



Science and Technology and Africa's Global Inclusion

Report of the ATPS 2002 Annual Workshop and
Conference held on November 11 - 15, 2002

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A report of the 2002 Annual Workshop of the African Technology Policy Studies Network held at Nicon Hilton, Abuja, Nigeria, from November 11 to 15, 2002.

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ABOUT THE AFRICAN TECHNOLOGY POLICY STUDIES NETWORK

The African Technology Policy Studies Network (ATPS) is a multi-disciplinary network of researchers, policy makers, actors in the private sector and other end users interested in generating, promoting and strengthening innovative science and technology policies in Africa. With a regional secretariat in Nairobi, the network operates through national chapters in 17 countries, with an expansion plan to cover the entire sub-Saharan Africa.

One of the objectives of the network is to disseminate research results to policy makers, legislators, the organized private sector, civil society, mass media and farmers' groups through publications, dialogue and advocacy. Among its range of publications are the Working Paper Series (WPS), Research Paper Series (RPS), Special Paper Series (SPS), Technopolicy Briefs and Workshop Reports.

ATPS is supported by a growing number of donors including the International Development Research Centre (IDRC), the Carnegie Corporation of New York, the Rockefeller Foundation, the World Bank, the OPEC Fund, Ford Foundation, Coca-Cola Eastern Africa, the African Development Bank, *infoDev* and the Royal Dutch Government.

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LIST OF ABBREVIATIONS

ACP	Africa, Caribbean and Pacific
AISI	African Information Society Initiative
ATAC	African Technical Advisory Committee
ATPS	African Technology Policy Studies Network
COMESA	Common Market for Eastern and Southern Africa
CTCs	Community Technology Centers
EAC	East African Community
ECOWAS	Economic Commission for Western African States
EU	European Union
FDI	Foreign Direct Investments
FIFA	Federation Internationale de Football Association
GDP	Gross Domestic Product
ICTs	Information Communication Technologies
IDEP	Institute for Economic Developing and Planning
IDRC	International Development Research Center
IK	Indigenous Knowledge
IMF	International Monetary Fund
IPUF	Indigenous Plants Use Forum
IT	Information Technology
IUPGR	International Undertaking on Plant Genetic Resources
LDCs	Least Developed Countries
MDGs	Millenium Development Goals
MNCs	Multi-National Corporations
MVA	Manufacturing Value Added
NAPRECA	Natural Products Network for Eastern and Central Africa
NEPAD	New Partnership for Africa's Development
NICI	National Information and Communication Infrastructure
NNMDA	Nigerian Natural Medicine Development Agency
PICTA	Partnership on Information and Communication Technologies for Africa
SADC	Southern African Development Community
SHESTCO	Sheda Science and Technology Complex
SMEs	Small and Medium Enterprises
TK	Traditional Knowledge
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UNECA	United Nations Economic Commission for Africa
UNESCO-IS	United Nations Economic, Scientific & Cultural Organisation-Institute for Statistics
USA	United States of America
WSSD	World Summit on Sustainable Development
WTO	World Trade Organisation



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1.0 ORGANIZATION OF CONFERENCE AND WORKSHOP

VENUE, DATE OF CONFERENCE AND WORKSHOP

The 2002 Annual Conference and Workshop of an autonomous African Technology Policy Studies Network (ATPS) was held at the Nicon Hilton Hotel in Abuja, Nigeria, from November 11 to 15, 2002.

SUPPORT FOR THE CONFERENCE AND WORKSHOP

The 2002 Conference and Workshop was organized by ATPS and hosted by Nigeria's Federal Ministry of Science and Technology.

THEME OF CONFERENCE AND WORKSHOP

The theme of 2002 ATPS Conference and Workshop was "Science and Technology and Africa's Global Inclusions."

OBJECTIVES OF THE CONFERENCE AND WORKSHOP

The Conference and Workshop aimed at realizing the following objectives:

- host an international conference on science and technology to address the theme "Science and Technology and Africa's Global Inclusion"
- review new research proposals for possible funding
- run a methodology workshop for ATPS researchers
- run a writing skills seminar for ATPS researchers
- conduct a meeting for ATPS National Chapter Coordinators.

WORKSHOP PROCESS AND STRUCTURE

The Abuja meeting was planned to run as a conference and workshop. The first and second days were devoted to the conference and workshop opening ceremony as well as professional presentations addressing the theme of the meeting. For each session there was a Chair, a presenter and a discussant. Part of the second day and the third day were devoted to presentation and review of research proposals while the fourth day was set aside for a methodology seminar and a writing skills

workshop for ATPS researchers. A presentation was also made on science and technology statistics and indications in developing countries, looking at perspectives and challenges. The ATPS Annual General Meeting was also held on the fourth day as well as an educational tour. The National Co-ordinators' Meeting was held on the fifth day of the conference and workshop.



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2.0 CONFERENCE AND WORKSHOP OPENING CEREMONY

REMARKS BY CHAIRMAN OF OPENING SESSION

The opening ceremony of the conference and workshop was chaired by Prof. Babatunde Thomas, Special Adviser to President Olusegun Obasanjo on Science, Technology and Human Resource Development. He commended ATPS for organizing the meeting and emphasized the need to intensify efforts on translating regional science and technology concerns into national and local actions. Prof. Babatunde also stressed the need to promote policy coherence and linkage between science and technology and microeconomic and sectoral policies.

Following the remarks, Prof. Babatunde drew attention to the challenges of “self-doubt” and weak public-private sector partnership in Africa, lack of vision, and the means for realization of the vision.

The Chairman of the session appealed to researchers and technology experts to “break new grounds” in the field, arguing that scientists are blamed for the continent’s development predicament, and likening them to a boy who said everybody blamed him for whatever he did. He urged scientists to aim at placing the continent in the frontline of science and technology. “We must translate our work and policy into action. We must link policy issues to macro-economies...” he declared. “That way we will make progress.”

REMARKS BY ATPS EXECUTIVE DIRECTOR

ATPS Executive Director, Dr. Osita Ogbu, said in a statement that his organization had brought science and technology experts together and thus fused a mix between academia and policy-makers. He said his network’s management would transform ATPS into vanguard for promotion of science and technology policy in Africa and called on all stakeholders to live up to their pledge in support of the organization.

Dr. Ogbu stressed that the crisis of African development was rooted in its people’s “crisis in self doubt.” Africans had no faith in their own scientists, economists, entrepreneurs, innovations and experts, he posited. In addition, Africans were shy about pursuing issues genuinely in their interest, Dr. Ogbu said, arguing the continent had surrendered its policy-making process to those who “hardly understand us.” He contended that there was no worse crisis than that of intellectual dependence and called for a re-awakening among Africans to disallow their primitive instincts to determine their destiny.

The Executive Director said time was against Africa as the continent was clearly some 20 years behind countries that were at par with it barely forty years ago.

He said Africa had demonstrated more dependence in science and technology than in any other sectors but still neglected formulating policy in biotechnology, information and communication



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technology, engineering, material science, socio-economic development and agricultural technology. Africa had taken a complacent attitude towards policy formulation in key areas, letting others lead. Despite the setback, he argued, Africa had an opportunity to leapfrog and use new technologies to fight poverty and underdevelopment.

Dr. Ogbu emphasized the need for Africa to use modern science and technology to close the digital, innovation, biotechnology and agricultural gaps, among others, between the continent and the developed world. The starting point, he posited, was embracing innovative science and technology policy.

ATPS, the Executive Director explained, was already in the frontline in showing the way forward. The network was working with national chapters, he said, to carry out capacity building, rejuvenate and use existing capacity. The network had contributed to policy formulation in key areas in Kenya, Uganda, Zimbabwe and Lesotho.

More importantly, ATPS was training researchers to be “entrepreneurs” of ideas to develop skills that will enable them participate actively on the global knowledge market. Further, the network was training journalists to support popularization of science and technology. He pledged his organization’s commitment to ensure the New Partnership for Africa Development (NEPAD) Framework Development is knowledge-based and science and technology driven.

Dr. Ogbu paid special tribute to the Federal Government of Nigeria for co-hosting the conference and workshop through the Ministry of Science and Technology. He singled out Prof. Turner Isoun, Nigeria’s Federal Minister for Science and Technology, for playing a pivotal role in the organization and hosting the meeting and for pushing for “new and purposeful” science and technology agenda for Nigeria and Africa. He also lauded Alhaji Abubakar Abdulahi, the Director General of the Raw Materials Research Council of Nigeria for “meticulously” planning the event. The Executive Director of United Nations Economic Commission for Africa, Mr. K.Y. Amoaka, also won accolades for the keynote address.

REMARKS BY THE ATPS CHAIRMAN

The ATPS Chairperson, Prof. Norah Olembo, noted that science and technology has a central role to play in the realization of sustainable development. She praised ATPS for its efforts in popularizing science and technology policy, and Nigeria’s Federal Ministry of Science and Technology for supporting the Abuja meeting.

She enunciated ATPS’ role and impact in the region and called on researchers to generate knowledge that would enable policy-makers to better address the issues of the day. Owing to attitudinal differences between researchers and policy-makers, she said, a closer understanding of the way each party works is important. Such an understanding would lead to effective interaction. Fortunately, ATPS is poised to bring together science and technology policy-makers from different disciplines.

Prof. Olembo observed that the coming together of more than 100 researchers, academics and policy-makers was testimony to the critical role ATPS played in bringing scientists and experts in science and technology together. She called for a bottom-up approach to science and technology policy and urged policy-makers to make it the foundation of development in Africa.

Prof. Olembo advised researchers to take advantage of networks, saying such networks were important in meeting capacity building needs. The Chairman urged for the development of mechanisms to strengthen partnerships between African policy-makers and researchers. Teamwork between stakeholders in science, technology and innovation policy formulation is crucial, Prof. Olembo noted.

She thanked the Federal Government of Nigeria for its support and hospitality. She praised the Ministry of Science and Technology and Prof. Turner Isoun for their role in hosting the conference and workshop.



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REMARKS BY FEDERAL MINISTER OF SCIENCE AND TECHNOLOGY

Prof. Turner Isoun, Nigeria's Federal Minister of Science and Technology, commended ATPS for organizing the Abuja meeting. He recalled Prof. Babatunde's concern that little had been achieved in Africa in science and technology innovation and development, pointing out that at a recent summit in South Africa on sustainable development, a lot had been discussed from an African perspective. NEPAD, he said, was one pointer to what was positively happening in science and technology in Africa.

In addition, he said, political will was growing towards adoption of science and technology policy.

He acknowledged that India and Nigeria were at par in development 20 years ago. However, India had launched 35 satellites while Nigeria had launched only one. ATPS had, he said, taken leadership in moving Africa the way India had moved.

Prof. Isoun called for creation of wealth and products.

OFFICIAL OPENING OF CONFERENCE AND WORKSHOP

The official opening of the 2002 ATPS Conference and Workshop was conducted by Prof. Turner Isoun, Nigeria's Federal Minister of Science and Technology. The Minister said he felt elated by the choice of the theme of the conference, "Science and Technology and Africa's Global Inclusion." He pointed out that the impact of science, engineering and technology in modern economies was obvious. It is important, therefore, that African governments should recognize that science and technology embraces virtually all development issues. The continent, however, was slow in developing sound science and technology policies that would ensure its inclusion in a global economy.

Prof. Isoun chronicled Africa's problems, including economic stagnation, marginalization, low productivity, worsening economic burden, low industrialization, phenomenal brain drain, poverty, political instability and unemployment. He said Africa needed science and technology intervention in the development process but had a dire need of scientists, engineers and technologists.

He said NEPAD faced a daunting task in helping translate words into action, and in ensuring Africa's global inclusion. Quoting Brian Tracy, a foremost American authority in management, Prof. Isoun said, "leaders think and talk about solutions. Followers think and talk about the problems." The challenge before the conference, he said, was formulation and implementation of innovative science and technology policies that would drive the African economy into the 21st century.

