ICSU
International Council for Science
Regional Office for
Africa

Republic of Mozambique

ICSU REGIONAL OFFICE FOR AFRICA
29th ICSU GENERAL ASSEMBLY

13–24 October 2008
Maputo, Mozambique

REPORT
on
ASSOCIATED EVENTS

National
Research
Foundation

Sida
SWEDISH INTERNATIONAL
DEVELOPMENT COOPERATION AGENCY

ICSU

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ABBREVIATIONS

AfDB	African Development Bank
AICIMO	Scientific Research Association of Mozambique [Associação de Investigação Científica de Moçambique]
AMCOST	African Ministerial Council on Science and Technology
ANSTI	African Network of Science and Technology Institutions
AU	African Union
AUC	African Union Commission
CARS	Centre for African Renaissance Studies
CSIR	Council for Scientific and Industrial Research
DAAD	German Academic Exchange Service [Deutscher Akademischer Austausch Dienst]
DBSA	Development Bank of Southern Africa
ESF	European Science Foundation
EU	European Union
HCB	Hidroelectrica de Cabora Bassa
HRST	Human resources, science and technology
GA	General Assembly
GDP	Gross domestic product
ICSU	International Council for Science
ICSU EB	ICSU Executive Board
ICSU RCA	ICSU Regional Committee for Africa
ICSU ROA	ICSU Regional Office for Africa
ICT	Information and communications technology
IFS	International Foundation for Science
IKS	Indigenous knowledge systems
ISTD	ICT, Science and Technology Division (of UNECA)
KNAW	Royal Netherlands Academy of Sciences [Koninklijke Nederlandse Akademie van Wetenschappen]
MCT	Ministry of Science and Technology (Mozambique) [Ministério da Ciência e Tecnologia]
MDGs	Millennium development goals

NASA	National Aeronautics and Space Administration
NASAC	Network of African Science Academies
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organization
NRF	National Research Foundation
R&D	Research and development
RD&I	Research, development and innovation
SAMCOST	Southern Africa Ministerial Council on Science and Technology
S&T	Science and technology
SET	Science, engineering and technology
SIDA	Swedish International Development Agency
STCPA	Science and Technology Consolidated Plan of Action
STI	Science, technology and innovation
SWOT	Strengths, weaknesses, opportunities and threats
TWAS	Academy of Sciences for the Developing World
UDEBA	Unity for the Development of Basic Education
UN	United Nations
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USA	United States of America
WMO	World Meteorological Organization
YEFA	Young Entrepreneurs for Africa

INTRODUCTION

As a tradition, General Assemblies of the International Council for Science (ICSU) are normally preceded by a one-day forum to discuss science and technology in the host country. In this regard, the ICSU Regional Office for Africa (ICSU ROA) with the support of its partners, and in collaboration with the Ministry of Science and Technology, Mozambique, and the Scientific Research Association of Mozambique (AICIMO), organized pre-General Assembly (pre-GA) workshops in various provinces of Mozambique on 13–17 October 2008; a Symposium at the Joaquim Chissano International Conference Centre in Maputo on 20 October 2008 to discuss science, technology and innovation (STI) in Africa; and an interactive dialogue at the same venue on 21 October 2008. The events brought together more than 800 participants from all over the world, including Nobel Prize awardees, African Ministers of science and technology (or their representatives), and representatives of intergovernmental bodies, regional economic commissions, non-governmental organizations (NGOs), United Nations (UN) agencies and the private sector. During the interactive dialogue, scientists and policy-makers (African ministers, representatives of intergovernmental bodies, NGOs and UN agencies) discussed in greater detail some of the issues raised during the one-day Symposium.

The core business of the 29th ICSU General Assembly was conducted by the members of the organization in plenary and breakaway sessions on 21–24 October 2008.

This report focuses mainly on the pre-GA activities. The deliberations of the core GA are reported elsewhere (www.icsu.org).

1 SYMPOSIUM: Science, Technology and Innovation in Africa

1.1 Opening Session

WELCOME

ICSU ROA Director (Professor Sospeter Muhongo) introduced and welcomed African Ministers of Science and Technology and their representatives. He went on to introduce representatives of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the UN Economic Commission for Africa (UNECA), African Development Bank (AfDB), and members of the ICSU Executive Board. Professor Muhongo introduced the programme and gave a brief background of the structure of ICSU and its membership. He explained that the purpose of the Symposium was to discuss the achievements and challenges faced by Africa in the application of science, engineering and technology (SET) for development, and to map a way forward.

OPENING

In his opening address, Professor Venancio Massingue, the Hon. Minister of Science and Technology of Mozambique, expressed his appreciation for the decision of the ICSU Executive Board (ICSU EB) to host the 29th ICSU General Assembly (GA) in Mozambique. He hoped that this event would benefit the science community in this country as well as the entire African continent. The Minister then explained

the value of STI in Africa as a whole and Mozambique in particular, and hoped that the Symposium would serve as an important step towards strengthening partnerships on the continent for the implementation of the African Science and Technology Consolidated Plan of Action (STCPA) developed by the African Union (AU) and the New Partnership for Africa's Development (NEPAD). He also acknowledged the support from partners of ICSU and the Government of Mozambique in ensuring the success of this event. He declared the Symposium open and wished participants every success in their deliberations.

