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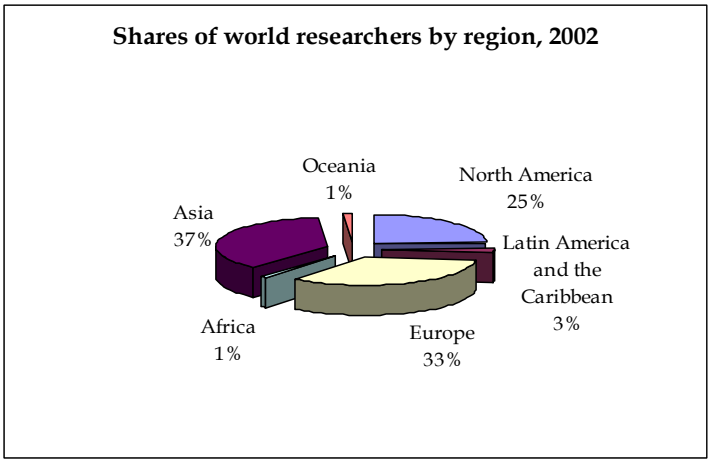
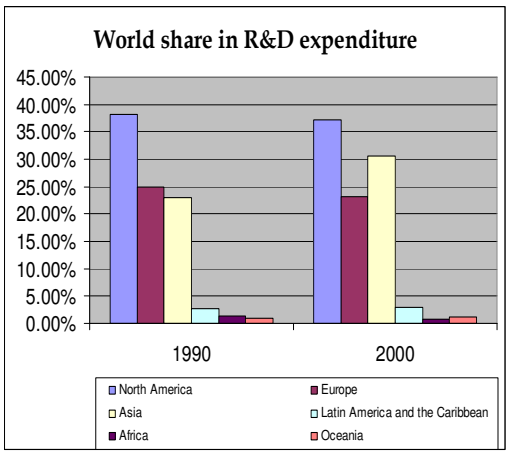
Science and Technology for Development: Outcome and Recommended Actions of the Conference on Science with Africa

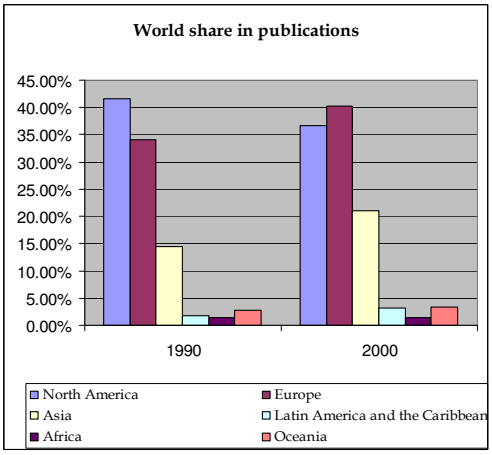
1. Background to Conference: The Relevance of Research and Development (R&D)

Africa is the only region yet to fully exploit the great potentials of using science and technology as an engine of growth and development. Economic development is dependent on the scientists and engineers, who discover, innovate and invent, which is why Research and Development has been seen as a development priority in many countries that benefited from investment in the area. With regard to R&D capacity, Africa, together with Oceania, has the lowest shares of world researchers. As shown in the figure below, Africa lags behind in the evolution of R&D – intensive economy hence its limited economic growth. Asia, Europe and North America represent 95 per cent of world researchers whereas the other 5 per cent is represented by Latin America and Caribbean, Oceania and Africa. It is also estimated for instance, that while Africa has 83 engineers for every one million people, the developed world has 1000 engineers per one million people, which shows the low level of investment in science education in Africa.



The results or outputs of R&D take the form of new knowledge and competence, scientific breakthroughs, new discoveries or inventions, new or considerably improved products or services and innovative scientific and technical methods, etc. On the other hand, the evaluation procedures for industrial R&D are essentially based on an analysis of statistics on patents and trade in high-technology products, and at more aggregated levels, the technology balance of payments of countries. In this regard, looking at the picture of the world science analysed against R&D expenditure and scientific output, as seen in the graphs below.