He called on researchers and scientists to invest their talent, time, skills and resources in areas that guarantee success. Prof. Isoun identified six main areas for innovative science and technology policy development:

1. Three global economies – industrial, digital information, and biotechnology. He said Africa was hardly part of the old economy and should now seek to promote sustainable industrial utilization of the continent's immense resources using the available cheap labour to solve poverty.
2. The challenge of using information and communication technologies to accelerate Africa's socio-economic development.
3. The task of ensuring Africa's inclusion into the global economy.
4. The challenge of ensuring emphasis is placed on science, engineering and technology education from primary to the tertiary levels of education.
5. Promoting research and development and integrated capacity-building activities to drive any science and technology-driven activities and economy.
6. Creating wealth and generating employment through knowledge.

Prof. Isoun also called for respect and protection of intellectual property rights and for promotion of innovation and creativity in national and regional economies. Critical partnerships at the local, national, regional and global levels are inevitable for success.



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STATEMENT FROM THE MINISTER OF COMMERCE

The Federal Minister of Commerce, Eng. Mustafa Bello, sent the conference and workshop a goodwill message that was delivered by Mrs. D.O Adewoye, Deputy Director of Research and Statistics at the Ministry.

Eng. Bello congratulated ATPS on convening the meeting and on raising issues that would stem poverty in Africa. The theme of the conference, he observed, sought to reposition Africa and guide the continent on how to mobilize its potential in order to gain from globalization.

He challenged African leaders to restrict liberalization that discriminates against products from developing countries.

Eng. Bello challenged conference participants to come up with recommendations on food preservation technologies that are acceptable locally and internationally, arguing that such technologies would ensure food sufficiency and restore African's food security.



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KEYNOTE BY THE EXECUTIVE SECRETARY, UNITED NATIONS ECONOMIC COMMISSION FOR AFRICA

The keynote was delivered by Dr. Josue' Dioné, the Director, Sustainable Development Division, on behalf of Dr. K.Y. Omaoko, the Executive Secretary of the United Nations Economic Commission for Africa (UNECA) based in Addis Ababa, Ethiopia. African policy-makers, he said, had recognized that adoption of new technologies was key to transition in sustainable development and the inclusion of the continent to the global economy. NEPAD, he observed, had explicitly made this urge. A clear science and technology regime was, therefore, desirable for socio-economic and environmental development, he said.

Dioné highlighted five challenges that a new technological regime for the continent must address:

1. Economic growth – which, he said, has remained elusive to Africa. He said 25 of the world's 30 poorest countries are in Africa; 32 of the 48 least developed countries are in sub-Saharan Africa; 50 percent of people in sub-Saharan Africa live in extreme poverty.
2. Agriculture, the backbone of the continent's economy – has the lowest yields in the world. The poor performance is attributable to weak commitment and poor policies for development of the sector. Sub-Saharan Africa, he said, is the only major developing region where per capita food grain has declined in the past four decades. As a result, some 200 million Africa are chronically hungry.
3. Health problems – have had a phenomenal increase. Of the 36 million people infected with HIV/Aids worldwide, 72 percent are in Africa. Malaria alone kills two million people annually. Tuberculosis has re-emerged and other diseases including pneumonia, whooping cough, polio, measles are wreaking havoc.
4. The continent's natural resources and biodiversity – are under fast degradation and thus threatening life in Africa. For instance, Africa lost 66 million hectares of forest between 1980 and 1995.
5. Africa remains a producer of primary goods for the rest of the world – most of which are exposed to piracy. To date no country in sub-Saharan Africa has achieved the 25 percent manufacturing share in Gross Domestic Product (GDP) projected by the United Nations.

In view of this, Dioné asserted the need for Africa to meet the Millennium Development Goals to reduce poverty, hunger, illiteracy and lack of access to water and sanitation. However, the speaker noted the difficulties in adopting a new technological regime. He proposed that the difficulties be tackled from different fronts.

The speaker said Africa's inclusion into the global economy would depend on improved performance in investments, trade and technology. Further, he said, the continent had not been able to harness its potential in natural resources. He noted Africa needs to counter the possibility of a

“double squeeze” – internal and external – and raise its competitiveness and diversify its economies in a globalized environment.

Dioné said a new technological regime in Africa must address the following:

1. Democratization and popularization of science and technology – in an effort that involves all key stakeholders.
2. Integration of science and technology and innovation policies with overall development policies.
3. Giving special attention to agriculture, energy, mining and water. This would entail use of new technologies in promotion of innovation crucial to realization of food security and a reduction of poverty.
4. Strengthening of science and technology policy-making and development institutions.
5. The building of an efficient science and technology infrastructure with managerial, entrepreneurial and innovation capacities.
6. Enhancing international co-operation through networking and collaboration.
7. Establishing mechanisms to monitor technology and development using internationally agreed standards and methods.

Dioné called on African governments to step up efforts in creating enabling environments for a new technological regime.



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3.0 CONFERENCE PLENARY PRESENTATIONS

1. JOHN MUGABE

UNLOCKING OUR FUTURE: SCIENCE AND TECHNOLOGY IN THE NEW PARTNERSHIP FOR AFRICA DEVELOPMENT

Dr. John Mugabe explained the role of NEPAD in promotion of science and technology, demonstrating that the African organization had recognized the central role science and technology must play in efforts to develop the continent. NEPAD had arisen, he said, out of African leaders' conviction that they must work collectively to eradicate poverty and facilitate the continent's inclusion in the global economy. Importantly, he pointed out, NEPAD recognizes that the region's economic recovery lay in the development and use of science and technology.

He noted that most regional groups had also recognized the pivotal role science and technology would play in their economic recovery. Such groups included the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC), the Economic Commission for Western African States (ECOWAS) and Southern African Development Community (SADC).

In addition, he said, the Plan of Implementation of Agenda 21, adopted at the World Summit on Sustainable Development (WSSD) in Johannesburg in September 2002 emphasized the role of science and technology in sustainable development.

The presenter stressed the need for African countries to work together to improve their innovation systems while still sharing capacity to solve common problems.

He also spoke of the Africa, Caribbean and Pacific (ACP) and the European Union (EU) Forum on Research for Sustainable Development as groups that stressed the need for regional cooperation in development science and technology initiatives.

Dr. Mugabe gave an overview of the scientific and technological developments, challenges and opportunities that African countries must address. He singled out biotechnology and information, as the two main technologies Africa must give priority to – creating conditions for co-operation in the continent. He also outlined the objectives of NEPAD's programmes and activities and the principles that would guide the implementation of the programme. He also devoted time demonstrating the modes of implementation of the initiative.

Dr. Mugabe saw the 21st century as an epoch of dual revolutions – in biotechnology and information communication technologies (ICTs). ICTs had radically changed global commerce and patterns of financial flows, he said. Developments in biotechnology provide potential for new, safer and cheaper products, he further pointed out. However, while the revolutions were sweeping most of the world they had little impact on Africa. For example, hunger, insecurity, deteriorating public health, environmental degradation and socio-political instability continued to beleaguer the continent.

More than 301 million Africans, he said, lived on less than US\$1 per day; the region had the least developed telecommunications infrastructure, with only about 10 million telephone lines by 1999.

Dr. Mugabe suggested that Africa draws lessons from some Asian countries that had achieved rapid economic recovery recently. Their new forms of technology dynamism, he said, had enabled them to improve economic production. Under nutrition in South Asia, for example, was reduced from about 40 percent in the 1970s to 23 percent in 1997, and chronic famine ended owing to technological breakthroughs in plant breeding, fertilizer and fertilizer processing in 1960s that doubled world cereal yields in only 40 years.

The presenter proposed possibilities of regional and international co-operation through partnerships. He also identified regional and international organizations, treaties and agreements that emphasized the role of science and technology in development, demonstrating the need for Africa to take advantage of them.

Dr. Mugabe stressed that NEPAD's major objective is to bridge the technological divide between Africa and the rest of the world. The organization also hopes to have doubled teledensity to two lines per 100 people by 2005.

Discussing NEPAD's programme areas, Dr. Mugabe said the organization proposed to:

- Build a better understanding and improve the quality of national innovation systems in Africa.
- Increase the quality and intensity of regional cooperation in science and technology.
- Establish and strengthen a regional network of centres of excellence in specific area of science and technological innovation.
- Build a strong, broad-based and dynamic African constituency for science and technology.
- Promote the sharing of experiences in funding science activities.
- Provide advisory services on key science and technology policy issues emerging from the World Trade Organization (WTO), WSSD and environmental conventions.

The presenter said guiding principles in the implementation of the NEPAD programme were adding new value, building on prior achievements, sharing progress and impacts, ensuring collective ownerships and broad-based participation, facilitating high-level political ownership and support, maintaining flexibility to change as regional needs and conditions change and ensuring collective action with differentiated capabilities.

DISCUSSION OF DR. MUGABE'S PRESENTATION

1. Participants cautioned against the temptation to reject technological transfer and embrace development, arguing that the two must go together. Dr. Mugabe clarified that most policies on science and technology in Africa stressed technological transfer. He contended that emphasis should be on innovation while still accommodating technological transfer.
2. Some participants argued that "intellectual protection" was vague and ambiguous in Africa. They said the meaning and implications of "intellectual protection" should be made clear. They argued that the term was clear in other countries but not in Africa. Intellectual property was protected in countries other than Africa, they said.

Dr. Mugabe said intellectual property protection was one way of ensuring African innovators and the continent gained from their inventions. In other countries firms and scientists, among others, applied for patents for specific innovations to exploit their use, normally through monopolies. The presenter said for over two decades, most developing countries argued that patenting rules denied them access to new technologies in the North while developed countries easily accessed traditional technologies in the South. He said WTO allowed that situation.

3. On NEPAD some participants sought to know how member countries would be affected and the level of consultations with stakeholders. Were ICT professionals being consulted to ensure best results in solving ICT problems on the African continent?

Dr. Mugabe said NEPAD had an e-commission process devoted to electronic commerce. Still, NEPAD has an agreement that seeks to establish linkages with member countries and stakeholders, Dr. Mugabe said NEPAD would put in place a "focused and specific" programme.

On the need for broad-based participation on NEPAD activities and processes, the presenter said consultations were still going on. A round table meeting was already scheduled for Pretoria,



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he said, to define NEPAD's science and technology programme agenda. He stressed that NEPAD aimed at addressing processes rather than short-term programmes.

4. A question arose about Africa's numerous languages and their place in development from NEPAD's viewpoint. Dr. Mugabe said the languages were probably an advantage to the continent. Saying languages were an issue to NEPAD, he argued a way had to be found to ensure inclusion of French-speaking Africa. Dr. Mugabe however said he did not anticipate NEPAD would begin working in all African languages. He said English, French and Portuguese would be used for the time being.

Prof. Turner T. Isoun said most children in Africa begin learning in local languages and suggested that NEPAD takes advantage of Africa's language diversity.

2. BANJI OYELARAN OYEYINKA

GLOBAL GOVERNANCE OF TECHNOLOGY AND AFRICA'S GLOBAL INCLUSION

In the presentation Prof. Oyeyinka advanced a set of propositions on the exclusion of African countries from the benefits of globalization. First, he said, is that this development could be explained by the lack of dynamism of the region's systems of innovation, institutions that underlie the adoption, diffusion and adaptation of innovation. Secondly, institutions possess path-dependent characteristics influencing the growth rate of per capita incomes. Third he said, the path-dependent variables, codified loosely into the concept of systems of innovation, have institutional origins that have persistently impacted on the evolution of African development. The variables include, among others, human capital, research and development systems and industrial capacity. Fourth, he pointed out that human capital formation represented by school enrolment and industrial skills capability acquisition has been inadequate in the new competitive global economy. He also showed that new kinds of infrastructure represented by ICT have revolutionized technology and trade exchanges.

However, Africa lags far behind other regions in adopting ICTs and putting in place the necessary infrastructure, such as electrical power to support their optimal utilization. For these reasons, he said, the nature of the state and its institutions (which are 'carriers of history') determine whether dynamic or non-dynamic learning systems of innovation will emerge. He suggested that the combined impact of pattern of school enrolment at the primary, secondary and tertiary levels combined with the commodity-based system of trade, rather than factory-based research and development supported system of industry gave form to the current low technological base of African industry.