STATEMENTS

Africa Union Commission (AUC)

Representing the African Union Commissioner for Human Resources, Science and Technology (HRST), Dr Chaibi Thameur acknowledged the work of the ICSU family in Africa. He explained the role of science in wealth creation, and called for intensification of North-South as well as South-South cooperation in STI for development. He explained that the African Union Commission (AUC) was created to drive specific key programmes of the AU, and that the HRST Commission is responsible in particular for driving the AU's STI programmes. NEPAD and the African Ministerial Council on Science and Technology (AMCOST) are strong arms used by the HRST in this endeavour through the implementation of the STCPA. Dr Thameur pledged the political will of the AU in promoting STI for the sustainable development of Africa. As an example, he cited the creation of the African Cluster for Science and Technology, which would drive the implementation of the STCPA. ICSU ROA is a member of this cluster. He further emphasized the role of the African Diaspora in applying STI for the development of Africa, and advocated the beneficial use of partnership with the USA, the European Union (EU) and China.

United Nations Economic Commission for Africa (UNECA)

Ms Aida Opoku Mensah, Director of the ICT, Science and Technology Division (ISTD) of UNECA, stated that STI features prominently on the agenda of UNECA. She stressed three significant items that drive science in Africa: strengthening scientific unions; the need to engage governments; and the creation of a viable and conducive environment for conducting research. She outlined the scientific challenges faced by Africa, guided by previous studies and existing plans, and expressed the value of partnerships with AU/NEPAD, ICSU ROA, the African Network of Science and Technology Institutions (ANSTI), the Academy of Sciences for the Developing World (TWAS), e-forums, and others. An important message for Africa was that the continent needs nothing less than a science revolution. Specific mention was made of the role of UNECA in promoting STI in Africa, which involves engaging and mobilizing multiple stakeholders and assisting in capacity building.

1.2 Science, Technology and Innovation in Africa – Part I

A Vision for STI in Africa (Derek Hanekom)

Mr Derek Hanekom, the Hon. Deputy Minister of Science and Technology, South Africa, presented a vision for STI in Africa. He reviewed the status of STI on the continent, and outlined the major challenges, which are: poverty; disease (including malaria, HIV/AIDS, TB); food insecurity; environmental degradation; low levels of education; political conflict; weak STI institutions; limited STI skills and capacity for research, development and innovation (RD&I); limited funding for STI development; and technology gaps. He noted that global competitiveness faces the challenge of the innovation chasm between developing and developed countries. He then presented a vision for the continent that would include an Africa well integrated into the global economy and free from poverty. He further shared South Africa's vision of a prosperous society with equitable benefits form science and technology.

As a way forward, he proposed that African governments should continue working towards investing 1% of their gross domestic product (GDP) on research, development and innovation (RD&I); encouraging regional STI integration; developing equitable STI societies; improving policy conditions that would enable monitoring and evaluation of STI progress; enhancing research and development (R&D) capacities and innovation for knowledge production and product development; and the building of STI infrastructure.

The Role of African Governments in the Development of STI in Africa (Francis Gudyanga)

In his address on the role of African governments in the development of STI in Africa, Professor Francis Gudyanga, Permanent Secretary in the Ministry of Science and Technology,

Zimbabwe, stressed that governments have an important role to play at national, regional and continental levels, as they can influence markets, technology, and behaviour through policies and regulations. He noted that judicious policy interventions are required to address pervasive market failures and to ensure that private incentives align with societal imperatives to produce economically and environmentally sustainable outcomes. Professor Gudyanga recommended a focus on the STCPA projects and programmes. He presented the various regional protocol objectives and the responsibility of the Southern African Ministerial Council on Science and Technology (SAMCOST).

Is the Mozambican Research System ready for Development Challenges? (Lídia Brito)

Professor Lídia Brito (Eduardo Mondlane Univeristy, Mozambique) discussed the readiness of the Mozambican research system for development challenges. She dealt with issues related to absolute poverty; the food crisis; the energy crisis; the financial crisis; global environmental changes; and health, particularly in relation to HIV/AIDS, malaria and other diseases. Key requirements for addressing these challenges would include strong leadership; the values and principles necessary to drive development; good governance and shared responsibility; broad ownership; dedicated commitment; and the development of strong partnerships and networks between Mozambique and the rest of the world.

Funding Mechanisms for STI in Mozambique (Narciso Matos)

Professor Narciso Matos (Foundation for Community Development, Mozambique) discussed the challenges of establishing funding mechanisms for STI in Mozambique. He highlighted the fact that most research funding is external and not guided by local priorities. He also noted that most funding is directed towards training, with very little allocated for actual research. As a result, although the number of research institutions and centres has grown in recent years, the focus remains on training rather than on serious scientific research. There is only a limited number of researchers in the country, and, furthermore, few women are involved in STI. Despite these constraints, however, he reported on some research achievements in the country.

Environment and Climate Change in Mozambique (Filipe Lucio)

Dr Filipe Lucio (World Meteorological Organization) discussed climate and environmental changes in Mozambique, pointing out that climate exerts significant control on living organisms and on day-to-day socio-economic development at regional, local and household levels. He provided evidence for increasing surface temperatures and rising sea levels; increased frequency and intensity of extreme weather events; increased variation in wind and rainfall patterns; and increasing risks of hazards and disasters. He discussed the consequences of these trends on the degradation of freshwater resources and fragile ecosystems, groundwater recharge, agricultural production, human health and population displacements. Dr Lucio proposed some strategies for mitigation and adaptation to environmental and climate changes. These include technological, behavioural, managerial and policy responses. In this regard, he identified some research priorities and explained the contribution of the World Meteorological Organization (WMO) to addressing these challenges.

Interventions from Ministers and Government Representatives/General discussion

The Ministers were asked how they thought the science community could expect to get evidence-based decisions from policy-makers. In response, the Ministers admitted that advice was needed from the science community to inform policies and decisions. They pointed out that the value of such advice would be influenced by the relevance and reliability of the research conducted in Africa; the willingness to share scientific knowledge among countries, with a vision for advancement of the continent as a single, unified entity; and proper budgeting and equitable sharing of resources at both community and national levels. The issue of brain drain vs. brain gain was also raised. It was concluded that incentives were required to stimulate brain gain, in addition to promoting indigenous knowledge systems (IKS) development and prioritizing research to target Africa's needs.