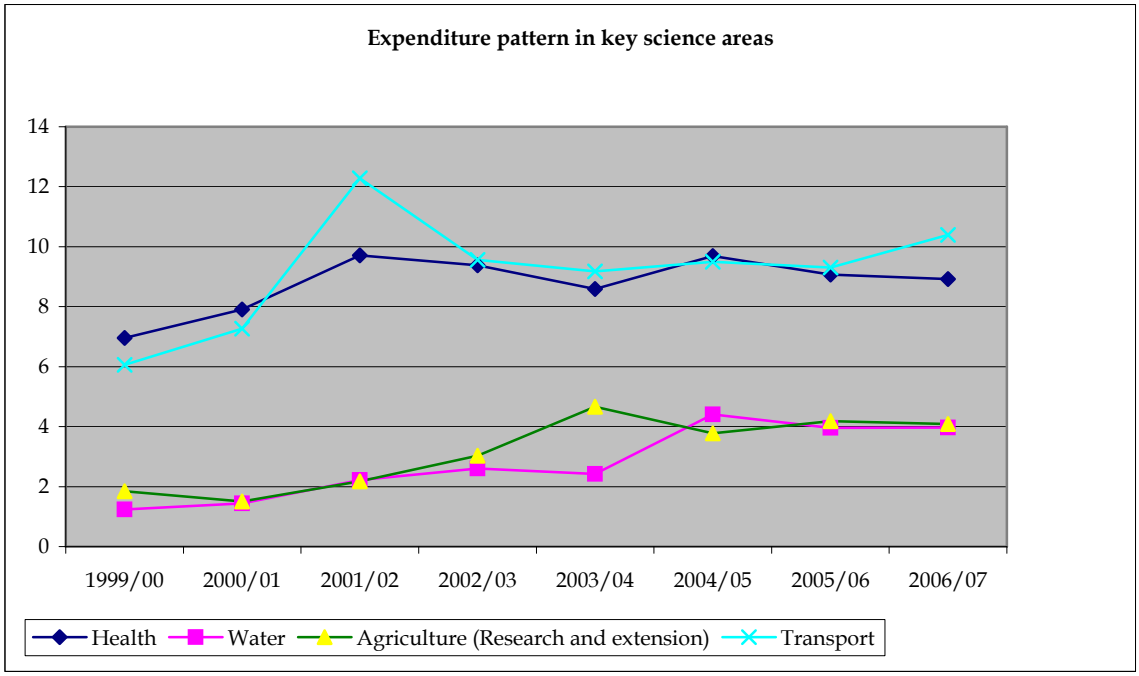
In recent years, Asia has shown a sharp increase in R&D expenditure and publications. Oceania and Latin America increased their share in publications, while maintaining R&D expenditure. Europe also increased its share of publications but also lost ground in expenditure. Africa shows an alarming drop in its (already low) proportion of global R&D expenditure, while the share of publications with authors in Africa remained constant throughout the period.

The level of investment in research and development is very low and recent research by ECA confirmed that research and development funding in Africa is still lower than 1 per cent of its GDP as shown in the graph above. World Bank data also shows that Organization for Economic Cooperation and Development (OECD) countries spend more on research and development annually than the total value of economic output of 61 of the world's poorest countries. This is why the 8th African Heads of State Summit held in January 2007 in Addis Ababa, Ethiopia declared that member States to promote Africa's Research and Development (R&D) and develop innovation strategies for wealth creation and economic development by allocating at least 1 per cent of Gross Domestic Product (GDP) of national economies by 2010.

However, there are positive developments in several African countries. Some countries like South Africa, Uganda and Ghana emphasized their intention for increased investment in R&D. To encourage businesses to increase investment in technology and innovation, South Africa's 2006 budget proposed the deduction for current research and development expenditure to increase from 100 per cent to 150 per cent and a more favourable regime for depreciation of R&D capital expenditure. In 2006/2007, the Government of Uganda has prioritized the provision of support to scientists who are undertaking research and innovations related to the country's production processes. In addition, the Government has negotiated a five-year $US 30 million project under the Millennium Science Initiative funded by the World Bank, to support research, education and training in science and technology with linkages to the industry. Recognizing that accelerated growth cannot be easily achieved without commercialization or linking the commercial and industrial sector to research, innovation and development in the country in 2006/2007 Ghana gave special support to industries that commercialize research findings.

This increase in R&D expenditure is conspicuously supported by the graphs below, which display how Tanzania and Rwanda have directed their resources towards key science and technology sectors of their countries in the last five years.

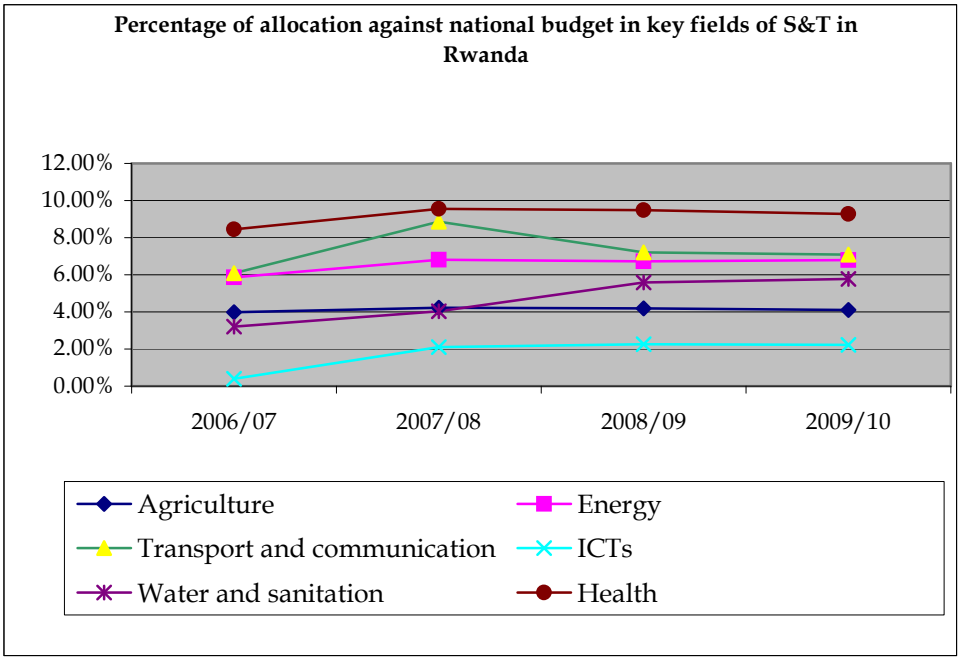
Government expenditure in key science sectors in Tanzania from 1999/2000 to 2006/2007



Source: Ministry of Finance, Government of Tanzania, http://www.mof.go.tz/

The above graph shows the percentage of expenditure against the national budget in key priority sectors of Science for the Government of Tanzania. Over the last 10 years and even more, the GDP of Tanzania has grown more than double from $US 4.5 billion in 1994 to $US 10.5 billion in 2003 and $US 10.9 billion in 2004 which to a certain extent, could be attributed to an increase in expenditure on R&D, science and technology.