Prof. Oyeyinka said considerable work remains to be done in understanding the systemic origin of Africa's non-dynamic innovation systems and that research may take several forms. First it is important to understand more specifically the key elements of the system of innovation that are the most influential and how much they contribute to building the systems of innovation. Secondly, it is important to seek an understanding of the nature of interactions, not only within the narrow domain specified for firms and industry, but at a wider socio-economic level. For instance, he posed, how do we intensify interactions of economic actors and make them more effective? Third, he said, research should explore the specific ways in which the institutional origins of the systems of innovation influence development and what policies can mitigate the negative impact that persists. Lastly, in globalizing economy, he said, research and policies would do well to understand better the disruptive influences of global agreements while accommodating latecomer countries in SSA. Global governance institutions have made short shrift of the challenges facing the region, he argued. African countries, he said, face the dilemma of imperative integration into a world economy of the 21st century with states and institutions that have changed little over time. Institutions developing human capital for both industry and the bureaucracy need to be transformed to fulfil the need of modernizing economies. The systems of innovation approach suggests that the skills and knowledge base of seemingly unrelated components could be fruitfully brought together to promote development. Capacities outside the productive firm, for instance, may well be as crucial for firm growth as the capacities within. As institutions and policies demonstrate persistent characteristics, African policy-



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makers, he argued, need to take a long-term view. Getting the institutions right is certainly more crucial than getting the prices right, Prof. Oyeyinka contended.

DISCUSSION OF PROF. OYEYINKA'S PRESENTATION

1. A participant sought to know the line African researchers should take in view of the problems in the continent – applied or basic research. The response was that innovation applied research must be emphasized.
2. Another participant sought to find out if problems related to science and technology in Africa had been recognized and quantified. Further, the way forward was sought. It was pointed out that “having a dream” in Africa was often the beginning of untold problems for the dreamer. In the developed world there always was a way of translating “a dream” into something of value. What should Africa do with all the knowledge accumulated?
3. He also pointed out that most policies on development in Africa contradicted each other. Such a situation should to be addressed to harmonize the policies.
4. A participant suggested that multinationals be asked to invest in areas apart from those of their specific interest. “Can we introduce policies that will make them invest in other areas?”
5. It was pointed out that most research institutions in Africa are imposed from the North and are therefore not a product of local needs. It was proposed that an “organic relation” be established for ICTs to work in Africa. For institutions to have a positive impact they should respond to the requirements of the economic system, it was suggested.
6. A participant raised the possibility of neglecting “domestic inclusion” in the craze for global inclusion. The informal sector in Africa, it was noted, serves more than 50 percent of Africa’s population. It was suggested that “global inclusion” risked excluding the local population from the development process. Majority of the people are at the grassroots and global inclusion has the risk of a “spill down” effect – thus alienating the general population. Dr. Ogbu, however, clarified that the thrust in the discussions was on “global governance” and “Africa’s inclusion.” The challenge, he clarified, was how to deal with constraints that may be caused by global governance. “We need to have three messages – all given with one hand.”

PROF. OYEYINKA'S RESPONSE

Prof. Oyeyinka said action was required immediately if the technological divide was to be bridged. He said countries such as Nigeria had not been assertive enough on science and technology policy. He called for a more aggressive push on the issues. At the national level, firm-level performance must be strengthened. National systems of innovation must also be strengthened.

The solution to the problem of alienation, he said, could be found with each nation dealing in what it has. There are disparate groups in societies. Netherlands, for example, deals in flowers and the sector is highly modernized.

On the informal sector contribution, policies should be drafted that encourage and raise production. There was rigidity leading to inertia in Africa, he said, and called on ATPS to initiate actions that could steer growth. He also noted that universities play some role in steering production and that applied research goes on all the time.

Prof. Oyeyinka said it was difficult to quantify the weakness leading to Africa’s lag in global inclusion. Further, dreams in Africa are difficult to deal with. “We need to continue to dream, however,” the presenter concluded.

Prof. Lynn Mytelka cautioned against succumbing to generalized arguments advanced by WTO and TRIPS, among other organizations. She said flexibility is important. “Let’s not accept the generalization that flexibility doesn’t work.” She also urged scientists to work together at a regional level.



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3. AWELE MADUEMEZIA

SCIENCE IN A GLOBALIZING WORLD: IMPLICATIONS FOR AFRICA

Prof. Awele Maduemezia delivered this paper at a luncheon meeting of the conference. The presenter said the term “globalization” was unpopular in developing countries because of the activities of the International Monetary Fund (IMF) and the World Bank. In Nigeria, globalization had been shown as an imperialist plot to keep Africa and the rest of the developing world down. He said, there are aspects of globalization that create problems; others are useful. Prof. Maduemezia defined globalization as a single coherent entity with respect to socio-economic planning, coupled with enforced development. He viewed it as an entity, under the pressure of international market forces, engineered primarily by the perspectives, national interests and current values of the Western world.

He proceeded to examine the various forms globalization takes: political, social, economic or financial and market, technological and scientific.

He also looked at the various characteristics of globalization.

- Political globalization as represented by the United Nations. He viewed it as a beneficial structure.
- Economic or financial and market globalisation is as represented by the IMF and its kindred organizations. This type of globalization, he said, seems to be creating problems throughout the developing world.
- Social globalization is one in which weaker cultures are subsumed in stronger ones and the speaker gave the example of English which had become the universal language of science and technology at the expense of relatively stronger European and African languages. This is a good thing for science as it simplifies publication, but not for the humanities, as it suppresses other cultures.
- Technological globalization leads to the creation of uniform technical specifications and standards in industry. It is driven by the need to create wider markets especially for hi-tech goods.
- Scientific globalization is the medium through which the science research front is universally accessible, so that the practice of science now has hardly any geographical boundaries. He termed it a good thing.

The speaker said globalization had many unresolved apparent contradictions and questions: Does the Internet bring people together or does it isolate them? Is global consumerism destroying diversity and identity or is it reviving national ethnic feelings? Is it not true that globalization in its present form deepens already existing inequalities? How can we distribute the benefits of globalization more evenly? Is the surging phenomenon of globalization not shrinking the decision making powers of the young and politically fragile nation states of the developing world?

But Prof. Maduemezia cautioned that Western nations should not be blamed for trying to protect their national interests as long as this does not stop others from doing likewise. And he added Africans are yet to master the art of managing their resources creatively which made the playing field uneven.

He said science in a globalizing world has benefits which Africa should take advantage of as “computers, telecommunications, and the Internet are the embryonic stages of a single global nervous system.” The communications revolution, which made economic globalization possible, provides, through the Internet, a new, quick and inexpensive way for scientists in developing countries to make contact with the research front in various disciplines. He refuted accusations that underdeveloped countries were being underdeveloped by someone else, saying, “we are underdeveloping ourselves.”

Prof. Maduemezia called on Africans to take early advantage of new technological advances. However, because Africans are only passive participants in the creation of this new computer culture, there is a tendency for them not to fully appreciate the benefits derivable them. The result is that while the West is latching on the computer and moving full steam ahead, Africans are pre-occupied



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with other things, so that the gap between Africa and the rest of the world is widening. Intellectuals who blame foreign powers for Africa's continuing backwardness, he said, are doing the continent great disservice.

He said the overriding concern today is that science should function as a tool for sustainable development, a means of improving the quality of life. This is why attention has been focused on four principal concerns, namely, energy, the environment, food and communication.

Examining the implications of the situation for Africa, Prof. Maduemezia said active research and development was going on in the USA on hydrogen fuel, obtainable from water. When the commercialization of the results begins it will eliminate the importance of petroleum in world politics. It will put nations that have not developed the capability to produce this new kind of fuel at a disadvantage. "That covers the whole of the sleeping African continent, with the probable exception of South Africa," the speaker said. He said Africans should not wait for Americans to produce alternative forms of energy and then complain they were being enslaved.

He said in the late 1970s at the urging of European friends, African scientists held on to the concept of appropriate technology for Africans, and argued endlessly about transfer of technology. Some people insisted that there was no such thing. Others argued that it was all over the place, and called for a shift of paradigm. The paradigm of appropriate technology must be rejected, he said, because it does not fit into what is now the global village.

One aspect of science in a globalizing world that impacts on Africa is that it spawns the "Tokunbo syndrome", thus giving rise to an equally rapid rate of obsolescence, especially in the automobile sector. Equipment that cannot satisfy the stringent standards operative in a hi-tech oriented society finds a ready market in Africa. This has both a positive impact and a negative one. The positive one is that it temporarily takes care of the short-term needs of cash-strapped consumers in Africa. The long-term effect is, however, harmful as the easy availability of such equipment impedes all efforts at local development of technology, and removes any initiatives that there might have been lying dormant in the local folk.

The speaker said the Internet has opened up a vast array of possibilities. One such possibility is software development, from which Africans could immensely benefit.

To make headway, he said, an environment such as the Sheda Science and Technology Complex (SHESTCO) should be created and a few dedicated people supported by the government. Most important is the paradigm of leap frogging.

4. MOSES M. IKIARA

FOREIGN DIRECT INVESTMENT, TECHNOLOGY TRANSFER, AND POVERTY ALLEVIATION: AFRICA'S HOPES AND DILEMMAS

Dr. Moses Ikiara defined Foreign Direct Investment (FDI) as long-term investment reflecting a lasting interest and control by a foreign direct investor of an enterprise entity resident in an economy other than that of the foreign investor. Poverty, which FDI sought to reduce, was Africa's overriding goal and the most important challenge. The presenter gave the following statistics: half of Africa's 800 million people live in extreme poverty – they make do with less than US\$1 a day; the proportion of the population in Africa's least developed countries living on less than US\$1 per day rose from 56 percent in 1965 and 1969 to 65 percent in 1995 and 1999. The incidence of extreme poverty is higher in non-oil exporting Least Developed Countries (LDCs) than in service exporting and manufacture-exporting LDCs.

The presenter argued that FDI can contribute in significant ways to reducing poverty. It would do this by making up for domestic capital shortfalls; providing technology, management and marketing skills; by facilitating access to foreign markets; and by generating technological and efficiency spill-over benefits to smaller farms.

He said FDI is also associated with many potential shortcomings, including:

- Importation of capital intensive and outdated technology;
- Exploitation of local labour;



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- Increase in local wage cost through payment of high wages by MNC affiliates;
- Contribution to economic leakage (and deterioration of balance of payments) through preference of imported inputs to local ones;
- Lack of linkages with local communities, that is, development of ‘enclaves’;
- Adverse effects on competition in the national market;
- Use of transfer prices to escape local taxes and to cheat local partners on returns;
- Encouragement of corruption;
- Pollution of the environment (especially in extractive and heavy industries) and weakening of safety;
- Social disruptions associated with accelerated commercialization, and creation of tastes for expensive foreign consumer goods, as alternatives to local brands; and
- Political dependency on FDI source countries.

The presenter said the greatest contribution of FDI to economic growth and, therefore, poverty reduction, occurs through technology transfer. Technology, he said, is defined as any tangible or intangible resource that can generate economic rent for host country firms by, for example, improving total factor productivity.

He further said FDI is one of the channels of technology transfer. Others include importation of machinery and intermediate inputs; international movement of labour, for example reverse brain drain and movement of consultants; “arms length” transactions or technology licensing; government efforts such as education provision and investment on high-tech projects, contract manufacturing for developed country markets, expert-guided tours of factories, apprenticeship, and illegitimate means such as industrial espionage.

Technology transfer, he argued, can occur directly to local firms involved in joint venture with the MNC or indirectly, as a spill over benefit to unaffiliated local firms.

Dr. Ikiara also examined what Africa must do to attract large and growing FDI flows and maximize the poverty alleviation. Africa, he said, must put in place the requisite institutional, policy, and regulatory frameworks and enforce them aggressively.