Ministers were also asked to what extent they sought advice from STI institutions to guide their decisions. One of the responses was that Ministries in certain countries do have committees of experts on policy development.

The Ministers raised concerns regarding the mode of communication of scientific findings to beneficiaries. In response, the researchers indicated that language remains a challenge, especially in early warning systems to mitigate the

impact of hazards and disasters, but that there was increasing progress in technology to overcome this barrier.

While recognizing the need to conduct research, the Ministers remarked that it is more important to be able to implement the findings of such research. This would require the establishment of connectivity between a country's production potential and the actual supply of goods and services. This connectivity could be facilitated by motivating the researchers and the private sector.

A further concern raised by the Ministers was the fact that the cost of research in certain areas can be prohibitive, despite the potential value of such research; for example, the cost of research in new energy sources prohibits its implementation, despite all other favourable conditions.

The scientists felt that it would be ideal if they were given the opportunity to address parliamentarians/politicians regularly, to enlighten them on the progress of scientific research in key areas. Research in agriculture is one example of areas that can be used to demonstrate research application at community level, and such opportunities for participatory research need to be exploited. It was also the opinion of the scientists that governments should not only be seeking intergovernmental partnerships, but should also explore possibilities of partnerships with relevant institutions. The need was emphasized for scientists to retain ownership of the research they conduct and to take the lead in advising policy. Research results ought to be useful in solving societal problems.

It was pointed out that the best advice is obtainable from the best scientists of each country, and that Science Academies constituted bodies of knowledge and experience from which governments could obtain advice and input.

Scientists recognized the need to develop networks and institutions of excellence in specific disciplines (for example, a network of excellence in dry land biodiversity), as well as the need to valorise indigenous knowledge systems, especially in alleviating problems related to health and in adapting to climate change.

A further concern raised by scientists was the risk of frustrating young scientists through poor working conditions that could compromise their career ambitions.

1.3 Science Technology and Innovation in Africa – Part II

Growing a Knowledge-based Economy: Evidence from Public Expenditure on Education in Africa (Abdul B. Kamara)

Dr Abdul B Kamara (African Development Bank) discussed the importance of knowledge and technology as key drivers of growth in a knowledge-based economy. He defined such an economy as one in which knowledge plays a pivotal role in driving production, exchange and distribution; in driving economic growth through employment generation and wealth creation; and where knowledge generation and utilization are associated with positive externalities that give a competitive edge. In his view, an emerging knowledge-based economy requires the following: (i) an economic and institutional regime that provides incentives for efficient use of knowledge with a view to enabling entrepreneurship to flourish; (ii) educated and skilled production, which creates, shares and uses knowledge to innovate and generate economic value; (iii) a dynamic information infrastructure to facilitate effective communication and processing of information; and (iv) an efficient innovative system of firms, research entities and other organizations that are capable of tapping into the growing stock of global knowledge and adapting it to local needs.

He pointed out that public expenditure on education can improve economic growth in terms of per capita GDP. However, due to high population growth rates in Africa and the inability of governments to provide the required social services, investment in education may not in practice contribute to human capital development and, as a result, the impact on economic growth may not be as significant as had been hoped. He referred to a study which revealed that, despite the short-term benefits, public expenditure on education in Africa does not contribute to knowledge and human capital accumulation on the continent in the long term, owing to the low retention rates of the trained human capital. In conclusion, he pointed out the need to strengthen government capacities to retain trained personnel through, for example, attractive remuneration packages. He also recommended structuring financing programmes so as to offer opportunities for talented young people to enter tertiary education.

The IFS Approach for Scientific Capacity Strengthening in Africa (Nighisty Ghezae)

Dr Nighisty Ghezae, representative of the International Foundation for Science (IFS), outlined the background and objectives of the IFS. She explained that the IFS is primarily a research granting, scientific capacity enhancement, development and support programme that focuses on young promising researchers. It works in all developing countries, supporting individual young scientists through their early careers before they get established. Supported research areas include projects that address the sustainable management of biological and water resources. She discussed the IFS granting process and criteria, adding that the scientific capacity enhancing support programme includes mentorship, travel, scientific paper-writing courses and thematic workshops. She indicated that the IFS granting programme strengthens capacity retention strategies to minimize brain drain. IFS support, she said, is measured through its monitoring and evaluation system for impact assessment, the analysis of data on grantees and through tracer studies.

UNESCO Perspective on STI in Africa (Joseph Massaquoi)

Professor Joseph Massaquoi (UNESCO Science and Technology Regional Office for Africa) outlined the strategic objectives of UNESCO for Africa, identifying research, policy and capacity building as the major priorities. He indicated that, in Africa, the challenges facing the implementation of science and technology initiatives include environmental and resources management, science policies, disaster management and mitigation, discrepancies between science and technology, lack of human capital and the low priority given to science. UNESCO's main concerns for STI in Africa would, amongst other things, be the need for greater collaboration for science development; the need to identify clearly the kind of science and technology that Africa requires; the need for African scientists to establish their own agendas; dismal government funding; and adapting education and training to focus on specific country needs.

He believed that priority should be given to building human resources capacity and to the application of science for the solving of societal problems. He was also of the view that intergovernmental organizations could be effective only if their member states want them to be.

General Discussion

The value of role models in encouraging young people in science education was recognized, and the general feeling was that development partners could contribute to such endeavours. The need was expressed for scientists to take the lead in managing partnership cooperation programmes, and to define the kind of science or research required for Africa. Such research should be guided by the continent's identified challenges.