Percentage of allocation against national budget in key fields of Science and Technology in Rwanda.



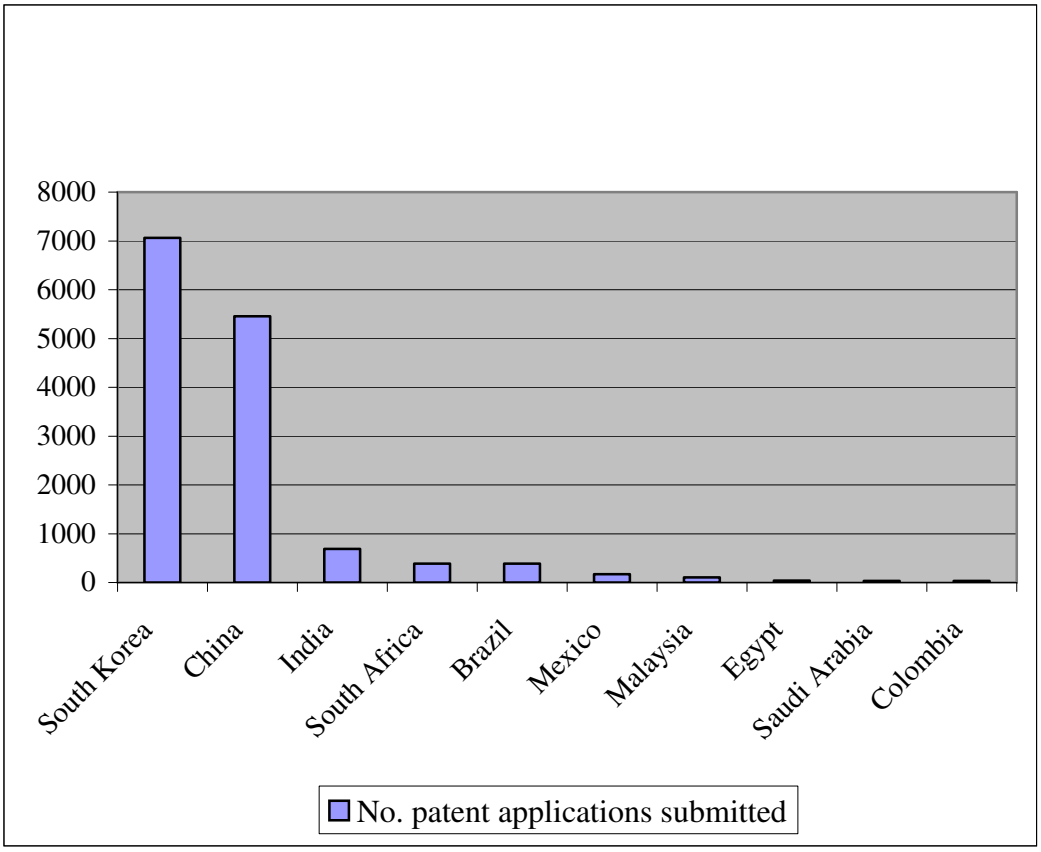
Source: Ministry of Finance and Economic Planning, Government of Rwanda.

Rwanda also recorded an increased GDP growth with its more focused strategy in Science and Technology investment with an average GDP annual growth of 4.2 per cent from 2004 to 2008.

2. Intellectual Property, Patents and Technology Transfer

One of the key issues in reaping the benefits of Science and Technology in Africa is that access to technologies can be constrained by lack of appropriate regimes to support the beneficial use of patents and intellectual property. For instance, Anti-Retroviral (ARVs) drugs and other medicines that have generic equivalents could be developed in Africa in line with Article 66.2 of the Trade-related Intellectual Property Rights (TRIPS) so as to promote and encourage technology transfer in least-developed countries for a sound and viable technological base. However, this is not happening as fast as expected. Given this situation, Africa's scientific output as a continent is also low as reflected in the application for international patents in the graph below. In 2007, for example, there were 7,061 applications for international patents in the Republic of Korea and 5,456 in China. In contrast, the highest number of applications in Africa was from South Africa, which had 390 applications while Egypt had 41.

International patent applications to the WIPO from developing countries in 2007



Source: WIPO.

Therefore, the scale of the challenge facing Africa in the area of science and technology is huge but, it can be overcome with vision, commitment and unwavering determination. Some of these challenges relate to low science and technology capacity, low investment in research and development, inadequate regulatory regimes, poor infrastructure base and a lack of access to helpful scientific ideas.