1. The continent must invest in a thorough understanding of the international production systems, multi-national corporations (MNC) strategies, and what pulls MNCs, as a first step towards getting integrated into regional and global production networks of MNCs. Surveys have shown that managers of African investment promotion agencies have incomplete understanding of the factors that attract the appropriate type of MNCs.
2. Proactive, deliberate, and strategic approach to FDI policy. FDI promotion and linkage policies should be consistent with each country’s overall development and industrialization strategies. Thus, policies should focus on a few competitive sectors and industries and target labour-intensive, value-adding, technology-intensive, and export-oriented FDI.
3. Promotion of co-operation between developed countries and Africa, in the spirit of NEPAD. This will not only lead to improved access to developed country markets but also to assistance towards building and improving the infrastructure necessary for attracting FDI.
4. Improvement of the general macroeconomic and institutional frameworks. This includes stable and high economic growth rate, liberal exchange rates, convertible currency, low inflation, minimal current account deficit and external indebtedness, low interest rates and access to capital, efficient banking system and capital markets, and competitive corporate tax rates.
5. Creation of a healthy and enabling business environment that encourages both foreign and local investors, provides incentives for innovation and skills improvement, and contributes to competitive corporate climate. This could be done through improvement of the requisite regulatory and legal frameworks; streamlining customs clearance, bureaucracy and business licensing; creation of institutions to reduce business risk such as risk insurance agencies; deregulation policy; formulation of policies to safeguard levels of competition such as openness to international trade, efficiency-enhancing competition laws, and establishment of effective enforcement agencies; through attractive investment (or FDI) policies; and through faster



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privatization.

6. Raising market size by striving for stable macroeconomic and socio-political regimes, pursuing regional trade liberalization and integration, and pursuing inclusion in free trade arrangements with major markets such as the EU and the US. NEPAD strategy of promoting intra-African trade is thus a step in the right direction.
7. Competition policy in host countries to create a level playing ground since MNC affiliates enjoy substantial advantages over local firms. Elements of such policy include initial protection of leading local firms (local champions) to build their brand names, restriction of the use by MNC affiliates of international brand names, in the local market, and prevention of takeovers and mergers involving affiliates and local firms to prevent accumulation of monopolistic advantages.
8. Upgrading of infrastructure, technology, and human competencies to levels that facilitate full realization of FDI benefits.
9. Strong role for the state in such areas as provision of an enabling business environment; development of education and skills; building of local technological capabilities; promotion of efficient programmes to link MNCs with domestic firms; promotion and support of small and medium enterprises (SMEs) to act as suppliers to MNC affiliates; and market identification, exploration and development.
10. Exploitation of the strength of public-private partnerships in the whole process, from designing infrastructure and policies that would attract and sustain FDI, building local technological capabilities, and designing policies and incentives to maximize the net benefits of FDI.
11. Effective investment promotion policies, including regional marketing initiatives, but only after the fundamental determinants of FDI are in place. This promotion is critically important if the continent's negative business image is to be changed.

5. MOHAMED KHALIL-TIMAMY

TECHNOLOGY TRANSFER IN A GLOBALIZING WORLD: MANY PROMISES, LACK OF RESPONSIBILITY, AND CHALLENGES FOR AFRICA

In his presentation, Dr. Khalil-Timamy described the controversies surrounding technology transfer and the modes employed in the transfer. He proceeded to examine the transfer commitments made by industrialised countries as embodied in various international conventions and agreements. He also sought an understanding of the reasons why the powerful signatories to the conventions and agreements have largely failed to fulfil their end of the bargain. Further, Dr. Khalil reflected on a number of insightful international experiences on technology transfer and demonstrated the main determinants of successful technology transfer processes. The presenter also dissected some African cases in a bid to show problems and prospects regarding technological change. He went on to propose strategies, including the potentialities offered by the information and communication strategies in enhancing the robust technologization of the world.

The presenter defined technology as knowledge related to production, distribution, products, processes, repair and maintenance, among other types of related knowledge. He brought out three levels of technology, first, that which is embodied in capital goods, engineering and managerial services, product and process capacity. Second, technology that includes knowledge and skills related to operation, maintenance, and repair of production facilities. Third, technology that consists in knowledge, skills, expertise, and experience used in generating and managing technical change.

The presenter defined technology transfer as the process of accumulation of skills and know-how by a receiving economy in the wake of investments, equipment, machinery and requisite services. It entails the build-up of indigenous capacities from the knowledge and capabilities possessed by the suppliers. He said three broad levels of technological capabilities have been identified: production, investment and innovation capabilities. Production capabilities, he said, refer to the accumulation of skills and competencies crucial to the to operating, maintaining and running production facilities while investment capabilities refer to the know-how that enables an economy to design and replicate



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production facilities domestically or abroad. And innovation capabilities refer to the skills, knowledge and ability to improve and modify production facilities in the direction of greater resource-use efficiency and higher domestic content.

The presenter clarified that technology transfer would not take place if a domestic economy fails to *acquire* some of the capabilities described.

Dr Khalil listed the factors that hamper a technology-importing country from acquiring the technology:

- absence of social carriers of technology,
- lack of integration with the national plan,
- lack of participation by all relevant institutions and stakeholders (from the private sector, civil society, and government) in technology policy-making processes,
- absence of a technologically-skilled and informed community sufficiently knowledgeable about the various aspects of the technology transformation chain,
- absence of a social system that duly recognizes and rewards innovators in high profile ways,
- lack of gatekeepers to monitor trends in the vast global domain of innovations,
- research and development systems plagued by inadequate funds, sparsely equipped facilities, and poorly rewarded manpower,
- prevalence of extremely weak linkages between research and development and production systems adaptation, absorption and acquisition of technologies,
- lack of tools and capacities for analysis,
- ministries and departments of technology not accorded a premium and deserving status by the political leadership,
- subverting of technology policy measures to promote the evolution of domestic technological capabilities by vested interests,
- collusion between a predatory political elite and foreign technological suppliers. The whole transfer process is hijacked and mismanaged under a cloak of secrecy. The under-the-counter deals are often fraudulent, tend to marginalize or under-utilize domestic capacities and promote technological rip-offs and rent-seeking behaviour among the colluding parties,
- the buyer of technology may lack capacity to undertake pre-investment work,
- the buyer of technology may be oblivious of the dynamic significance of pre-investment activities in domestic technological capacity building,
- the domestic economy may be presided over by leaders who fail to recognize and appreciate the true worth of valuable technological capacities in their midst,
- lack or shortage of local capital resources that compel governments to secure influence. This often works to the disadvantage of the buyer,
- poor information about the existence of alternative suppliers,
- the government may fail to spearhead the conscious application of technology policy,
- the domestic economy may lack or suffer shortage of certain categories of indispensable manpower resources and, therefore, certain forms of managerial skills, and
- the buyer may be poorly informed about how to acquire vital inputs.

Dr Khalil also argued that the West's reluctance to transfer technologies to sub-Saharan Africa has been a blessing in disguise in at least two important respects. One, Africa is spared a wholesale onslaught on the environment. Most technologies from the West have been associated with adverse environmental ramifications. The innovations have been underpinned by a *mechanistic paradigm*, i.e. a Cartesian-Newtonian conceptual framework. The view, he said, that Africa could embrace environmentally-destructive technologies and seek to repair the attendant ecological damage once fortunes have been built underlines the depth of influence of the mechanistic tradition.

The second blessing in disguise, he said, can be explained by factors occasioned by *exigent* temporal and *global* shifts. Since the publication of *Our Common Future* in 1987 and the inauguration of unprecedented international environmental events thereafter, the policy-makers around the world have come to appreciate the depth of inter-dependence between the various components of the



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global system.

Dr. Khalil also pointed out the exogenous constraints that limit acquisition of technology:

- The imposition of restrictive clauses by technology suppliers such as provisions restricting exports and those stressing mandatory purchases.
- Conditions that stipulate that know-how would remain confidential during the contract period.
- Compulsory demands to purchase technical assistance when purchasing patents or trademarks.
- Contractual clauses fixing the final price of goods manufactured.
- Prohibitions to produce and market similar products.
- Contractual provisions that grant the supplier full control of the client company.
- Technology supplier encourages reliance of overseas manpower resources.
- Encouragement of grant-based finance by technology supplier and export credit agencies.
- Private appropriation by technology supplier of domestic innovation.

DISCUSSION OF DR. IKIARA'S AND DR. KHALIL'S PRESENTATIONS

DISCUSSION BY MELVIN AYOJU

The discussant for Dr. Ikiara's and Dr. Khalil's papers was Dr. Melvin Ayogu. He said Dr. Ikiara's discourse had raised the concept of Africa's hope in FDI adding, however, that there was a "low equilibrium trap". The presenter considered FDI as an important "way out" for Africa. He described what he viewed as Ikiara's conception of Africa's dilemma: the trading off of scarce resources between poverty reduction and incentives for FDI inflow whose future benefits are uncertain, particularly with regard to poverty reduction.

Dr. Ayogu saw Khalil's paper as focusing on "promises" by the North, looking at the reasons why they had not delivered, and what would have led to success in technologization and in technological transfer. He noted that the presenter had listed 26 items of "contributory negligence", saying the paper found the North as basically self-serving with no real intention of "altruistically delivering". The discussant viewed this line as "sanguine", arguing that Khalil's historical analysis portends major disappointments as diplomacy is not borne out of charity but expediency. He said discussions of FDI - poverty reduction, and transmission mechanisms need "unpacking" because of the new received wisdom that growth is insufficient and because of the many dimensions of poverty. Dr. Ayogu contended that claims of inadequate savings and wealth were unsatisfactory. The measures were additionally inappropriate. Types of savings and investments matters, and claims about inadequacy in savings or wealth, therefore, need interrogation.

He further queried the distinction between installed capacity and operable capacity, and wondered what the destination and sector distribution of FDI flows into Africa taught the continent. He talked of the need to "unpack" some of the FDI flows but recognized that the presenter had given some empirical evidence for Africa from the manufacturing sector.

Clarity was required, Dr. Ayogu argued, on the driving force where FDI had fostered technological capabilities. He further said it was important to study how knowledge is transmitted within and between firms or how technological capabilities are actualized in economies. It is also crucial to understand how firms make investment decisions, saying a more recent theoretical framework had been provided by the Real Options Theory that empathizes that investments are lumpy.

DISCUSSION BY PARTICIPANTS

The following came out from participants during the open discussion of Dr. Khalil's and Dr. Ikiara's papers:

1. Those working in the realm of science and technology must ensure they understand themselves and their discipline first. They also must ensure they speak in a language that those in humanities and other disciplines understand.
2. The concept of technological transfer takes everyone back to the 1980s. To suggest technology



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is knowledge leaves Africa in a passive position.

3. Dr. Ikiara's paper recommended strongly on ways to attract FDI but did not clearly show whether there would be benefits or losses.
4. On FDI, it was suggested that investors are entrepreneurs looking for maximum benefits. What is it they put back in return - and especially after flouting international trade standards? a participant asked.
5. Researchers were cautioned against blaming government for their failures all the time. It was suggested they need tools, and therefore co-operation with government to be able to carry out their work. Tools, it was argued, would determine the outcome of the effort. ATPS was called upon to put together research teams that are action-oriented.
6. On the hiatus between scientists and government, it was argued that the discussion would take participants back to the 1980s when ATPS worked only with engineers. It was argued the organization had opened up to other professionals and should now probably think of bringing on board international public relations experts in order to carry out its mandate effectively.
7. Africa looked perpetually impotent as if there was little, if anything, that it could do. It was proposed that *something* be incorporated in school curricula so that children can begin learning science and technology right from youth. It was argued that leaving the task to politicians would be defeatist as they worried more about their political survival. Dr. Osita promised to bring in policy-makers to ATPS discussions of science and technology.

6. EMMANUEL ANIEBONAM

THE FUTURE GENERATION OF ICT EXPERTS: CAN AFRICA LEAD THE WAY?

The presenter gave a detailed description of the status of ICT development in Africa. The data were discomfoting, demonstrating the grievous unpreparedness of Africa in ICT use and development and the many years the continent would take to bridge the digital divide between itself and the North if it maintained the current pace of embracing science and technology.

The speaker also gave startling data on the sheer number of Nigerian experts working in high-profile jobs in the US alone when it was still thought Africa had no experts. For example, there are some 1,800 Nigerian professors teaching in US universities. There are many others working as doctors, information technology (IT) specialists, engineers and innovators.

Prof. Aniebonam told the gathering that the often-used top-bottom approach to ICT development does not work ; a bottom-up approach works. He said in the past 25 years, Nigeria had spent US\$ 70 billion on development but the money had only gone to help other countries. The building of alliances, partnerships, clustering and networking would help reverse the trend.