It was also noted that human capacity in Africa faces the dilemma of competing signals between the need for capacity retention and the concept of freedom of movement of scientists, which allows for migration. A suggestion was made for IFS to facilitate brain recirculation between Africa and Europe. Meanwhile, capacity retention strategies should seek to link up with initiatives at the level of local communities and their respective governments.

1.4 Panel Discussion

The panel discussions were designed to focus on the outcome of the workshops in the Mozambican provinces, with reference to the ICSU ROA science plans. Hence, the session began with two lead presentations on Global Environmental Change and Desertification in Africa and on Natural and Human Induced Hazards and Disasters in Africa; followed by a synthesis Report on the workshops in the provinces of Mozambique.

Global Environmental Change and Desertification in Africa (Robert Scholes)

Dr Robert Scholes (Council for Scientific and Industrial Research, South Africa) outlined the environmental challenges faced by Africa, most prominent among which is the fact that the continent experiences a hot, dry and highly unreliable climate that is likely to become hotter and dryer in some places, and more variable in future. He illuminated the adverse effects of climate change on African agriculture, human health, water resources and biodiversity. He pointed out that Africa has a rich, iconic, economically important and often still-intact biodiversity, which is declining at an accelerating rate. He recognized the increasing interest by African researchers to forge partnerships within the global science community and amongst African scientists in addressing the challenges of global environmental change to the socio-economic development of the continent.

Natural and Human-induced Hazards and Disasters in Africa (Genene Mulugeta)

According to Professor Genene Mulugeta (Uppsala University, Sweden), the hazards and disasters in Africa can be categorized into five major types, namely: hydro-meteorological, geological, biological, technological and conflict-related. Hydro-meteorological disasters are the most common and have the highest impact. He noted that, although this category of disasters is natural in origin, they can be exacerbated by human activity. He also noted that Africa is the only continent whose share of reported disasters in the world has increased over the past decade. Professor Mulugeta explained that Africa's high vulnerability to hazards and disasters is due partly to factors such as high population growth rate, food insecurity, high levels of poverty, inappropriate use of natural resources, and failures of policy and institutional frameworks. He further discussed the need to assess properly the frequency of hazards and disasters and to develop appropriate strategies for awareness-raising among African communities, so as to mitigate more effectively the impact of these events.

Professor Mulugeta drew the audience's attention to the ICSU ROA science plan on Natural and Human-induced Hazards and Disasters, in which most of these challenges are addressed. In this regard, he outlined the two mega-projects under preparation – one on hydro-meteorological hazards and the other on geohazards.

Synthesis Report on the Workshops in the Provinces of Mozambique (Almeida A. Sitoe)

To optimize the impact of the 29th ICSU GA in Mozambique, the country's government felt that this event would be an ideal opportunity to expose international scientists to Mozambican reality, and to expose young Mozambican scientists to international and experienced scientists for the purpose of initiating the process of identifying research needs in the country. It was thought that the most appropriate way to achieve this was by organizing workshops in different provinces of the country. At these workshops, international scientists could interact with both Mozambican scientists and the local population to discuss issues of specific importance identified by the local community. The workshops were attended by more than 60 international scientists in various disciplines, as well as by representatives from government agencies, universities, research institutions, NGOs, the private sector and over 500 Mozambican young scientists.

Professor Almeida Sitoe (Eduardo Mondlane University, Mozambique) presented an overview of the summary reports of these workshops, which covered the following themes: sustainable energy, global environmental change (including climate change and adaptation, with a focus on water resource management), marine sciences and fisheries, hazards and disasters, human health and well-being, and education.

Two workshops on **sustainable energy** were held in Niassa and Tete provinces. The workshops revealed that, in Niassa, there is already production of improved stoves in Lichinga; improved techniques for charcoal making in the Muembe district; and solar energy in the districts of Mecanhelas (Chiuta), Marrupa (Nungo) and Lago (Cóbuè). In Tete, there is already the high output Cabora Bassa dam serving Mozambique, South Africa, Namibia, Zimbabwe and Swaziland; as well as limited use of solar power (restricted to mobile phone operators). There is also good potential for wind-power generation. However, some districts such as Tsangano still rely on a diesel generator for electricity.

The research needs identified at the workshops included:

- Assessing wind speed for electricity generation
- Evaluating the costs of solar and wind power generation
- Establishing an industry for manufacturing and marketing solar panel components and accessories
- Evaluating the potential to build dams for medium-scale hydro-power generation
- Improving the efficiency of biomass use as energy source
- Finding alternatives to Jatropha as raw materials for biofuels.

Two workshops on **global and environmental change** were held in Zambezia and Inhambane provinces. In Zambezia, the key challenges encountered were coastal erosion including sea-level rise, river invasion and mangrove destruction; flood damage in inhabited flood plains; and wildfires resulting from agriculture and hunting activities. It was noted that efforts are being made to control erosion and to sequestrate carbon through the establishment of forest plantations. The actions recommended to address these challenges included information exchange among government, research community, NGOs and civil society; research on adaptation and mitigation strategies; media involvement to facilitate information dissemination; the involvement of community

leaders as the entry point for dialogue with local communities; and the empowerment of communities in problem-solving techniques.

The research needs identified were:

- Assessing saline intrusion and its effect on agriculture
- Assessing the variability and occurrence of floods in the Zambezi valley
- Improving systematic observation and the recording of meteorological data
- Improving land use planning by local authorities
- Introducing environmental education at all levels
- Assessing the variability of coastline and sea-levels in relation to climate change
- Modelling of land-ocean-river dynamics
- Long-term monitoring of climatic variability.