In order for Africa to occupy an appropriate position in the contemporary global knowledge-driven economy, it has to put to better use current scientific knowledge and skills to address its priority needs. The continent needs to engage in the new fields of science and cutting-edge technologies that have strong impact onto sustainable socio-economic development. These fields include life and health sciences, nanotechnology and biotechnology, ICTs, agricultural technologies and industries, space and earth sciences, energy technologies and the science of climate change. Furthermore, the twenty-first century offers promise of even greater and accelerated progress as digital technologies drive down the costs of creation, reproduction, distribution, and consumption of knowledge.

In 2007, The African Union recognized the need for a focused discussion at the highest level on effective development and utilization of science and technology and assigned the theme **"**Science, Technology and Scientific Research for Development" to its January 2007 Summit of Heads of State

and Government. The Summit subsequently declared the year 2007 as the lunching year of building constituencies and champions for Science and Technology and innovation in Africa. It supported the establishment of Pan-African Intellectual Property Organization (PAIPO). It reiterated its commitment to Khartoum 2006 decision urging member States to allocate at least 1 per cent of Gross Domestic product (GDP) to Research and Development. It also endorsed the need for South- South and North – South cooperation in science, technology and innovation. Consequently, in support of the AU Summit outcomes, the Science with Africa Conference offered such a unique opportunity to revisit the role of R&D in Africa development, based on concrete areas such as health, water, energy, ICTs, agriculture and climate change, transport/infrastructure and life sciences.

3. The Science with Africa Conference, 3-7 March 2008

ECA in collaboration with the African Union Commission (AUC), other UN agencies and partners organized the conference on "Science with Africa" in Addis Ababa, Ethiopia at the United Nations Conference Centre from 3-7 March 2008. The main objectives of this Conference were: (i) to promote South-South and North-South cooperation in Science, Technology and Innovation (STI) through increased synergies between African-based scientific organizations and those outside the continent; (ii) to explore ways of improving the interface between scientific research, policy development and business enterprises; and (iii) to provide a framework for utilizing STI for attaining accelerated economic growth in Africa. There were approximately 700 participants who attended the Conference representing African member States, Asian, European and North American countries, international and regional organizations, business communities, civil society organizations, and development partners. There were 26 local and international companies and organizations that exhibited, and the exhibition was throughout the Conference. Some 200 people attended the one-day pre-conference GKP 2008 workshop.

3.1 Key Issues Discussed

The Conference dealt with the following topics/issues pertaining to Africa's socio-economic development: (i) STI policy; (ii) Innovation and production of ideas; (iii) Intellectual Property Rights (IPR), patents and technology transfer; (iv) High Level Panel on the Future of STI in Africa; (v) International programmes to support STI; (vi) Energy, water, transport and infrastructure; (vii) ICTs and innovation; and (viii) Agriculture, health and life sciences; (ix) Science with Africa marketplace; and (x) Developing guidelines for health research in Africa. Cross cutting issues such as, STI capacity-building and climate change in Africa formed part of the lively discussions.

3.2 Outcome and Recommended Actions

3.2.1 Science Technology and Innovation (STI) policies in Africa

Many countries around the world have been using STI to shape their socio-economic development, the situation in Africa is unsatisfactory despite the pronouncement of national development visions. Most of these visions have components dealing with the development of S&T and its relation to economic development. The African Union's Consolidated Plan of Action (CPA) of 2005, which is a continent-wide blueprint for accelerating economic growth through the application of S&T, is being implemented. This is expected to help African governments prioritize

STI for development. In light of the continent's current challenges, implementation of the CPA needs to be accelerated, while African governments also need to scale-up investment in STI. Linkages between STI policy, research products and business enterprises need to be strengthened. Consequently, Africa requires STI policies, which are founded on its basic needs, especially poverty reduction through sustainable economic growth. The formulation of such problem solving policies should be based on development indicators and should take into account the country's existing STI infrastructure, human and financial capacities. They should incorporate prospective South-South and North-South STI cooperation (technology transfer and domestication), but avoid heavy dependence on external funding. At the moment, almost all African countries do not have an enabling environment for the utilization of S&T for socio-economic development and hence their market competitiveness is weak.

The experience from Korea showed that the Korean Innovation System has three sources: Government research institutions, universities and the private sector which Africa could emulate. The key factors that influenced the Innovation System of that country were its outward development strategy, which created pressure for R&D investment, government policy, which focused on indigenous R&D capacity, the necessary S &T infrastructure and a rich pool of well-educated S & T professionals. At the policy level, innovation in India included the field of telecommunications, which led to the collapse of consumer prices as a result of deregulation. A lesson here is that policy initiatives can provide access to high technology to the poor.

Funds for STI Policy implementation: The case of the European Commission

The European Commission stated that collaboration by African scientists in their 7th R&D Framework Programme is possible through a number of activities such as the European Research Area Nets (ERA-Nets), but due to the lack of technical skills in building the necessary research capacities and the inability to deal with Intellectual Property Rights and contract management, African scientists experience difficulties accessing these funds. The Conference was also informed that the recent European Parliament Resolution on Science with Africa is requesting the European Commission to place research on climate change at the forefront of its collaboration with Africa. A number of development cooperation partners are willing to support collaborative R&D activities originating from the continent. In the case of the European Commission, funds are available from the 10th European Development Fund, but during the programming phase, with the exception of South Africa, not one single country has earmarked funds for Science and Technology.