The presenter spoke of his organization's efforts to build a Nigerian IT World, expected to have been launched by December 15, 2002. The organization would help Nigerians marshal their resources in rebuilding an IT skills bank, Internet cafes and education. He said the Nigerian IT Professionals in the Americas aim to bridge the digital divide between Africa and the North. The organization takes off from the premise that "until lions raise their own historians, the story of the hunt will always glorify the hunter". It further seeks to create an environment for IT professionals of Nigerian and African descent to network, collaborate in, and execute entrepreneurship opportunities in information technology as essential means for nation building and individual career development.

7. WARIGIA BOWMAN

CONNECTING RURAL COMMUNITIES: LESSONS ABOUT PUBLIC ACCESS FROM THE AMERICAN EXPERIENCE

The presenter, Ms. Warigia Bowman, sought to bring out the best practices in public connectivity by describing the impact of community technology centres (CTCs) in the United States. She sought to bring American lessons to the African experience, drawing parallels between the US and Africa.



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She said the digital divide is closing within the US due in part to aggressive public funding and heroic non-profit efforts. CTCs are an excellent vehicle for closing the digital divide globally. CTCs are making a difference in the US in creating technological literacy, providing users of limited means with access to up to date equipment and software, improving job-related skills such as word-processing and the use of basic applications, and even creating social capital. CTCs are serving their target population of African-Americans, Latinos and native Americans, as well as rural and inner-city users, the unemployed and low-income users. Further, CTCs are meeting their planned objectives in a timely fashion, indicating that public funds are being used well. More research is sorely needed in the sustainability arena, she said. The presenter discussed the rural-urban ICT divide, showing why bridging it mattered. Bridging the gap would reduce isolation of large population, promote economic development and enhance education. She gave examples of farms that had used ICTs to improve production techniques.

The major themes for ICT development, she said, are infrastructure, public access, institutions, culture, and sustainability.

Ms. Bowman said one criticism that emerges is that CTCs are few in number and, therefore, can serve only a very limited population. Indeed, the Commerce Department study indicates that only 0.6 percent of users report getting access to technology at CTCs. Anthony Wilhelm observes that public access programmes as they currently exist are “dramatically under-funded and woefully insufficient to provide low-income and minority communities quality public access to advanced information technologies”. The cure to this weakness is likely more CTCs, not fewer. If Compaine and other conservative critics are right that the gap will close on its own eventually, CTCs and other public access points remain valuable as a stopgap measure as we wait for that transition to full diffusion to occur. If large corporations with profit motives dominate ICT development and the public and NGO sector do not intervene, rural areas may simply not get connected. Accordingly, literature to date indicates that stable or increased funding for CTCs, both in the United States and abroad, is warranted.

The debate about ensuring citizens a minimum public access to the Internet through CTCs, libraries and schools calls into question the very purpose of government as an agent of education, of information distribution, of equity and democracy. The decision of the US on universal service for the telephone in the 1930s was that all Americans were entitled to participate in the most advanced technology of the time: the information technology of that era. Policy-makers believed that society would be improved by creating a world-class information infrastructure. Furthermore, policy-makers acknowledged that the utility of the telephone system, in accordance with Metcalfe’s law, would be heightened if the greatest possible number of residents were connected to the network. The government, therefore, made a commitment, under the Communications Act of 1934, to subsidize this access for even the most rural of users. The question is whether we should make a similar decision regarding access to the Internet.

She said providing infrastructure, computers, training and broadband connectivity to public centres will reduce the digital divide by giving those who cannot afford a computer or Internet connection at home access to information technology. Equipping libraries, schools and CTCs with information technology will facilitate educational goals, ensuring that every student has the opportunity to develop computer literacy skills and has access to the full range of research materials and literature that they need to participate fully as an informed citizen. Ensuring that local jurisdictions, even those in remote local areas, have some level of connectivity will enhance democracy by increasing access to government services and forcing government to be more responsive.

The most important lesson for African policy-makers from the American experience with ICT is that institutions matter. New and innovative collaborations between universities and schools are promoting infrastructure for the poor. Governments can be effective agents for technology diffusion where the market has failed. However, “good governance” is key. Industry capture of the regulatory process can stop development in its tracks like in many parts of the US, Ms Bowman said.

For new, cheaper technologies to promote connectivity, open-minded regulatory regimes that allow municipalities and NGOs to compete with the private sector at low costs are necessary. Cable operators and telecommunications providers in the US are beginning to oppose municipally provided



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infrastructure as well as non-profit provided infrastructure using wireless fidelity technology. In other words, the challenge facing the rural US and Africa is not just a technological challenge, not just a funding challenge, but a regulatory challenge. If we can keep these options open, the evidence from the US indicates that CTCs seem to be helping to develop a learning society, an empowered workforce, and better democracy. Africa needs public access, Bowman declared.

DISCUSSION OF ANIEBONAM'S AND BOWMAN'S PRESENTATIONS

DISCUSSION BY PROF G.O. AJAYI

The discussant for Ms. Bowman's presentation was Prof. Gabriel O. Ajayi who said the digital divide in Africa is everywhere - between Africa and Europe, Africa and economic development, among other areas. He said 60-70 percent of Africa's population live in rural areas and there was, therefore, need to re-orient priorities and give greater attention to that segment of the population.

IT, he said, had provided a major distinction between nations based not on natural resource, military or numerical strength but on access. Africa, he said, was the most affected by the digital divide. Industrialized countries with 15 percent of the world population had 88 percent of the world's Internet users. If the gap between Africa and the North continues to widen, he said, a new cycle of poverty, underdevelopment and attendant problems would be ushered in.

Bridging the digital divide requires human resource capacity building, institutional capacity building and infrastructure capacity building. The 21st Century had heralded a knowledge-driven global economy and human capital had become an expensive commodity. Still, there was an acute shortage of IT professionals in the world, especially in the developed countries. Globally, the IT industry was expanding at twice the rate of the world economy. He added that the IT industry in the US accounts for one-third of the US economic growth and employs 74 million people at wages of more than 80 percent of the average private sector wages.

DISCUSSION BY PARTICIPANTS

Issues were raised on the presentations as follows:

1. *To Prof. Aniebonam:* You see the need to educate for development. That we should aim at universities. Should focus only be at universities? Shall we not be making a serious mistake if we do not catch the young early enough?
2. A participant expressed the view that discussions always hinge on the *use* and not production of technology.
3. *To Aniebonam:* What are your plans for primary schools, teacher training colleges and polytechnics?
4. A participant said there were learners in Africa looking for mentors but the environment was not conducive for that form of development. What should be done?
5. What are the plans for rural areas where most people in Africa live?
6. A number of participants told Prof. Aniebonam and other experts to go back to their countries and work there. That's where your services are needed. That's how you can make an impact, the participants told African experts based in US and other countries in the North.
7. Some participants expressed the view that some of the proposals made were theoretical. They argued it was difficult, probably impossible, without a sound road infrastructure and telephone service.
8. Prof. Aniebonam was reminded that his presentations showed a large number of highly educated Nigerian and African experts worked in the North, especially in the US. If you still want to build cadres of human experts, how do you do that by remote control? And will you not be building capacity for already capacity-endowed countries?



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RESPONSES TO ISSUES RAISED BY PARTICIPANTS

1. Participants were told the issue should be how resources are harnessed not where the expert is based or working from. An environment conducive to foreign investments and to the working of experts should be created in African countries. For Korea to develop, Koreans working outside their country were given incentives to work and invest back in their country. Africans should do the same by encouraging Africans working in other countries to come back and work on the continent.
2. Dr. Osita Ogbu sought for moderation of the debate on the brain drain, arguing for a need to be realistic and practical. Bringing back all Africans was not possible, not even wise, he said. He used the example of the Fédération Internationale de Football Association (FIFA), arguing that what Africa needed to do was to “Fifarize” its activities and concerns - in the same way FIFA allows its players to go and play for their national teams. Patriotism, he argued, drives such players back home to play for their teams. “Can’t we have those teaching at the George Washington University teach at our own universities?” he posed. If such links and a conducive environment were established, he reasoned, experts would even return to their countries of their own volition. Korea and other countries, he said, had used the method effectively.
3. Prof. G.O. Ajayi added that whenever FIFA took on a player they ordinarily paid his country. In addition, he said, experts outside Africa could be made use of through the Internet. However, the network must be available for that to happen.
4. Ms. Bowman urged Africa to give priority to the training of girls in ICTs.
5. Prof. Aniebonam said his organization was on IT training in schools. Nigerian IT professionals, he said, were already working with those interested from other parts of Africa. A memorandum for the launch of Teachers Without Borders had been developed. Teachers at all levels would be involved. About 100 community training centres are expected to have opened in the year 2003 in Nigeria alone. The Nigerian IT Professionals had also established links with the Aids Relief Fund and other interested groups. The IT professionals would work with ATPS to help other countries.

He further said his organization was working with other stakeholders to promote professional mentorship.

And on why he would not wage the professional and IT war from Nigeria, the speaker said he had lived in the US for 25 years but considered his home as Anambra, a Nigerian state. He argued he probably visited his rural home from the US more often than some Nigerians who lived in Lagos.

8. C. P. E. OMALIKO

INDIGENOUS KNOWLEDGE AND GLOBAL INCLUSION: RECENT ADVANCES IN AFRICA'S BIOPHARMACY RESEARCH AND APPLICATION

The presenter said indigenous knowledge (IK) otherwise known as traditional knowledge (TK) is a body of knowledge based on facts, information, understanding and skills that have been in existence and emanates from a group of people from a particular place, being the natural abode of the inhabitants. The knowledge encompasses the people’s way of life that is well reflected in their cultural, spiritual beliefs, etc. Indigenous knowledge can be seen as a “tool” or instrument to promote culturally sensitive or appropriate forms of development. This is particularly clear in environment and natural resource management, where indigenous knowledge is increasingly recognized as key to sustainable development.

Globalization of a body of knowledge, he said, essentially entails inclusion of facts, information, understanding and skills into the global arena. Many pharmaceutical companies are identifying traditional medicines and patenting them but not giving back anything to the indigenous communities. There are 27 indigenous knowledge resource centres in the world with about 11 of them in Africa.



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The presenter said about 300 million indigenous people live in over 70 countries. These groups of people have been socially discriminated against and culturally marginalized by the process of economic modernization and development. It is only recently that policy-makers, development planners, scientists and the public at large are becoming increasingly aware of the important role IK has to play in the promotion of sustainable development.

Whereas ethno-botany deals with how indigenous people linguistically encode plants for their use in agricultural development, health care delivery and medicine, ethno-pharmacology is more concerned with the use of plants by indigenous people for drugs development or herbal treatment.

He said bio-pharmacy is concerned with the production of drugs from plants, micro-organisms and animals. It owes its discovery, existence and development to ethno-botany. While about 50 percent of natural products from these plant resources, micro-organisms and animals are in use today in pharmaceutical industries, upto 25 percent of the drugs prescribed are related directly or indirectly to naturally occurring substances mostly of plant origin. The substances come from about 90 plant species alone. Of more than 130 clinically useful major prescription drugs that are derived from higher plants, over 70 percent of them came to the attention of pharmaceutical companies because of their use in traditional systems.

He further discussed efforts on the continent to co-ordinate research in natural product development. There also have been regional efforts. Such efforts have been steered through:

- Nigerian Natural Medicine Development Agency (NNMDA) in Nigeria
- Natural Products Network for Eastern and Central Africa (NAPRECA) in East Africa. NAPRECA is an active network, which provides an excellent regular review of phyto-chemical studies of African plant species based on current literature
- Indigenous Plants Use Forum (IPUF) in South Africa
- African Ethno-botany Network established to stimulate a co-ordinated approach to research to avoid research repetition, encourage dissemination of information, and stimulate publication of research in international journals.

However, these initiatives did not include the extra stages leading to full drug development.

He said a remarkable issue in ethno-botanical research is the continuity in use of the few key plant species across time or several medicinal plants that cover large areas of Africa. Several of these species, he said, have made the transition from wild species to crop plants.

He gave an inventory of pharmacological research developments in Africa, particularly in Nigeria, Kenya, Uganda, Tanzania and South Africa. The presentation also observed that bio-pharmaceutical research and development in Africa is desperately in need of strong institutional encouragement by way of special grants, infrastructural encouragement, private sector participation in drug discovery areas with proven cases of established natural drug efficacy, and further progress in bio-pharmaceutical research and development.