In Inhambane province, it was observed that over the last ten years, annual rainfall has been decreasing and temperatures have been rising. This climatic uncertainty has affected the agricultural production system, as planting dates can no longer be reliably predicted. These uncertainties, compounded by poor soil fertility, induce low crop yields. As a result, fishing has become the main activity along the coastal zones. Another problem was that of poor water resource management.

The following research needs were identified:

- Assessing the impact of climate change on fisheries and agriculture
- Evaluating the potential for tourism as a complementary source of income to fishing
- Development of teaching modules for community education in water resource management
- Quantitative and qualitative increase in collection of meteorological data across the province
- Developing agricultural practices adapted to the changing climate.

The workshop on **hazards and disasters** took place in Sofala and Manica provinces. Workshop participants observed that the most common disasters affecting Sofala province were floods, wildfires and coastal erosion; while Manica province was mostly hit by wildfires, drought, earthquakes and water pollution. The research needs identified in this workshop included:

- Mapping areas prone to natural and human-induced hazards and disasters
- Assessing the vulnerability and resilience of socio-ecological systems to hazards and disasters
- Identifying indigenous adaptation strategies to mitigate the hazards and disasters
- Standardizing data collection methods
- Assessing the potential for the use of organic fertilizers and biological control of pests and diseases in agriculture
- Developing strategies for community education towards disaster preparedness.

Some specific actions that need to be taken include:

- Developing a framework for identifying national and local disaster risks
- Bridging the information gap between scientists, decision-makers and civil society
- Law enforcement to reduce the occurrence of wildfires.

The workshop on **health and human well-being** took place in Nampula province. The participants observed, during their field visits, that the main economic activities in the province are fishing, agriculture and tourism. Important lessons learned in the province were as follows.

- The private sector (the printing press in Nampula, for example), through a good workers welfare policy, promotes the social well-being of the people.
- Interactive training programme for medical students at Lurio University, where students regularly interact very closely with the population in multidisciplinary teams, is not just efficient for student training but also increases confidence within the population and enhances their use of medical services. This practice also facilitates community education on proper feeding habits for healthy nutrition and on best behavioural practices with regard to disease prevention, especially in the case of communicable diseases.
- Community water supply. Nampula has a good water treatment system operating, with modern technology. The water supply scheme still needs more efforts, however, as water supply remains a critical problem in some parts of the province, such as at the newly established hospital in the outskirts of the Nampula city.

Some challenges identified included the following:

- Poor maintenance of some of the tourist attractions despite the economic importance of this sector
- Poor use of available medical facilities (for example,

pregnancies are monitored in the hospital but deliveries mostly take place out of the hospital, so patients are often rushed to hospital as a last resort after wasting time and resources in traditional healing homes)
- High rates of absenteeism from work due to ill-health of workers or of their family members, and due to the deaths of relatives
- High rates of teenage pregnancy
- Government policy to centralize certain services, which frustrates private enterprises (for example, the high capacity printing press in Nampula is operating below its potential because all school text books have to be produced in Maputo).

For their part, the people of Nampula province questioned why scientists have still not been able to produce a vaccine against HIV. This question was retained as a crucial research need, in addition to the research areas identified in the ICSU ROA science plan on Health and Human Well-being, which also addresses most of the concerns of the Mozambican people.

The workshop on **education** was held in Gaza province and it focused on discussing strategies to improve and facilitate education at all levels. The issues discussed included:

- Adoption of the Unity for the Development of Basic Education (UDEBA) approach for school construction and rehabilitation
- Distance learning for communities with low population densities
- Development of tools for pedagogic supervision
- Encouragement of entrepreneurship among students
- The role of higher education institutions in basic professional training
- Development of indicators for assessment of quality and performance of the educational system
- The contribution of philosophy to education.

Participants at the workshop recommended that:

- Collaboration among teaching institutions in Africa should be encouraged and strengthened
- Regional integration of systems of educational should be encouraged
- Research in education should be oriented towards solving local problems
- Entrepreneurship should be a priority in education
- The role of technical training should be strengthened
- Quality control should be effected at all levels of education
- Bilingual education should be encouraged, to facilitate access to scientific information.

General Discussion

Responding to the presentations for this session, the scientists pointed out that Africa is very diversified and has problems as well as capabilities. While it is important to point out the problems, it is also necessary to provide a clear picture of the continent's capabilities, and to identify what would be needed to transform the potentials into products.

It was also noted that much information and many technologies are available on the continent, but that these are not fully utilized. It is therefore necessary to improve the sharing of knowledge and technologies to optimize their utilization.

Concluding Remarks

In her concluding remarks, Aida Opoku-Mensah, Director of ISTD at UNECA, emphasized the role of science and technology (S&T) as a necessary tool for socio-economic development. She noted that knowledge is at the heart of development, and that qualified researchers are necessary to produce a broad base of knowledge relevant to the solution of current and future societal problems. She drew the attention of the audience to some crucial questions, such as how to strengthen S&T policy linkages with development policies; what lessons have been learnt from the past that can enable effective STI policy implementation; and how to strengthen dialogue between politicians and scientists in order to ensure the political leadership required to develop and implement appropriate STI policies.

Ms Opoku-Mensah remarked that politicians are concerned with seeking strategies to solve real-life problems as quickly as possible. For this reason, the scientific knowledge that interests them has to be relevant and applicable to a particular policy problem. Such an approach tends to solve problems in the short term, and places emphasis on quick results. She also noted that scientists often complain about politicians not fully appreciating the importance of their work, and that too much bureaucracy often slows down planned research activities. She recommended the creation of more opportunities for interaction between the two parties so that the message from scientists can be presented to politicians in language

that non-specialists would understand. This would enable discussions that lead to useful scientific advice to policy, as well as feedback policy guidance to scientific research.