Recommendations:

(i) African governments should establish enabling environments for the sustenance of local STI experts, creation of a critical mass of STI experts and of knowledge communities in their respective countries.

(ii) African governments should develop mechanisms to profitably address the brain drain and encourage brain circulation through South-South and North-South scientific cooperation.

(iii) African countries should incorporate climate change issues in their S&T priorities, particularly in their partnership projects with EU, G-8 and other development partners, including emerging economies such as India, China, Korea, Malaysia and Brazil.

(iv) ECA in collaboration with AU should assist African countries and their regional economic communities (RECs) to prepare or review national and harmonized regional STI policies. Such policies should have adequate STI development indicators.

(v) The African Union with the support of its partners needs to foster the development of the African S&T policy framework.

(vi) African countries need to prioritize innovation as part of their S&T strategy for job creation, market competitiveness and wealth creation. Hence, African countries should develop national innovation systems that have clear development indicators, and clear interface between education, research, STI policy and business enterprises.

(vii) African governments should strengthen their will and commitment to prioritise the sustainable funding for STI activities in their respective countries. R&D funds should be mobilized from both the government and private sector.

(viii) AU and ECA in consultation with governments should create the mechanism to support African scientists to access funds for R&D.

3.2.2 Intellectual Property Rights (IPR), patents and technology transfer

Whereas numerous African countries are improving their science base, further effort is needed for economic benefits from publicly financed S&T. Innovation is commonly understood to represent this process. Since the adoption of the Lisbon Agenda, EU and its member States have launched numerous initiatives to improve the commercialization of research results covering all stages of the development chain: the protection of research results via IPR[1], the transfer of knowledge[2] and technology through the exchange of scientists, the creation of spin-offs, the agreement of research contracts and the licensing of technology and finally financing schemes for the commercialization of research results such as venture capital and start-up funds.[3] Science cooperation and investment in African science based organizations can only benefit the African economy and people if mechanisms are in place that help to transfer the knowledge into the economy and general knowledge base.

Discussion were on how Africa could benefit from the IP systems being put forward through international organizations like the World Trade Organization (WTO). It was observed that for Africa to benefit from that, there is need for a lot of awareness in the area of IPRs. From the presentations, it was also observed that for Africa to enjoy the benefits of IP systems, the African states should ensure that IP institutions are efficiently and sufficiently funded, should keep the costs

[1] Communication on Knowledge Transfer; Community's Patent Strategy.
[2] Communication on Knowledge Transfer; European Institute of Technology (EIT).
[3] Competitiveness and Innovation Framework Programme.

of obtaining, maintaining and enforcing property rights low, and countries should take actions against counterfeiting and piracy.

The Conference was also informed that Africa has two institutional patents registration organizations, one for Francophone Africa (Organisation Africaine pour la protection Intellectuelle (OAPI) and the other for Anglophone Africa (African Regional Intellectual Property Organization (ARIPO). AU has recently decided to establish a continent-wide (The Pan-Africa Intellectual Property Organization (PAIPO), body to take care of African IPR and patents. Beside these organizations, each African country has its own established registration body dealing with IPR and licensing of patents. It was reported that African countries face many challenges in relation to the establishment of balanced IPR systems, technical capacity-building, and adoption of common position at international IPR foras. Some of the existing IPR protocols have strong protection regimes that increase prices of some commodities and promote piracy. Africa continues to lose its indigenous knowledge and traditional artefacts due to inadequate IPR regimes. The few available patents cannot be commercialized due to lack of financial resources, technology and access to markets.

Recommendations:

(i) ARIPO, OAPI, PAIPO and the national IPR bodies should embark on intensive capacity-building and awareness raising campaigns in IPR and patent issues.

(ii) African countries and their respective institutions should enhance their role as custodians of the governance of Africa's indigenous knowledge and traditional artefacts by enforcing protection laws related to IPRs.

(iii) AU and ECA need to sensitize policy makers, the public and the private sector on Patents and IP issues and how they can contribute to research and development.

(iv) For Africa to enjoy the benefits of IP systems, African countries should ensure that IP institutions are sufficiently funded, to obtain, maintain and enforce property rights.

3.2.3 High Level Panel on STI in Africa

The object of the session was to discuss the status of STI in Africa and how it contributes to the socio-economic development of Africa, with High Level Policy makers giving their perspectives on the way forward. The Panel was composed of four Ministers of Science and Technology from Algeria, DRC, Guinea and Tanzania, as well as the Speaker of Rwanda's National Parliament. This composition was complemented by three leading African scientists who would also speak about the gaps in policy and visioning for STI in Africa and proposals for the way forward. The key recommendations from the Panel included:

(i) The need to prioritize programmes to promote transfer of S&T knowledge at the subregional and regional levels in Africa.

(ii) The resurrection of the Pan-African Union of Science and Technology.

(iii) The need for the adoption of a political science system for all African countries and also made a number of proposals that would contribute to the development of STI in Africa.

(iv) The adoption of a new vision for development that focus on Science and Technology to mobilize through innovation, the social energy needed for the development of Africa and her People.

(v) STI should therefore be addressed from various dimensions such as gender, rural community, business enterprise, engineering, private/public partnership; capacity-building and knowledge sharing.