Prof. Omaliko also demonstrated the use of an assortment of traditional drugs. He discussed their nature, texture, packaging and use, explaining how their often bulky and non-refined state made them difficult to use and to compete with modern medicines.

DISCUSSION ON OMALIKO'S PRESENTATION

The discussant was Prof. Joseph Massaquoi. He said from the outset that a prerequisite for Africa in the globalization process was to have something on the table. He said Africa needed to make a niche for itself, pointing out that this should not be difficult as the region had numerous geographical advantages. There are also advantages emanating from Africa's rich natural resource, he said. In addition, from Prof. Massaquoi said, there is in Africa a dearth of indigenous knowledge, particularly on biodiversity. He pointed out that the paper had clearly shown the history of indigenous knowledge in Africa but pointed out that too much attention was devoted to documentation. He urged for a move towards commercialization. Still, he argued, there was need to address property rights, among other issues. Dealing with issues revolving around indigenous knowledge, he said, was complicated



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by its systems of rights protection: property rights in the realm of indigenous knowledge include claims, for example, that discovery of some drug happened in a dream or was passed over by a grandparent.

He challenged participants to find ways of creating interaction between modern and indigenous knowledge.

DISCUSSION OF PRESENTATION BY PARTICIPANTS

1. Lynn Mytelka said Nigeria had demonstrated a capacity to carry out research in biopharmacology but wondered how standardization of indigenous drugs would be done.
2. It was pointed out that there was a missing link that should lead to an all-inclusive partnership necessary in making a headstart in the tapping of indigenous knowledge. Such a partnership should bring together biopharmacy institutions, advertisers, banks, marketing institutions and politicians, among other stakeholders.
3. It was suggested it might be a good idea to start “small”: produce an efficacious drug for a small community in a manner that will not involve multinationals or large sums of money borrowed from commercial banks.
4. Some participants proposed that the advocacy strategy be incorporated in the work of scientists in order to promote result of their work. “Time has come when scientists must begin to see things beyond themselves,” a participant declared.
5. A participant contended that most Africans resort to herbal medicine whenever they are unwell. He argued the problem with herbal medicine was not efficacy as was widely touted but dosage and administration. He said some herbal practitioners blended their drugs with liquor, probably causing more problems for the patient.
6. It was observed that majority of Nigerians use traditional medicine. New stores for traditional medicine were opening every other day and patenting was going on. The fundamental issue now was that of quality control. The issue was considered important considering that most graduates going into herbal medicine are marketers rather than traditional healers.
7. It was proposed that since the material base for traditional medicine was already in existence, the next step should be to create linkages with engineers to deal with problems of packaging and quality control.
8. Prof. Norah Olembo raised the issue of property rights, saying it was a major problem in Africa. She sought for a solution to the problem.

PROFESSOR OMALIKO’S RESPONSE

In response to some of the issues raised, Prof. Omaliko made the following remarks:

1. Research institutions carry out work up to the laboratory level but more could be done to achieve better results.
2. Researchers studying indigenous knowledge are getting in touch with entrepreneurs to address a major missing link. The idea is to establish links with entrepreneurs with a good track record.
3. Much work has been done in advocacy and most people already patronize herbal medicine. However, in most stores, one finds herbal drugs from China. Africa should have its own drugs.
4. Contractual agreements are signed enabling an innovator to enjoy the benefits of innovation.
5. Action was being developed to protect innovators and inventors against piracy and to protect their intellectual rights. However, action must start with the scientists.
6. Control measures are in place. For example, in Nigeria traditional healers are not allowed to advertise their work on the mass media.
7. More engineers will be deployed to help the field of herbal medicinal practice. As the process unfolds, more professionals will come in as partners.



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9. JOHN MUGABE

NEW FORMS OF PARTNERSHIP FOR AFRICA'S ENTRY INTO THE BIOTECHNOLOGY REVOLUTION

The presenter stressed the need to establish partnerships, networks and links that would enable the continent to collectively steer the course towards a biotechnology revolution. Globalization, he demonstrated, required regional co-operation if success by individual countries was to be realized.

The presenter also discussed the need to develop intellectual property rights regimes, which would protect inventions and innovations. The setting up of such regimes entails enacting legislation to protect intellectual property. Equally important, he said, is the establishment of biosafety regimes that would facilitate protection of biodiversity and regulate its exploitation.

Dr. Mugabe said for Africa to achieve its goals towards a biotechnology revolution, science and technology infrastructures must be set up to carry out the mandate. There also would be need for the establishment of local biotechnology companies. Thorough and exhaustive research and processing of certain foods, particularly genetically modified foods, would be important in order to restore people's confidence in them.

DISCUSSION OF MUGABE'S PRESENTATION

The discussant for the paper was Prof. Oliver Saasa who noted the presenter's concern about the need to create partnerships if Africa is to find entry into the biotechnology revolution. He said participants should think about the lessons to be learnt from the local, regional and international levels on the issues of property rights and biosafety regimes. He asked the question: Who is in control of property rights? It is important that partnerships are developed in the developing countries to address the issues.

Another question to be asked is: What institutions are available to deal with these issues at the regional level? He said SADC and ECOWAS, among others exist. Despite their existence, however, regional initiatives in this direction do not enjoy requisite support or resources for any meaningful research. The regional leadership, he said, is too weak to facilitate the way forward. Africa, for example, does not have sufficient legislation to regulate genetically modified foods.

Prof. Saasa said there was an even bigger problem at the national level. Science and technology policies are required at that level. Equally important are research and development efforts. "Human resource is still very key in Africa. Africa needs to do more," Prof. Saasa said.

DISCUSSION BY PARTICIPANTS

1. A participant said biotechnology "baffles" most people. He proposed that the discipline is taught from the high school level. This way Africa would have a stronger entry point into the biotechnology arena.
2. It was suggested clinical trials be carried out on humans to test the correct dosage of indigenous drugs and also establish their toxicity. There is good reason for this as many people are turning to traditional drugs. It is important to show indications and contra-indications of the drugs.

RESPONSE BY MUGABE

1. Many countries in Africa are debating legislations to regulate biotechnology. Such countries, particularly those that have developed specific policies, are also involved in research and development in biotechnology.
2. In most African countries the expertise that is available is hardly utilized. Ironically, most people are more worried about the brain drain.



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10. BASHORUN J.K. RANDLE

SCIENCE AND TECHNOLOGY AND GLOBALIZATION: PERSPECTIVE FROM THE PRIVATE SECTOR

The paper on science and technology and globalization from the perspective of the private was delivered by Bashorun J.K. Randle, the chief executive of Nigeria's KPMG. The luncheon presentation was wide-ranging and eclectic, approaching the issues of science and technology from a multidisciplinary position and attempting to place them on a global context.

Science and technology knows no geographical boundaries, he said, adding the discipline was globalizing long before the private sector. Science had taught the world, he pointed out, that the most important thing was love for fellow human beings. What Thomas did with electricity, he explained, did not benefit the scientist alone but mankind irrespective of their race, creed, philosophy or geographical location. Science had brought achievements in health, for example, in the development of vaccines and antibiotics, in travel, in communication and in many other ways. The inventor of Viagra and Bill Gates are not worried about who uses their products. Neil Armstrong's memorable words when he stepped on the moon, "one small step for man but a giant stride for mankind" still resonate, showing a major breakthrough for science to the benefit of mankind.

Randle further gave the 10 ten health risks as identified by the World Health Organization. The risks are underweight, unsafe sex, high blood pressure, smoking and taking of tobacco, alcohol, unsafe water and sanitation cholesterol, indoor smoke, iron deficiency, and overweight. He brought out the irony in the Federal Government of Nigeria's accommodation of a cigarette company that planned to invest millions of dollars in the tobacco industry in the country.

Randle also cited various scientific research efforts that would improve the health and well being of man. He also noted the progress being made in agriculture as well as in the US Silicon Valley.

The presenter called for strengthening of the link between science and technology. Such strengthening, he proposed, would be better done by universities. For universities to play a successful role on the scientific front, he said, adequate funding was a must. The speaker demonstrated that successful universities had requisite funding, enabling them to support research efforts.

Randle urged participants to draw inspiration from the mission statement of Metronic, an American company whose chief executive officer, Art Collins, had won adulation by enunciating clear goals aiming at alleviation of pain, preservation of the environment, and extension of life. The speaker proposed additional of a fourth goal – happiness to people.



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SPECIAL MINISTERIAL AND POLICY FORUM ON SCIENCE AND TECHNOLOGY AND AFRICA'S GLOBAL INCLUSION

A Special Ministerial Meeting and Policy Forum on Science and Technology and Africa's Global Inclusion was held on Tuesday afternoon when participants broke up into groups to discuss research proposals. The theme of the forum was "Marking the agenda for the future." It was chaired by Hon. Prof. Turner T. Isoun, Nigeria's Federal Minister for Science and Technology. Dr. Osita Ogbu was the forum's moderator. The agenda of the forum was:

1. Global Governance and Science and Technology
 - Foreign Direct Investment
 - Intellectual Property Rights
 - Institutions
2. National Level Experiences and Responses
 - Capacity Building
 - Institutions
 - Policies and Incentives
3. Common Agenda
 - Research
 - Capacity Building
 - Institutional Co-ordination
 - South-South Co-operation
 - Concluding Remarks

Those present at the forum were:

Dr Tonipre Apiribo
Bayelsa State Government
Nigeria

Amor Nedjai
Algeria Embassy, Abuja

Prof Robert A. Boroffice
National Space Research and
Development Agency (NASRBA) FMST
Nigeria

Prof G. O. Ajayi
National Information Technology
Development Agency, FMST Nigeria

Alhaji Abubakar Abdullahi
Raw Materials Research and
Development Council, FMST Nigeria

Ayodele Omowumi
Federal Ministry of Science and
Technology, Abuja, Nigeria

Eng. M. T. Ahmed

Federal Ministry of Science and
Technology, Abuja, Nigeria

Dr A. Tunji Bolade

Federal Ministry of Science and
Technology, Abuja, Nigeria

B. A. Adegbesan

Raw Materials Research and
Development Council, Abuja, Nigeria

R. N. Ihenacho

Raw Materials Research and
Development Council, Nigeria

Dr E. O. Denemu

Federal Ministry of Science and
Technology, Abuja, Nigeria

L. Ajunwon

National Agency for Science and
Engineering Infrastructure (NASeni)
FMST Abuja, Nigeria

Prof Manny Aniebonam

George Washington University,
SBPM 2115 G St. NW Washington DC

Prof Melvin Ayogu

School of Economics,
University of Cape Town,
South Africa

Sylvester Ndeso Atanga

Faculty of Health Sciences,
University of Buea
Cameroon

Prof Akpan H. Ekpo

Vice-Chancellor,
University of Iyo,
Akwa Ioum State, Nigeria

Rob Collins Ughasoro

Federal Ministry of Science and
Technology, Abuja, Nigeria

J. G. M. Massaquoi

UNESCO, Nairobi, Kenya

Prof Oliver S. Saasa

Institute of Economic and
Social Research,
University of Zambia,

Magayu K. Magayu

University of Nairobi,
School of Journalism
Nairobi, Kenya

Dr M. H. Khalil Timamy

University of Nairobi,
Department of Economics,
Nairobi, Kenya

Prince Ademola F. Adenuga

Federal Ministry of Science and
Technology, Abuja, Nigeria

Dr A. J. Coker

Sheda Science and Technology
Complex, Abuja
Nigeria

Dr S. S. Achi

Federal College of Chemical and
Leather Technology, Zaria
Nigeria

Prof Awele Maduemezia

Ibadan University
Nigeria

Prof Norah K. Olembo

Kenya Industrial Property Institute,
Ministry of Trade and Industry,
Nairobi, Kenya

Prof Banji Oyelaran-Oyeyinka

United Nations University,
Institute for New Technologies,
The Netherlands

Prof C.P.E. Omaliko

National Biotechnology
Development Agency,
Abuja, Nigeria

Prof Haraoubia Rachid

Ministre de L'enseignement Supellent
et de la recherch e Scientifique Universite
Algeria



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Prof Ben Zaghou Benali

Recteur de l'Université des Sciences
et de la Technologie
Algeria

Dr Bachiri Messaoud

Counseiller Protocole de le Ministre Nsrs
Algeria

OPENING OF FORUM

Dr. Ogbu called the forum to order and explained it was a brainstorming session intended to find out how science and technology could be used to address some of the problems that the continent faced.

