)-1-771-660/
265(0)111-205-535
Email: hjoloma@yahoo.com,
hjoloma@gmail.com

Mali

88. Mrs. Assétou Kanoute

Research Assistant IPR /
IFRA de Katibogu
Tel: 00223 21 26 20 12 / 00 223 764 10 507
Email: kalilouka@yahoo.fr;
adafgalle@afribone.net.ml

Morocco

89. Prof. Saïd Boujraf
ATPS Morocco National Coordinator,
Professor, Director
Tel : (+212) 667 780 442
Email: sboujraf@gmail.com

Nigeria

90. Ms. Anabela Zacarias
Academy of Science of Mozambique
(ASM)
P.O. Box 3733, Calabar

91. Azubike Emmanuel Achike
Department of Economics, University of
Nigeria
Email: azubikachike@gmail.com

92. Ebele Chinelo Amaechina
Lecturer Department of Agricultural
Economics
University of Nigeria, Nsukka
Tel : (234) 803 35010306
Email: ebelchina@yahoo.com

93. Dr. Anselm A. Enete
Lecturer Department of Agricultural
Economics
University of Nigeria
[Tel:\(+234\)8064448030](tel:+2348064448030)
Email: anselmenete@hotmail.com

94. Ms. Blessing Chinenye Aruah
Senior Scientific Officer
National Biotechnology Development
Agency
Tel: +234 803 5993237
Email: ar_chinny@yahoo.co.uk

95. Mr. John Buchi Ekere

Great John Bosco Ltd
Email: greatjohnbosco@ymail.com

96. Mr. Onyenekenwa Cyprian Eneh
Senior Research Fellow University of
Nigeria
Tel : (+234)803-338-7472
Email: esccha@yahoo.com

97. Dr Adaku Bridget Chide Ezeibe
Research Fellow/ Lecturer
Tel (+234) 806 7321127
Email: adakuezeibe@yahoo.com

98. Dr. Chidiebere Udeh. Ibe
Public Finance and Policy Consultant
Tel: (+234)803-566-3820
Email: chidierai@yahoo.com;
cibe@ippam.org

99. Mr. Ubokudom Etim Okon
PhD Student, University of Nigeria
Tel: +234)8030757061/8028286019
Email: otobong2003@yahoo.com

100. Mr. Adebola Simeon
Oluwafunmilore
Student Obafemi Awolowo University
Department of Mechanical Engineering
Tel: (234) 705 8656729
Email: Oluwafunmilore4g@yahoo.com

101. Prof Michael Ifeanyi Uguru
Head of Department, University of
Nigeria, Nsukka
Tel : (+234) 803 772 3307
Email: michael.uguru@unn.edu.ng

102. Mr Kingsley Ogheneovo Ukoba
Research Engineer Federal University of
Technology Akure
Tel: (+234) 803 5431913
Email: ukobaking@yahoo.com

103. Prof Turner T. Isoun,
Vice Chair, ATPS Board

Tel : (+234) 803 314 2395
Email: ttisoun@aol.com

104. Prof Adefenmi Olatunde Femi
Olokesusi
ICT Nigerian Institute for Social and
Economic Research (NISER)
Tel: (+234)8023322052/8034115310
Email: femioloke@yahoo.com

105. Prof Eric Chiedum Eboh
President Agricultural Policy Research
Network (APRNet)
Tel : (+234) 803 6660475
Email: eceboh@yahoo.com

106. Hon Prof Ita Okon Bassey Ewa
Honorable Minister of Science and
Technology
Email: adogbogm@yahoo.com

107. Mr. Victor Emeka Ngwoke
Chair (AYFST)
Email: emvictoruk@gmail.com

108. Prof Emmanuel Okechukwu Ezugwu
Provost Air Force Institute of
Technology (AFIT-Nigeria)
Tel : (+234)702 930 6013/803 705 9313
Email: eozeugwu@gmail.com

109. Prof. Peter Azikiwe Onwualu
Director General, Raw Materials Research
and Development Council (RMRDC)
Tel : (+234) 803 7432497
Email: ponwualu@yahoo.com;
ceo@rmrdc.gov.ng

110. Mrs. Rachel Kai Kotso
Assistant Director, International
Collaboration Unit
Tel : (+234)8033020954
Email: rmrdcinfo@yahoo.com or
rkotso@rmrdc.gov.ng

111. Prof. Osita ogbu

Former Chief Economic Advisor to the President, Nigeria
Executive Director (ADSI)
Tel : (+234)8037002500
Email: ovoko@yahoo.com