(vi) The need for concrete proposals as financing mechanisms for S&T, such as Technical Invest Fund and a National Science Foundation in all countries.

3.2.4 International programmes to support STI in Africa

Despite low investments in R&D by African countries, there are a number of international programmes to support African scientists, which are often under-subscribed (for instance, from the European Commission). There are various forms of international cooperation in the S&T sector, including peer-to-peer scientific cooperation, development cooperation programmes, competitive funding programmes, international investment initiatives, global policy fora, and regional collaborative programmes. For instance, the Bill & Melinda Gates Foundation launched a new $US100 million initiative to help scientists across the globe pursue ideas that have never before been tested for solving major health problems. Consequently, discussions of the session focused on sustainable partnerships for longer, healthier and productive lives, for developing and sharing knowledge skills for wealth creation that is country-driven and people-centred. This was against the backdrop of various programmes to support S&T in Africa, including the Africa-EU Strategic Partnership that prioritized Science, Information Society and Space programmes.

Furthermore, the European Commission IST-Africa Initiative was presented, which supports African Participation in the ICT Theme of Framework Programme 7, with information on the categories of participants, types of organizations that are eligible for EU funding. Participants welcomed the various sources of funding from EU to support R&D in Africa and Africans were urged to utilize this opportunity. African countries, in particular welcomed UNESCO's 2008-2013 Strategic Plan which emphasises its support to Africa's STI initiatives, including the African Union's Consolidated Plan of Action (CPA). Pledges were made by NOKIA and the Global Knowledge Partnership (GKP) to support the continent's STI efforts.

Recommendations:

(i) Strategies should be developed for scientists to benefit from international programmes in a more strategic and concerted manner than is currently the case.

(ii) How African researchers should define and develop coordination mechanisms amongst themselves in order to avoid fragmentation of their efforts as well as target such efforts towards national development.

(iii) African scientists need to share knowledge on the various programmes taking place and change their mindset on approaches to collaborative R&D activities. Therefore, there is a need to compile an inventory of all the known programmes as well as profiles of research entities so that the information can be channeled to all research institutions and other relevant stakeholders.

(iv) The existing working partnership between the International Council for Science (ICSU), ECA and AU should be strengthened.

3.2.5 R&D Idea factory

The Idea Factory is an innovative method for generating ideas, selecting and implementing innovative ones. Industrial IdeaProduction is BrainStore's unique process of stimulating innovative and lateral thinking in a systematic – industrial – process, in dazzling speed. IdeaProduction will tap the depths of creativity and expertise of the «Science with Africa» participants to develop these ideas in only three days. The resulting strategy of ideas will stimulate and support the strengthening of African R&D by looking at issues such as capacity needs, increasing usability of research output, fostering interaction among African scientists and other stakeholders, and enabling participation of African scientists in international research projects.

Supported by the Swiss Agency for Development and Cooperation, this project is an example for meaningful international collaborations of Global Knowledge Partnership members. GKP is the world's first international multi-stakeholder network. This innovation aims at establishing concrete measures to boost R&D in Africa. In the context of this Conference, the Idea Factory has facilitated the establishment of selected research ideas, which will be jointly implemented by BrainStore and African scientists, engineers and technologists. Conference participants developed practical ideas for concrete initiatives that foster the scientific development and research in Africa. All ideas must correspond to the following criteria.

(i) The idea takes into account current challenges in Africa and builds the foundation to strengthen and expand R&D capacities.

(ii) The idea increases the visibility of African R&D capabilities on the international level and creates the basis for sustainable partnerships.

(iii) The idea contributes to increasing the usability, practicability and commercialization of research results.

During the Conference, 5,000 inspirations were collected in the Creative Workshop and at the Ideation Shop; these were compressed to 450 proposals of which 144 have been examined by a panel of experts. Twenty ideas were presented to the Conference and participants voted on their

preferences. ECA, SDC and BrainStore will organize a workshop devoted to the implementation of the outcomes of the Idea Factory in Africa within a few months after the Conference.

Recommendation:

AU, ECA and the UN family, in collaboration with other implementing partners, should work with African based S&T entities to generate many factory ideas in order to boost R&D in Africa.

3.3 Thematic Issues

3.3.1 Energy, water, transport and infrastructure

It was reported that 75 per cent of the sub-Saharan Africa population has no access to electricity. This impacts negatively on the attainment of MDGs, especially the fight against poverty on the continent. However, records show that Africa has abundant primary energy resources (i.e., water for hydro-power, oil, natural gas, coal and nuclear). In addition, Africa has enormous amounts of renewable energy sources, such as solar, wind, ocean waves and tides, geothermal, and biofuels. It is commonly found that there is not much emphasis on the nexus of energy production, utilization and environment protection issues in Africa. R&D on the energy sector in Africa has yet to focus on energy resource assessment; conversion technologies; low cost transport and distribution technologies; and energy efficiency.

On average, the African population with access to clean and safe water is about 60-80 per cent in the urban areas and about 30-50 per cent in rural areas. It has also been reported that sanitation levels in the urban and rural areas is about 55 per cent and 25 per cent, respectively. This promotes the prevalence of high levels of water-borne diseases on the continent. The main concerns in the water sector in Africa include variable precipitation due to climate change, water scarcity, uneven geographical distribution of water resources, water governance, and trans-boundary aquifers. The other challenges facing Africa in this sector include the unavailability of reliable data, lack of adequate well-trained human capital and functioning research infrastructure.