1.5 Closing Session

Remarks by the Chair of ICSU RCA

The Chair of the ICSU Regional Committee for Africa (ICSU RCA), Professor Gabriel Ogunmola, expressed appreciation to the ICSU Executive Board for agreeing to hold its 29th GA in sub-Saharan Africa for the first time in the history of the organization. He congratulated the Government of Mozambique for supporting AICIMO in its bid to host the GA, adding that both ICSU ROA and ICSU RCA had committed themselves to share the challenge to ensure the GA's success with AICIMO and the government of Mozambique. He praised the innovative idea of organizing pre-GA workshops, an initiative that gave additional flavour to the activities of the GA.

Professor Ogunmola expressed delight in seeing scientists from the whole world gathered to discuss science in Africa, and cautioned that the continent ought not to be left behind in the global development train. He reminded the audience that ICSU ROA was the first of four ICSU Regional Offices to be established, and that it is, so far, taking the lead in implementation of the ICSU strategic plan through the preparation, publication and implementation of its four science plans and the projects therein. He called on Africans to stand united in applying science and technology to solve Africa's numerous challenges, pointing out that ICSU ROA serves as the unifying factor for a consolidated scientific community on the continent.

Statement from Professor Mohamed Hassan (TWAS/AAS)

Professor Mohamed Hassan presented a brief history of the Academy of Sciences for the Developing Countries (TWAS) and explained the purpose of its creation. He discussed the main focus of TWAS, which is to promote human capacity development in developing countries. He pointed out that many nations need to build a critical mass of scientists, and that this can be achieved by post-graduate training that involves South-South as well as North-South cooperation. In this endeavour, TWAS organizes research capacity building programmes such as, amongst others, the research grants programme in basic sciences, and conferences for young as well as female scientists

Young Entrepreneurs for Africa (Sandra Irobi)

Ms Sandra Irobi presented the Young Entrepreneurs for Africa (YEFA), an NGO established in The Netherlands with the main objective of fostering the impact of Africa's professionals on the continent. She explained that YEFA has the vision to facilitate Africa's development and transformation through its own young students, graduates and active entrepreneurs, particularly those in the Diaspora. This vision would be realized through practical techno-social entrepreneurship engagement. The potential partners in this endeavour include educational institutions, African embassies in host countries, as well as governments, the private sector and individuals.

According to Ms Irobi, YEFA plans to achieve its mission by providing information and training aimed at changing current mind-sets; using YEFA's policy think tank to create awareness and organize debates and relevant actions on Africa's design and evaluation of investment policies to encourage young professionals; providing platforms and opportunities to create practical business start-ups; and facilitating peer-to-peer partnerships, networks, and collaborations with non-African counterparts.

ICSU ROA Book launch (Sospeter Muhongo)

The book, entitled Science, Technology and Innovation for Socio-Economic Development: Success stories from Africa, edited by ICSU ROA, was introduced by Professor Sospeter Muhongo, Director of the ICSU Regional Office for Africa. The aim of the book is to promote science education and research in Africa, and to showcase Africa's contribution to the world's development of STI as a legacy of the ICSU General Assembly. It will be useful to scientists, engineers, technologists, educators, and policy- and decision-makers engaged in socio-economic development programmes in Africa, as well as to public and private sectors that have an interest in the sustainable utilization and profitable commercialization of Africa's natural resources. Professor Muhongo presented the contents of the book and congratulated the contributing authors and the editors. Professor Venancio Massingue, Minister of Science and Technology, Mozambique, officiated at this launch.

Statement from AMCOST Secretariat (Umar Bindir)

Dr Umar Bindir stressed the link between government, industry, and research and development, on the one hand, and the recognition and application of attributes of free market, rule of law and science-based technology on the other hand. This phenomenon has worked for Europe and North America, and is now being applied in Asia and Latin America. It can also work for Africa. He emphasized the opportunities presented by the proper functioning of organizations such as the African Ministerial Council on Science and Technology (AMCOST) working closely with partners such as ICSU ROA, UNECA, UNESCO, and others.

Dr Bindir noted that Africa is increasingly recognizing the importance of science and technology in addressing the numerous problems faced by the continent's communities. He cited, as examples, the adoption of the theme "Science and Technology" for the year 2007 at the 8th Summit of African Heads of State and Government in January 2007; the resolution by the African Heads of State and Government to commit a minimum of 1% of their GDP to research and development; the numerous conferences and workshops held recently on the continent focusing on science and technology; and the dedicated involvement of African government representatives in the one-day Symposium in discussing science, technology and innovation in Africa.

Closing Remarks (Hon. Venancio Massingue)

The Minister of Science and Technology of the Republic of Mozambique, Professor Venancio Massingue, expressed his appreciation for the smooth organization of the Symposium, and the enthusiasm with which both scientists and policy makers engaged in valuable discussions. He thanked ICSU ROA for creating the opportunity for such a discussion forum, which benefited from the presence of renowned scientists from around the world. The Minister expressed great satisfaction with the proceedings of the Symposium, and recommended the adoption of developmental approaches that would target the grassroots' population to improve their livelihoods. He then declared the Symposium closed.

2 The Dialogue on Science, Technology and Innovation in Africa

The dialogue was led by a panel composed of the Hon. Professor Ibrahim Ahmed Omer, Minister of Science and Technology, Sudan (Chair); the Hon. Derek Hanekom, Deputy Minister of Science and Technology, South Africa; the Hon. Dr Becky Ndjoze-Ojo, Deputy Minister of Education, Namibia; Professor Gabriel Ogunmola, Chair of ICSU Regional Committee for Africa; and Dr Umar Bindir, Secretary General of AMCOST. Professor Sospeter Muhongo, Director of ICSU ROA, introduced the dialogue, explaining that it aimed at having an in-depth discussion of some of the issue raised during the Symposium, and based on the implementation of the ICSU ROA science plans. He outlined the following topics to be covered in the dialogue:

(i) The role of STI in the attainment of the Millennium Development Goals (MDGs)
(ii) STI partnership between Africa and Europe, and the rest of the world
(iii) The involvement of the African Diaspora in STI activities in Africa
(iv) Funding of science research and development (R&D) in Africa.