112. Prof Charles Livinus Anija Asadu
Head of Department, Soil Science, University of Nigeria
Tel: (+254) 7030617380
Email: charlesasadu@yahoo.com

113. Prof Anthonia Ifeyinwa Achike
University of Nigeria, department of Agricultural Economics
Tel : (+234) 803 4234147
Email: ifyachike@gmail.com

114. Prof Sonny Angus N. Chidebelu
University of Nigeria, Department of Agricultural Economics
Tel : (+234) 803 7720684
Email: sandchidebelu@yahoo.com

115. Prof, Doc Mrs. Obioma C. Nwaorgu
Global Health Awareness, Research Foundation (GHARF)
Tel: (+234) 803 7097410
Email: gharf_enugu@yahoo.com

116. Prof. Malachy Okwueze
Deputy Vice Chancellors Office, University of Nigeria
Tel: (234) 803 7759549
Email: malachyokwueze@yahoo.com

117. Prof Vincent Anigbogu
Director General, Institute for National Transformation
Email: vanigbogu@gmail.com

118. Mrs. Faith Chinwe Omeke
Research Fellow II/Lecturer II, University of Nigeria
Tel : (+234) 7030585395
Email: f.omeke@yahoo.com

South Africa

119. Mr Denis Carl Fourie
Chairman The Lobbyist Group Ltd
Tel. (+27)721269844
Email: denis.fourie@thelobbyist.org

120. Mr Luckson Muganyizi Kaino
College of Education, University of South Africa
Tel: (+27) 766 000 182
Email: kainolm@unisa.ac.za

121. Velaphi Zakhele Msimang
The Mapungubwe Institute for Strategic Reflection
Tel: (+27) 11 518 0260
Email: velaphim@mistra.org.za

122. Prof Mark Swilling
ATPS South Africa Chapter Coordinator
Tel : (+27)83-459 7417
Email: swilling@sun.ac.za

123. Dr Takalani Simon Rambau
Liaison Manager, Academy of Science Of South Africa
Switchboard: +27 12 349 6600
Tel: +27 12 349 6609
Fax: +27 (0) 86 576 9521
Email: takalani@assaf.org.za

124. Ms Phakamile Truth Mngadi
Programme Officer, Academy of Science of South Africa
Switchboard: +27 12 349 6600
Tel: +27 12 349 6609
Fax: +27 (0) 86 576 9521
Email: phakamile@assaf.org.za

125. Dr. Jan-Hendrik Groenewald
Executive Manager, Bio-safety
Email: hennie@biosafety.org.za
126. Dr Ibrahim Assane Mayaki,
Chief Executive Officer, NEPAD Secretariat

Email: info@nepad.org

127. Prof. Doc Reckson Thakhathi
Faculty of Management and
Commerce, University of Fort Hare
Email: RThakhathi@ufh.ac.za

Sudan

128. Mr. Ibrahim Mohamed Ahmed
Managing Director, Industrial Research
& Consultancy Centre
Tel: (+249)912115469
Email: i.mohmed@ircc.gov.sd

129. Ms Nadia Hassan Sidahmed
ATPS Sudan Chapter Coordinator
Industrial Research & Consultancy
Centre (IRCC)
Tel: +249)911449106, (+249) 185 313
753
Email: nadiahsh@yahoo.co.uk

130. H.E. Mukhtar Adulkareim Adam
Bormah
State Minister of Environment,
Forestry & Physical Development
Tel : (+249)123913913
Email: daladongi@gmail.com

131. Dr. Ghazi Badawi Shamseldin
Hamid
Assistant Professor,
University of Khartoum
Faculty of Agriculture, Department of
Agronomy
Tel: +249) 121071754
Email: ghazibadawi@yahoo.com;
ghbadawi@uofk.edu

Swaziland

132. Dr Musa A. Dube
ATPS Swaziland Chapter Coordinator
Senior Lecturer, Faculty of Agriculture
University of Swaziland, Luyengo Campus
Tel: (+268) 618 15 79
Email: madube@agric.uniswa.sz

Tanzania

133. Prof. Roshan Abdallah
Tanzania Academy of Sciences (TAS)
Email: raifa52@yahoo.com

Tunisia

134. Dr Agnes Soucat
Director, Human Development OSHD
TEL: (216)711720 Cell (216)98709232
Email: a.soucat@afdb.org

135. Dr Boukary Savadogo
Head, Education Division, African
Development Bank (AfDB)
Tel: (216)71102984 F(216)71830586
Email: b.savadogo@afdb.org

136. Mr. Ahlin Byll-Cataria
Executive Secretary, ADEA, African
Development Bank (AfDB)
Tel: (216)71103202 F(216)71252669
Email: a.byll-cataria@afdb.org