The main challenges in the transport sector in Africa include poorly functioning transport systems, due to weak infrastructure and maintenance schemes. Furthermore, there is a big mismatch between demand and supply of transport services in many African countries. The integration between population growth, land use and transport networks is weak while the transport industry in Africa does not sufficiently utilize modern techniques such as ICT tools (i.e. GPS, GIS).

Recommendations:

(i) African Institutions dealing with energy, water, transport and infrastructure sectors should establish professional networks for sharing information, knowledge, skills and experiences in these sectors.

(ii) African countries should harness their enormous energy resources for socio-economic development paying special attention to renewable energies, which are amenable for use in rural areas.

(iii) ECA should continue to work with the African energy institutions, such as the African Energy Commission, and AU and its NEPAD energy initiative.

3.3.2 ICTs and innovation

This session acknowledged that ICTs constitute a solid foundation for harnessing science technology and innovation for development. They support research activities that deal with data capturing, storage and dissemination. Consequently, the application of ICTs facilitates access to knowledge and the creation of networked communities and business enterprises. Unfortunately, the low level of ICT penetration, absence of national and subregional innovation systems due to lack of affordable infrastructure, inappropriate legal and regulatory environment to support market competition and participation of all stakeholders (e.g., the widely dispersed rural community and the disenfranchized groups) constitute the main challenges that most African countries face. The lack of technological innovation to support growth of SMEs limits their contribution to national economies in Africa.

Recommendations:

(i) ECA should continue its assistance to African countries and Regional Economic Communities (RECs) for development, implementation and monitoring of national, subregional harmonized ICT policies. Greater emphasis should be put on reinforcing implementation mechanisms and on meeting the needs of rural communities, youth and women.

(ii) African countries should develop ICT and Innovation policies and strategies.

(iii) African countries should establish enabling environment for partnership for knowledge sharing and networking.

(iv) African Union Commission and ECA, in collaboration with its partners should support the implementation of the African Regional Action Plan on the Knowledge Economy (ARAPKE).

3.3.3 Agriculture, health and life sciences

About 70 per cent of Africa's workforce is employed in the agriculture sector, most of them being small-holder farmers and traditional pastoralists, while 40 per cent of the GDP of African countries derives from agriculture products. About 80 per cent of African population depends on traditional medicine; hence, African biodiversity is very important to livelihoods in Africa. Despite this prominence, investment in agricultural research has been declining leading to reduced capacities to address issues of agricultural productivity. Agriculture in Africa is heavily dependent on rainfall, but due to climate change, rainfall patterns have become erratic. The migration of the productive

workforce (i.e., youths) to urban centres, the aging of rural populations, malaria and HIV/AIDS pandemic has drastically reduced the human resource potential in the agriculture sector. Consequently, famine remains a major problem facing many countries on the continent. Currently, Africa is not fully benefiting from biotechnology, despite its potential to contribute to the achievement of MDGs. Partly, this is due to the perceived risks of biotech (especially those around genetic modification) including concerns over a reduction in biodiversity, a fear of possible multi-national dominance, and human health issues. There do exist containment and confinement approaches as well as genetic manipulation approaches to mitigate these risks.

Recommendations:

(i) African governments should support R&D programmes in the agriculture sector, which aim at modernizing the agriculture sector, so as to increase productivity, industrialization and commercialization. At the same time, indigenous and simple technologies should be harnessed so that they can contribute to poverty alleviation.

(ii) African governments should establish adequate policy frameworks to support the modernization and commercialization of traditional medicine products.

(iii) African countries should focus on identifying more viable seed storage systems for indigenous African plants, the rollout of a user-friendlier bio-safety legislative framework, and improved support and service conditions for African scientists. South-south and north-south collaboration should emphasize biotechnology.

(iv) The paucity of data and weak data collection infrastructures remains a considerable impediment to the development of scientific and technical research in Africa. To this end, a real-time Internet based data collection infrastructure should be developed to assist African researchers to better study climate change, its impacts, and formulate mitigation strategies.

3.3.4 Science with Africa marketplace

Prior to the Conference, there were calls for papers on the major conference themes on energy, transport and infrastructure, health, life sciences, agriculture and climate change and ICTs. There were considerable responses to the calls and subsequently, some of the accepted abstracts were featured in the marketplace of ideas, where participants would defend their ideas in a peer-to-peer environment. The session cautioned that research activities in Africa should focus on a few niche areas based on comparative advantage, and carried out, with a view to industrialization and commercialization. The research environment needed risk-taking for cutting edge R&D and to engage with partners, including inter-African collaboration. Currently, in Africa, there is not enough human sciences related to technology development, acquisition, adaptation and commercialization. These are necessary for adequately dealing with the social and cultural factors favouring or impeding scientific and technological progress. It was also observed that research in the areas of human and social sciences often exist but are not applicable because of cultural constraints, and the experiences and lessons of Asian countries, such as India, can be useful to African planners. Furthermore, in the area of scientific outputs, it was observed that the number of scientific publications by Africans is

increasing but remains low outside South Africa, Egypt and Nigeria. Furthermore, bibliographic databases do not take into account many publications in Africa.