The chairman acknowledged the presence of the ministers in attendance. He expressed optimism that the forum was the "beginning of a long journey for Africa" in science and technology.

The Algerian Minister thanked organizers for inviting his team to participate in the forum. Such fora can greatly benefit Africans, he said, as they helped to find ways in which Africa's modest resources could be pooled and thus create concerted efforts. It was possible, he said, to bring together scientists and technologists to deal with the issues raised at the conference. Algeria had been able to make progress in this direction by cooperating with other countries. He said progress on the science and technology front would be difficult to achieve until an environment is created enabling scientists and researchers to bring out their best potential. Africa needed to create synergy to support such efforts, he said. He thanked Nigeria for bringing scientists together to address problems affecting Africa.

The representative from Mali said his country was large but had scarce resources. A basis for the development of his country had been established but not much had been achieved, particularly in science and technology. There was particular need for education in Mali, he said, and some African countries were supportive, especially in improving the country's A-level students. Algeria was among the countries supporting Mali to improve her education. Support came in form of scholarships. He said his country was ready to pursue developments in science and technology.

GLOBAL GOVERNANCE AND SCIENCE AND TECHNOLOGY

1. Dr. John Mugabe, the Executive Secretary, African Commission on Science and Technology, told the forum most Africa countries incurred certain obligations when they became members of WTO. WTO agreements, trade-related aspects of intellectual property rights (TRIPS) for example, take away what has already been offered by biotechnology agreements. He called for a harmonization of legal regimes. Africa requires to adopt a common stand through NEPAD to ensure the region's interests are safeguarded.

Dr. Mugabe said the other area calling for attention revolves around transfer of technology to developing countries. He said evidence shows FDI was not a carrier of new technologies and was, therefore, not transferring technology to Africa. He said NEPAD was showing that FDI is "not only not flowing; it does not come with science and technology when it does."

2. Prof. Oliver Saasa raised the issue of negotiation, arguing that for Africa to gain recognition and have its agenda considered at the global level the continent required to develop requisite negotiations. He said Africa must face the challenge of developing capacity to negotiate for the continent at the regional and global levels. He said academics and experts had failed to speak in a language that showed others what their disciplines were, their potential and expertise. Even when scientists raised issues, he said, they were not packaged in a manner that was easy to understand.

Prof. Aniebonam said those in the diaspora like him wished to see the creation of synergy that would enable Africa to address its problems. He called for an Africa-wide perspective to the issues being addressed and expressed hope that resources would be pooled for the benefit of all. "We hope contacts will continue... that the message will go across Africa... that professionals and experts will support the initiative."

3. A representative from the Federal Government proposed that each nation works out its strength



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in science and technology. “Each country should be able to select what they want,” he said.

4. Prof. Olembo, the Chairman of the ATPS Board, underlined the importance of intellectual property rights, particularly in international trade. She said creation of awareness was necessary “to bring people on board.” She stressed the need to demystify intellectual property rights issues. “We need to encourage utilization of science and technology to bring wealth to Africa and add value to protect IPRS.”
5. The Algerian delegate demanded that Africa takes stand on the issues at hand. The continent still faced serious problems. A major one, he said, was reflected in university systems and education. The challenge was that of reconciling development to research and training. He said strategizing on the way forward was crucial.
6. In response, Prof. Isoun said universities were very few in Africa in the 1960s but did extremely well, insisting on very high standards. After independence, there was an increase in enrolment and standards went down. “The system collapsed. We lost the backbone to insist on standards, on who became a university student, a professor or who got awarded what...” Prof. Isoun said African universities lost prestige and revenue as a consequence. “The question is how to restore the credibility and quality of our graduates. How do you ensure quality,” he asked.
7. But Prof. Awele Maduemezie said it was just as well the system collapsed, arguing the colonial system of education Africa inherited was based on certificates. Africa had not reworked a new philosophy, he argued. “We should ask ourselves how we teach so that our graduates do things the best way. This will require a lot of thinking,” the physics Professor said. “Appropriate curricula will be useful.”
8. A delegate from Cameroon said Africa had minimum human resource. He said there has been some South-South co-operation to be proud of. He said an enabling environment was important for science and technology development. He gave the example of a “very educated” past president who set up very important institutions and occasioned a green revolution. But when the president died, the institutions and his projects also died. “We need to make an inventory by finding who we have in our countries and what they can do.”
9. The Algerian Minister said his country had carried out research through research centres and universities. There are some four-research organizations – with autonomy. The country, he said, has 20 laboratories for technical and social sciences attached to different ministries. The budgets for the organizations are high, and financed by government. In the year 2002, one percent of Algeria’s GDP was devoted to research and about 34,000 students are undergoing training. He said the country cooperates with others – among them France, Britain and the US. He called on research centres in Africa to work together “for added value,” saying the more would facilitate synergy and support for each other.
10. Prof. Ajayi said it would be difficult to solve problems of education in African universities. It was possible in Africa, he said, to have a certificate but no knowledge. Yet, Africa was at a stage when knowledge was critical to have. He said some university graduates were unemployable. He gave the example of India which has turned its education around saying the country had the highest output of English-speaking graduates after the US. India’s graduates, he said, could work in the US Silicon Valley, owing to their standard of education. “Why can’t we do the same?” he asked.



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SUMMARY OF DISCUSSIONS

Dr. Osita Ogbu made a summary of highlights of the issues raised in the forum as follows:

1. When signing international conventions, treaties or agreements, every effort must be made to ensure they benefit Africa.
2. Conventions, agreements and treaties on international governance often confuse Africa, as they are invariably contradictory. What one agreement appears to have given to Africa is taken away by a different agreement.
3. The quality of education and training in Africa is far below expectations as the standards have gone down drastically. African educational and training institutions must be re-examined with a

view to reworking their curricula to ensure quality and relevance.

4. NEPAD should be a critical platform from which Africa can take off. It would be useful in terms of concentration of regional ideas and efforts, and in terms of co-ordination.
5. African countries should diversify their areas of co-operation in research by transcending the borders of their traditional friends and reaching out to others. They should also go beyond their regional borders.

NATIONAL LEVEL EXPERIENCES AND RESPONSES

1. Prof. Melvin Ayogu, introducing the agenda item, said in the move towards global governance nations were being asked to give up their sovereignty. WTO, for example, became notorious when the IPRS issue was at centre-stage. The question to be asked then is what African leaders are doing to solve the problem. He said in global governance a problem was created, re-located and an institution established to deal with it. To face the challenge, Prof. Ayogu said, politics must be made a necessary addition to the issue.
2. A participant referred the forum to what Prof. Isoun had said about falling standards and asked whether what was happening today could have happened 30 years ago. He attributed today's falling standards of education to free learning. He said those who do not pay for education do not appreciate its value. Students of 30 years ago, he said, paid for their tuition. "The issue of policy is important," he said, "lets go back and build schools and maintain quality... NEPAD is just another game."
3. Another delegate said in Nigeria, quality moves from federal to state to local government and then to the community. When people talk of NEPAD, he said, no one knows what it is. Decisions, must be made, on how much money must go to science and technology. Local governments and other governance organs must enact policies to deal with the issues, he proposed.
4. Dr. Mohamed Khalil of the University of Nairobi proposed the development of national technological capabilities for Africa. He proposed that no project should be allowed to start without the involvement of technological experts in those countries. He said capabilities were built in Africa but not utilized.
5. Prof. Massaquoi said Africa had the capacity to train in science and technology but did little.
6. A delegate expressed the view that policies on the issues being discussed were not bad. The problem was with implementation, he said.

SUMMARY ON NATIONAL LEVEL EXPERIENCES

Dr. Osita Ogbu gave the following summary:

1. The forum had agreed that in looking at national responses Africa must be certain of what it is getting in return.
2. There is need to create awareness to ensure NEPAD is known as widely as possible in Africa.
3. At all levels of international negotiations, Africa must be represented by their best.
4. Science and technology is not just a government issue; it is an issue for everyone – provinces, states, local governments, and the village.
5. It is not enough to build capability; it is more important to use and retain it.
6. Leaders in Africa should drive the development process and especially the science and technology process. Market forces do not always do it.

DISCUSSION ON COMMON AGENDA ITEM

Most of the issues to be discussed under this item had already been raised and discussed under the first two agendas.

However, Prof. Isoun concluded the session by noting that the modern academic had a "new definition. A university professor also owns a shop in town."

CONCLUSION OF DISCUSSION ON POLICY FORUM

Dr. Osita Ogbu made the concluding remarks of the session. He said ATPS would endeavour to bring in more decision-makers to such fora and conferences in the future. He noted that both the Algerian and Nigerian ministers at the forum were professors, an indication of the way forward. He said this was one way towards bridging the gap and called on all to pass on the message to others. A full ministerial meeting with key decision-makers would be held as soon as possible. Dr. Osita said the agenda were common; they should have a purpose and be community-driven. All, he said, should think of the concept of comparative advantage: You may not be able to produce a glass today but be able to produce a better one five years later.

Prof. Isoun commended ATPS for “doing very well. You can see the quality that has come out of the partnership.” He said what needed to be done next was to use the model created by ATPS and identify key people in government to work with.



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3.0 METHODOLOGY WORKSHOP

1. DR. KHALIL-TIMAMY MOHAMED

PURSUING TECHNOLOGY POLICY RESEARCH IN SUB-SAHARAN AFRICA: REFLECTIONS ON DIMENSIONS, APPLICATIONS AND IMPLICATION OF A METHODOLOGICAL FRAMEWORK

The presenter said technology deals with issues of know-how and science with issues of know-why. He defined technology as knowledge – knowledge of some application and gave examples of products of technology as pens, bulbs and machines. He said science was influenced by the technological developments and brought the four main parts of technology: technoware, infoware, orgaware and humanware. The four, he said, influence the performance of some equipment.

Dr. Khalil discussed three important technological capabilities: knowledge of production (production capability), investment capability (ability and knowledge), and innovation capability (skills to improve and modify existing capability.)

Further he described the concept of technical change as minor changes – as changes occurring within a production technique. Technological change on the other hand is change in the total sum of knowledge. The presenter said in technological policy research one should look for technological change indicators – e.g. the economy and sub-contracting.

The presenter said a methodological approach was necessary to find factors that influence the rate and direction of technological change and how innovations are diffused or acquired. It is also necessary to understand the mechanisms and policies that would stimulate viable technological processes.

Dr. Khalil explored the issues in the context of technology policy research for interested parties in sub-Saharan Africa. He also provided background information on the nature of technology policy and situates the discussion within the purview of methodological sensibilities, epistemological demands and scientific objectivity. Further, he discussed the evolution of technology policy research by examining, first, the profound links that exist between conceptual categories and the configurations of methodological devices, and second, how changes in research focus have over time led to non-trivial methodological shifts.

The presenter identified priorities and the potential directions of future technology policy research, placing a special premium on the imperative of relevance. He concluded by noting that sustainable development has posed profound research and technology policy challenges to African researchers; challenges that are bound to influence the internal aspects of methodological devices.

2. MAGAYU K. MAGAYU

THE CHALLENGES OF PUBLISHING RESEARCH: TOWARDS BETTER PRESENTATION OF PAPERS

The presenter took participants through some of the most common mistakes in writing research reports. Drawing from his experience as editor of ATPS publications, he demonstrated strengths as well as weaknesses in the reports submitted to the network.

Some of the common mistakes dealt with related to spelling and the writing of titles for the papers, names and designations of people, places or organizations. The presenter also addressed problems relating to the use of punctuation marks, the full stop, the comma, the semi-colon and the full colon. Also addressed were problems with the use of brackets, the question mark and the stroke. The presenter also demonstrated proper use of the dash and hyphen and the ellipsis. Grammatical as well as conventional use of the upper and lower cases in writing was also taught. The more accepted use of abbreviations and acronyms was also explained, as well as the use of 'e.g.' and 'etc.' He also demonstrated proper use of a stem and a list of items under the stem, and discussed ways in which repetition, redundancy and tautology could ruin an otherwise good paper.