2.1 The Role of STI in the Attainment of the Millennium Development Goals

From the discussion on this topic, the following points emerged.

(i) The MDGs were conceived in the "dire need of emergency solutions to address Africa's problems", but it is important to recognize that African countries need more than emergency solutions to problems. They need actions towards sustainable development. The MDGs do not completely cover the desired drivers of development. For example, energy is not among the MDGs but it is an essential driver of all other aspects of development. The MDGs and the infrastructure required to achieve them were never discussed with the people targeted in the goals. A holistic approach, where science becomes the driver, is required for these goals to be achieved.

(ii) Achievement of the MDGs follows a linear progression that needs to be dealt with professionally. For example, poverty cannot be alleviated when the people are not educated. Universal education, therefore, constitutes the starting point to achieve the goal of reducing poverty.

(iii) Science and technology development needs to be established systematically at all levels, including research in basic and applied sciences, and the commercialization of the products of science, engineering and technology.

(iv) Governments know the "real" objectives of the MDGs, but have failed to recognize the essential drivers required to achieve these goals. These drivers include adaptation of science and technology in order to reduce dependence and to create jobs; protection of intellectual property rights; and development of country-specific models synergized by the AU through NEPAD and AMCOST.

(v) It is necessary to encourage multi-stakeholder and multidisciplinary partnerships to leverage outputs towards meeting the MDGs.

(vi) Experts and specialized institutions with expertise in specific fields need to be engaged by governments at national and regional scales to address the relevant MDGs pertaining to their expertise.

(vii) The diversity of Africa and the wide variation in individual country specificities must be considered in designing programmes to meet the MDGs. Implementation of the programmes also requires mobilizing and involving the targeted local communities. Such programmes should have well defined measurable impacts on the population.

(viii) National governments need to set visible milestones to assess the level of implementation and achievements of development programmes.

(ix) Agriculture is the main economic activity in Africa and should be given priority in most development programmes.

(x) The UN Millennium report by the Task Force on Science, Technology and Innovation under the leadership of Professor Calestus Juma, **"Innovation: applying knowledge in development"**, needs to be systematically analysed to see how it can be applied to meet the MDGs. The report deals mainly with issues of infrastructure development, energy and transport in Africa.

2.2 STI Partnership between Africa and Europe, and the Rest of the World

From the discussion on this topic the following points were raised.

(i) There are numerous openings for partnership between Africa and the industrialized countries. The Blair convention for example, advocates for EU funding to support research and development in Africa. However, some pressure is required from the African governments to get such plans implemented.

(ii) There are some partnership projects already in operation, such as the Europe–Africa partnership for capacity building workshops in the basic sciences. This initiative is driven by the European Science Foundation (ESF), the Royal Netherlands Academy of Sciences (KNAW), the Network of African Science Academies (NASAC) and ICSU through its Regional Office for Africa.

(iii) African research groups and universities have benefited from funding from European countries such as Sweden, but most African countries lack organized research groups with which such funded partnerships can be established. In some cases, partnership funds are diverted through corrupt practices.

(iv) There are many uncoordinated programmes in Africa, and the AU should be the nucleus through which efforts may be channelled. However, it should be recognized that strategies for partnership in research support vary from one country to another, based on the specific country priorities. Therefore, continent-scale partnership frameworks may be difficult to achieve.

(v) Partnership initiatives should not focus only on Europe, but also look elsewhere. For example, cooperation between Africa and other leading developing countries such as China, India, South Korea and Brazil needs to be strengthened. South-South cooperation should exploit the potential within the continent before going abroad. Tri-lateral (South-South-North) partnerships should also be encouraged. Success stories in any African country should be identified and replicated in other countries facing similar problems.

(vi) It is important for African countries to get their houses in order first, interact more with each other, and share their experiences and challenges, before reaching out for partnership.

(vii) Partnership programmes should aim at transfer and domestication of science and technology.

(viii) Partnership requires equal strength of negotiation and equal knowledge, but this is not usually the case. Partnership programmes should be relevant to the African agenda. African governments should engage development partners on specific terms as equal partners, and not on giver–taker arrangements. Opportunities need to be created for foreign interests to match local interests on the challenges identified.

(ix) Equal strength in partnership negotiations requires experts in the field, and this may call for training of scientists to be policy advisers and to represent their governments in partnership negotiations. Such scientists need to be informed about the issues where advice is needed and should focus on the set goals.

(x) Partnership initiatives are often frustrated by the fact that government officials have to face such challenges as finding compromises between local political agendas, geo-politics, and conflicting donor interests.

2.3 Involvement of the African Diaspora in STI and Activities in Africa

With regard to involvement of the African Diaspora in STI activities on the continent, it was admitted that several initiatives have been made and that there is now a strong recognition of the need to harmonize the efforts and drive the process forward, building from the ongoing activities while learning from lessons of the past. The following specific issues were raised.

(i) The concept of the African Diaspora is evolving and there is no specificity on how to tackle it.

(ii) The initiative of the African Diaspora plough-back came from members of the Diaspora themselves in the first place, so it is not necessary to discuss how to engage them, but rather to discuss the frameworks that need to be put in place to facilitate this engagement. The AU report on the Diaspora initiative has indicated what each party ought to do.