Recommendations:

(i) African countries should begin the free circulation of scientists, engineers and technicians within Africa to share capacities and spur STI progress.

(ii) African scientists have to federate available means and capacities through networking in order to compete with the rest of the world.

(iii) The issues related to gender and STI have to be taken into account in STI policy-making.

(iv) There is a need to improve systems of observation, information, strengthen the link between knowledge acquisition and the transformation of reality.

(v) There is also a need for prevention and mitigation of natural disasters and the need to enhance R&D activities related to climate variability with opportunities for collaboration.

3.3.5 Roundtable on developing guidelines for health research in Africa

The discussion of the roundtable highlighted the need for strong political will from African leaders with support from health research experts and African communities for developing the relevant legal, regulatory, and practical guidance needed to promote health research and the protection of human subjects involved in health research. Africa needs harmonized Pan-African based (with international support) guidelines and model law(s) for health research covering the areas of GCP, GLP and other health research requirements. Participants concluded that health research in Africa is a key component to driving health policy and healthcare across the continent. The leadership of the Africa Union (AU) and the United Nations Economic Commission for Africa (UNECA) is of central importance for developing both Pan-African approach, as well as national approaches to establishing commonly accepted African and international standards for research promotion and human subjects protections. Furthermore, Africa should develop its own guidelines for ethics, good clinical practice, and other key areas for the development of investment and outcomes in African health needs. The Africa Union Commission and the Pan-African Parliament, as well as the national parliaments and governments of Africa should also consider a model bioethics law. The guidelines and model bioethics law should be developed by experts working in close cooperation with national, African, and international policy makers in health research and health policy in order to ensure their implementation, as appropriate, into national law, regulation, education, and practices. A model initiative is being set up in Douala, Cameroon, by the Cameroon Bioethics Society (CBS), and in Brussels, Belgium by the Good Clinical Practice Alliance - Europe (GCPA).

Recommendations:

(i) AU and UNECA should provide the leadership needed to create the political will for linking health research to health policy and health care through shared African standards.

(ii) ECA and AUC in collaboration with their partners such as EU, will continue working together in sharing the benefits of medical research to improve the health systems in African countries.

(iii) African governments should develop integrated frameworks on ethics in their respective countries, such as the creation of an African and International Secretariat, which should coordinate with African institutions and international collaborators to form the bridge across Africa and with Brussels to facilitate northern collaboration.

(iv) African institutions should participate in the forthcoming 1st African Bioethics Congress, so as to develop guidelines and model law(s) that truly reflect the needs of the African continent for promoting health research and human subjects protections.

3.3.6 STI capacity-building

Capacity-building in STI is a crosscutting issue and was presented and discussed in all plenary and breakout sessions. An innovation system approach offers solutions to bridging the gap between S&T and the productive sector. Measures should be put in place to strengthen capacities in STI in Africa. However, the reality is that in many African countries, there are still limited national innovation systems to take up technological opportunities, combined with poor management structures and basic infrastructure to harness science programmes. As a result, there are weak S&T capacities in human and financial resources and with poor programming and poor working conditions for researchers. Furthermore, African universities that can be the engine and drive for R&D are often poorly equipped and still too theoretical in their teaching methods and approaches, with no real links between industry and universities and other research institutions. Consequently, this session focuses on strategies and activities for STI capacity-building in Africa. Participants during the session, acknowledged that promoting STI capacity-building, through the development of adequate STI infrastructure, building and strengthening human capital in STI and strengthening the links among education, research, and society is indispensable for building of knowledge societies. In addition, human capital is the key to scientific capacity-building, which is a long-term process. Therefore, African countries need to undertaking strategic educational system reforms to better integrate science education at all levels, develop or improve science curricula with emphasis on the role of science in socio-economic development tailored for industrial expansion

Recommendations:

(i) ECA, AUC and other international organizations strategies should be adopted to creating conditions for attracting young talent, especially women, to careers in science, building scientifically literate publics, assessing the effectiveness of various interventions, solving problems of mobility and brain drain, and encouraging the participation of women in science. This also requires building future workforces capable of managing and participating in programmes for the advancement of science and technology.

(ii) African countries should develop clear national strategies for building their capacities for research in science and technology, as well as link to science and technology goals to economic growth and to improve science-based decision-making and problem solving.

(iii) African countries should revisit and adopt innovative science education strategies to increase the number of girls and young people in science and establish a pool of women of excellence in science and technology.

(iv) At the continental and national levels, there is need to increase political support and funding for programmes to improve training and capacity-building for science-based technology development and transfer.

(v) New reforms are needed in African countries, focusing on affordable educational systems based on excellence, energized by its human resources, dedicated to high standards, social values and a healthy spirit of competition, in order to prepare individuals with the necessary knowledge and skills to enable them to be successfully employed.

(vi) African countries need to improve systems of observation, information, prediction and mitigation of natural hazards and disasters. African institutions dealing with hazards and disasters should collaborate among themselves and provide services to decision makers and end-users.

3.4 Way Forward

Overall, the Conference recommended that ECA, in collaboration with AUC and UNESCO, and under the framework of AU/NEPAD S&T Consolidated Plan of Action, will constitute a Working Group to define the programme priorities for implementation of recommendations and the ideas of this Conference. Implementation will be at the regional, subregional and country levels, within the established mandate of each institution.