Uganda

137. Ms Irene Magara
Assistant Lecturer, Mbarara University of
Science and Technology
Tel: (+256)772558314
Email: imagara@gmail.com

138. Eng. John Okuonzi
ATPS Uganda Chapter Coordinator,
Tel: (+256)782 353034
Email: jokuonzi@kyu.ac.ug

139. Dr. Andrew Kiggundu
Uganda National Academy of Sciences
(UNAS)
Email: akiggundu@gmail.com

United Kingdom

140. Prof Sir Brian heap
ATPS Board Member, Vice-President
Tel : (+44)1223 248509
Email:

brianheap1@gmail.com/rbh22@com

141. Mrs. Martha Ada Ugwu
ATPS Focal Point Coordinator
Tel : (+44)01634310389/07985476289
Email: Martha.ugwu@yahoo.co.uk
Martha@ugwu.fsworld.co.uk

142. Dr Robert Patrick David Byrne
Research Fellow, STEPS Centre
Tel : (+44)1865794713
Email: chris.leaver@plants.ox.ac.uk

143. Prof Christopher John Leaver,
Emeritus Professor of Plant Science
Fellow of St John's College,
Oxford University
Tel: (+44)1865794713,
Email: chris.leaver@plants.ox.ac.uk

144. Dr Holzeis Claudia Canales
EASAC Secretariat,
Research Associate at Biosciences
University of Oxford
Email: claudia.canales@plants.ox.ac.uk.

145. Ms. Bronwen Manby
Acting Director, Africa Climate
Change Adaptation Initiative (ACCAI)
Tel: (+44) 20 7031 1611
Email: bronwen.manby@opensocietyfoundations.org

146. Ms. Ngozi Uche Onyejeli
Email: ngozi@yahoo.com

147. Chux Uzoka Daniels
Doctoral Researcher and Associate
Tutor
University of Sussex
Tel : (+44)79 5046 5054
Email: c.u.daniels@sussex.ac.uk,
cd278@sussex.ac.uk.

148. Dr Divine Ikenwilo
Research Fellow, University of

Aberdeen
Email: divine@ikenwilo.com

149. Mrs Ihuoma Ibeji Ngozi phd
University of Aberdeen
Accounting and Finance Department
Tel: (+44) 750 6903855
Email: r01nii11@abdn.ac.uk

150. Prof. Christopher Garforth
Professor of Agricultural Extension and
Rural Development
University of Reading
Email: c.j.garforth@reading.ac.uk

151. Prof, Ian David Hodge
University of Cambridge,
Department of Land Economy
Email: idh3@cam.ac.uk

152. Prof Egil Robert Orskov
The Orskov Foundation,
The Hutton Institute
Tel: (+44)1224 498200
Email: boborskov@hotmail.com

USA

153. Dr Anthony C Ikeme
ATPS USA Chapter Coordinator
Tel : (+1)215 380 9920
Email: aikeme@clintriad.com

154. Mr Andrew Gerard
Program Officer,
Global Knowledge Initiative
Tel: (+1) 617 755 3232
Email: andrew.gerard@gkinitiative.org

155. Dr Jeffery Herrick
Research Scientist, Unites States
Department of Agriculture
Tel: (+1) 575 6465194
Email: jherrick@ad.nmsu.edu

156. Prof Caroline S. Wagner
John Glenn School of Public Affairs

Ohio State University
Tel: +1-614-292-7791
Email: wagner.911@osu.edu

157. Ms Alyson Lyons
Program Assistant
Woodrow Wilson International Centre for
Scholars
Tel: (202) 691-4083; Fax: (202) 691-4001
Email: alyson.lyons@wilsoncenter.org

158. Mr. Derek Langford
Program Assistant Africa Program
Woodrow Wilson International Centre for
Scholars
Tel: 202-691-4355; Fax 202-691-4001
Email: derek.langford@wilsoncenter.org

Zambia

159. Mr. Billy Katontoka
Director Operations & Projects
Africa Carbon Credit Exchange
Tel: (+260)975366274
Email: bkatontoka@africacce.com

160. Prof Francis Davison Yamba
ATPS Zambia Chapter Coordinator
Tel : (+260) 211 223118
Email: yambafd@yahoo.com

161. Dr Felix Mwangala
Zambia Academy of Sciences (ZaAS)
Email: fsmwangala@hotmail.com

Zimbabwe

162. Mr Darlington Ndlovu
ATPS Zimbabwe Chapter
Tel: +263 772 915 161
Email: mthoniselwa@yahoo.com;
mthoniselwa@gmail.com