(iii) One ongoing initiative that should be built upon is that of establishing a database of African experts in the Diaspora. This is an elaborate project run by ICSU ROA, the National Research Foundation (NRF) of South Africa, and the Centre for African Renaissance studies (CARS), which is hosted at the University of South Africa (UNISA). Other potential partners in this project are AU/NEPAD, the Development Bank of Southern Africa (DBSA) and UNESCO.

(iv) The CARS, in collaboration with its partners, is currently conducting a study on the establishment of centres of excellence involving African experts in the Diaspora.

(v) Some African experts in the Diaspora have become significant icons in the world of STI. Such individuals, as, for example, the Malian IT engineer working for NASA, should specifically be targeted to develop STI in Africa.

(vi) The African Diaspora can be involved through partnership projects, whereby a project in Africa is funded by a foreign institution hosting the Diaspora. Such projects will provide the opportunity for members of the African Diaspora to employ their skills to develop STI on the continent.

(vii) Expertise of the African Diaspora can already be exploited by involving its members in relevant on-going development programmes.

2.4 Funding of Science Research and Development in Africa

From the discussion of funding mechanisms for science research and development (R&D) in Africa the following points were raised.

(i) African researchers operate in a vicious cycle of no research funding ↔no output. Governments need to be sensitized by scientists to break this cycle by providing dedicated funding for research, with the budget for salaries separated from that for conducting research.

(ii) Each country needs to get its R&D programme right before considering how to fund it. Local funding should be exploited first before supplementary funding is sought from elsewhere. Donor funding goes with the risk of compromising Africa's independence, as donor interest may conflict with and compromise the interest and agenda of the recipient.

(iii) Most S&T funding from government is limited to the payment of salaries, while the actual research has to rely on external funding. AU/NEPAD should re-orientate its plans to focus more on funding research to solve local problems.

(iv) There seems to be a conflict of interest in the AU/NEPAD STCPA, whereby governments and the

research community are divided on the governance of the implementation of the plan. This conflict may be resolved by developing a hybrid plan.

(v) Africa needs to know how to deploy its resources. This requires setting priorities and developing a regional strategy. With such a strategy, donor funding can be requested and obtained through a unitary structure rather than through fragmented requests from individual institutions or governments. It is necessary to understand the operational modalities of global conventions that fund development projects in order to be able to benefit from such funding.

(vi) Big endowment funding is needed, which, if properly invested, should be able to generate further funding in future. Governments can raise substantial endowment funds through simple and easily applicable taxation, such as, for example, a minimal tax on telephone calls.

(vii) Research funding needs to be distributed between fundamental or basic research (to keep pace with the rest of the world) and applied research to solve local problems.

(viii) African policy-makers seem to have submitted to foreign forces for the development of the continent. Both government and the private sector need imperatively to contribute to research and development. Proper legislation is required to enforce such obligatory contributions. Governments need to create incentives for the private sector to invest in R&D.

(ix) There is too much bureaucracy in science and technology, whereby the bulk of the budget goes into administration, with too little trickling down to fund research.

(x) To attract research funding, projects need to be designed to have a visible impact on the glaring problems facing local communities. Standards need to be set for identifying 'first class' research in Africa, which can attract private sector buy-in and funding.

(xi) Some foreign donors have lost faith in African institutions because of poor accountability for research grants. Sometimes the funds are diverted to other uses and nothing is left to implement the R&D projects.

(xii) Africa lacks organized research groups that can attract the interest of foreign donors. There is no proper coordination of efforts within or among African countries.

2.5 Issues of General Concern

(i) Capacity building remains a big challenge on the continent. One step towards resolving the issue could be to match African higher education institutions with those in developed countries for collaboration in research and training through staff and student exchange programmes.

(ii) Vocational training needs to be reinforced and incentives created for science students at all educational levels.

(iii) Functioning ICT infrastructure needs to be strengthened on the continent as this constitutes an essential tool for linkages among scientists, as well as for broader connectivity among various role players in socio-economic development.

(iv) Each country needs to carry out stringent self-examination through a SWOT analysis, and then design its way forward. Sometimes available technologies cannot be applied because of governance constraints.

(v) It is important to develop local facilities for training, so as to curb brain drain.

(vi) The concept of centres of excellence does not seem to be a priority for Africa. It might be more useful to deploy efforts for attainment of excellence at various levels than simply to designate institutions as centres of excellence.

(vii) Application of science and technology for sustainable development requires the deployment of simple but tangible solutions to common societal problems.

(viii) There is a need to improve communication among government, R&D communities or agencies, and the private sector on issues relating to the application of S&T for development.

(ix) Outstanding scientists are often withdrawn from practicing science and, instead, are loaded with administrative responsibilities, which reduce the capacity to conduct science. Such senior scientists deployed to administration need to continue to be available for the development of science and for training a new generation of scientists.

2.6 The Dialogue on STI in Africa: Proposed Resolutions

The following resolutions were proposed.

(i) Create national, regional and international research groups to address specific problems by applying science, technology and innovation.

(ii) Create a research fund under the umbrella of AU/UNECA/ICSU ROA to guide appropriate funding of targeted problem-solving research into burning issues on the continent.

(iii) Create linkages of research groups with the private sector to fund research for business promotion and poverty alleviation.

(iv) Set up research standards for first-class research in Africa so that the results can be taken up as investments by the business sector.

(v) Adopt existing success stories in Africa and apply them in other countries with similar problems.

(vi) Hold frequent dialogues between researchers and policy-makers to enable better understanding of the roles played by each party and the challenges faced, and to enable them, jointly, to map a sustainable and impact-yielding research and development agenda.

(vii) Create an enabling environment for African human resources, including those in the Diaspora, to contribute to STI development on the continent.

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