The presenter also took participants through the conventional use of words and figures in writing and the style researchers should adopt when writing titles, heads and sub-heads for their papers.

Also discussed was the more acceptable style of giving references and making citations. Problems to do with figures and tables in research output presentations were also raised, as was the use of tired words and expressions.

Mr. Magayu emphasized the need on the part of researchers to adhere to the rules of grammar when writing their reports in order to enhance comprehension of their work.

Due to shortage of time, it was not possible to take participants through a designed writing and editing process.

DISCUSSION OF PRESENTATION BY PARTICIPANTS

1. Participant after participant commended ATPS for organizing and facilitating the training in writing skills. They said such sessions should be held more regularly as part of capacity building and to enhance the quality of ATPS work.
2. A Tanzanian researcher described the writing skills session as "God-send," saying it had helped her overcome a lot of problems she had been unable to deal with in her writing. She called on the presenter to prepare answers for some of the issues he did not deal with in the presentation and offer the answers at a future presentation. The researcher said they would 'treasure' the paper to act as their guide in writing.
3. Majority of participants complained that their thirst for the writing skills session was not quenched as very little time was given to it and the presenter was forced to rush through his presentation in a matter of minutes. They called for adequate time for such presentations.

3. BANJI OYELARAN OYEYINKA

RESEARCH METHODOLOGY

Prof. Oyeyinka made a presentation on research methodology. He began by showing how to do a checklist of attributes of a good research topic and proceeded to demonstrate how to phrase research questions as research objectives. Further, he showed participants the way to run a checklist to evaluate the literature review and also the relevance of the literature.

The presenter gave a research outline summarizing the nature of research, the research process, the research proposal, the major research methods and the forms of research reporting. He then took participants through sophisticated and rigorous levels of the research process.



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He discussed a research proposal as the blueprint of the research project, its structure, and gave selected readings.

Prof. Oyeyinka discussed various research designs and data collection methods, looking first, at data objectives, data sources and later at secondary search and primary data gathering. He further examined the different measurement level and the characteristics of the four levels of measurement. He also appraised participants on questionnaire design, on sampling, on the sampling process and the classification of sampling methods.

He also looked at data analysis and interpretation and gave several software packages available for the task. Finally, he discussed the process of data analysis.

DISCUSSION OF OYEYINKA'S PRESENTATION

1. The presenter proposed that ATPS provides materials for literature review and research if individual researchers cannot access them.
2. It was proposed that cross-country research be stepped up. ATPS was requested to take up the matter and initiate the way forward.
3. It was agreed a common basis for policy work was needed. ATPS was asked to take-up the matter and develop a document that would guide the process.

4. UNESCO

SCIENCE AND TECHNOLOGY STATISTICS AND INDICATORS IN DEVELOPING COUNTRIES: PERSPECTIVE AND CHALLENGES

A representative from united nations educational, scientific and cultural organisation (UNESCO) made a presentation on an international review of science and technology statistics and indicators before distributing a questionnaire on science and technology priorities to be completed participants. He explained that the UNESCO Institute for Statistics (UIS) in cooperation with UNESCO's Division of Science Analysis and Policy and Regional Office for Science and Technology in Latin America and the Caribbean was launching an international consultation aimed at assessing policy information needs in science and technology among member states and the international community. This is to be done to identify priority areas for developing cross-national science and technology statistics and indicators and to assess the feasibility for member states to produce these statistics. The process will be used to define future programme priorities of the UNESCO Institute for Statistics in science and technology statistics.

The representative said the questionnaire was aimed essentially at the gathering information on the priority to be given to the policy issues across the world. It is intended primarily for science policy-makers and those either directly involved in or advising on science policies at national and international level.

The questionnaire seeks to identify the most important science and technology policy issue in each country.

The presenter gave a background paper summarizing the findings and issues identified during the first International Expert Meeting held from 2 to 5 April 2002 at the UNESCO Institute for Statistics in Montreal, Canada. It describes some perspectives on monitoring and measurement of scientific and technological activities and progress in the world. Based on experiences and inputs of experts from different regions and organizations, the paper highlights some key policy issues in science and technology in relation to existing statistical systems and methodological development among various country groups and networks. During the stage of direct consultation of member states and relevant institutions and experts across the world, the paper serves as a basic reference by providing background information and explanations to the questions raised in the consultation instrument.



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5. ERIC C. EBOH

SKILLS ACCUMULATION AND ENTREPRENEURSHIP AMONG NIGERIAN URBAN ARTISANS

The presenter looked at the potentialities of the informal sector, which he saw as easy routes to employment and income for the poor estimated at about 70 percent of the Nigerian population. They are socially cost effective in poverty reduction, economic growth and skill accumulation. They also have potential for stimulating competitiveness and domestic growth mobilisation. There are, however, policy dilemmas, which are reflected in the low skills profile, low productivity, poor capital accumulation, technological and enterprise stagnation and retarded enterprises growth.

The presenter said the informal sector contributed 37.8 percent of GDP in 1998 and employed more than 12 million people the same year. The need for the research arose out of the fact that there was poor understanding of artisans' skill accumulation and entrepreneurial and managerial outlook. There has also been insufficient explanation of the socio-economic and institutional factors that shape artisan' outlook and a lack of reliable bases for effective and sustainable strategies and inventions.

The presenter concluded by showing that the artisans enterprise problems were multidimensional. Education is fundamental in influencing their work, and there is poor capture by government schemes.



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5.0 CLOSURE OF CONFERENCE AND WORKSHOP

CONCLUDING REMARKS

A number of people made concluding remarks at the closure of the conference and workshop, highlighting the landmarks and summarizing the various issues raised:

1. Prof. Oliver Saasa noted the ATPS is a policy network and its success would in the longer term be measured against its achievements in the realm of policy. He said ATPS had recorded tremendous improvements in preparation and presentation of proposals, in research methodology and in research. What ATPS needed to do next was to move into implementation. In this regard, he said, ATPS Chapters must take action.
2. Prof. Massaquoi declared that ATPS had dispelled misgivings about its ability to be autonomous. Clear testimony to this is that the network initially had two donors but the number had risen to eight. "This means we are doing something good," he said, telling the scientists present that the quality of their work had enhanced the image and stature of ATPS. He said ATPS faced the challenge of having to absorb new members all the time but said new-comers should adopt the network's discipline and face the challenge of embracing policy studies as an area of study.
3. Prof. Lynn Mytelka said she looked forward to another exciting conference the following year.
4. Dr. Osita Ogbu called on participants to spend some time reviewing how to do things the next time round.

6.0 COMMENTS AND REVIEW BY PARTICIPANTS

Participants made the following comments:

1. Inadequate time was allocated to interesting presentations, particularly during the methodology workshop. In future, such sessions should be given enough time.
2. Forty-eight proposals were presented at the workshop. It was proposed that issues of methodology be dealt with at the national level, not at the annual conference.
3. Capacity building should be addressed at the national level, not at the conference.
4. ATPS received accolades for organizing what was seen as a most successful conference and workshop.
5. "It's the first conference of its kind for me," one female participant said. "I did not know what to expect. But I enjoyed it. It is good to have organizations, such as the ATPS searching for solutions to problems affecting Africa and the future of our youth."

OGBU'S RESPONSE TO SOME ISSUES

1. On methodology: ATPS plans to run methodology workshops at the regional level. It may not be economically sound to run them on a national level basis.
2. On proposals: Chapters should join in and support the financing of research. But they should not support projects that are not worthwhile.

7.0 REPORT FROM THE ATPS SECRETARIAT

Dr. Osita Ogbu presented a list of ATPS' achievements and initiatives:

1. ATPS had major contributions to the constitutional review effort in Kenya. The network had presented a document on science and technology policy that had significant impact. The organization was doing the same in Uganda.
2. ATPS had been working closely with the Nigerian government on bio-technology policy, among other areas, and positive results were expected.
3. ATPS was vibrant in Lesotho and significant policy initiatives were underway in the country.
4. ATPS was working well in Tanzania and its work had already been linked to Unesco, thus creating synergy.
5. ATPS was active in Ethiopia. The issue of the brain drain in the country was being examined.
6. ATPS was working with parliamentarians in Zimbabwe.
7. In many African countries, national co-ordinators had also been enjoined to taskforces working on policy issues in those countries.
8. A science writers' workshop under the auspices of ATPS had been held in Entebbe, Uganda.
9. ATPS had led in observance of OAU's Science Revival Day. The occasion had been held in Nairobi.
10. ATPS had set up a website that should afford those interested access to ATPS material, contacts and developments.
11. ATPS had more than 30 publications in the Working Paper Series and more than five publications in Special Paper Series.
12. ATPS financial supporters had increased from two to seven.



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VENUE FOR THE NEXT CONFERENCE AND WORKSHOP

After discussions and consultations, it was agreed that the 2003 conference and workshop be held in Lesotho and the 2004 conference and workshop be held in Sierra Leone.

8.0 REPORT FROM THE NATIONAL CO-ORDINATORS MEETING

Dr. Osita Ogbu, the Executive Director of ATPS, reported that a lot had been achieved in the past one year and that ATPS is finally getting due recognition. Noting that with recognition comes resources, he urged the co-ordinators not to rest because they are constantly being watched to see if the institution can stand by itself. He pointed out that relevance came from the activities of the national chapters.

Dr. Ogbu also expressed fear that the ATPS Secretariat is moving faster than the national chapters because the budget for the chapters is not adequately used. He advised the co-ordinators to increase the number of activities that they plan for each year. He urged them to allow other members of the steering committee to serve in different capacities to build national chapters in the spirit of comradeship. He noted that most chapters are at various stages of registration and acquisition of office space. The meeting agreed that registration of the chapters would also help in fund-raising at

the local level.

The Sierra Leone National Co-ordinator, Mr. Chris Squire, encouraged his colleagues to tap on national peculiarities when soliciting for funds. The need for permanent office space and staff for effective running of the national chapters was also debated. It was pointed out that some national chapters with co-ordinators who are staff members of local universities are fortunate to get office space in those institutions. Others need adequate funds to lease offices. Office equipment such as computers and e-mail facilities are also needed. Dr Ogbu suggested that post-graduate volunteer students could be utilized to man the offices.

Tanzania Chapter's National Co-ordinator called for networking among ATPS chapter members to shift focus from the Secretariat. The meeting also noted that various chapter members, including national co-ordinators, have been appointed to serve in various committees and boards because of their association with ATPS. The Lesotho Chapter reported the launching of a newsletter to act as a publicity document for the activities initiated by the chapter.



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APPENDIX 1: OPENING SPEECH

Opening Remarks by Prof. Turner T. Isoun, Honourable Minister of Science and Technology of the Federal Republic of Nigeria at the African Technology Policy Studies Network (ATPS)/Federal Ministry of Science and Technology (Nigeria) Conference/Workshop on “Science and Technology and Africa’s Global Inclusion”

I feel highly elated to be part of this unique gathering of key science and technology policy players drawn from government, academia, industry, international development agencies and other stakeholders from within and outside Africa. Also the theme of the collaborative International Conference and Workshop – “Science and Technology and Africa’s Global Inclusion” is quite apt considering Africa’s current economic predicament.

The pervasive role of science, engineering and technology in driving the economies of modern nations is no longer in doubt. Governments (at national, sub-regional, and regional levels) must therefore recognize that science and technology policies affect a myriad of development issues. Africa has not been forthcoming in developing good and implementable science and technology policies to ensure her global inclusion in the emerging globalized economy. I wish to thank ATPS for facilitating the partnership that has given birth to this conference and workshop being held here in Abuja, Nigeria.

I wish to draw our attention to some African realities on ground. Africa still suffers from economic stagnation and marginalization, low productivity, a worsening debt burden, low industrialization and de-industrialization, a phenomenal brain-drain, pervasive poverty, political instability, major unemployment and under-employment problems, among others. Furthermore, Africa, which is in dire need of science and technology intervention in solving her socio-economic and political problems, has low production levels of scientists, engineers and technologists which is now as low as 0.02 percent of the global total as against the functional minimum of 1.5 percent (i.e. only 1.3 percent of the functional minimum of the technical manpower currently required by Africa is being produced).

The challenge before African nations and especially the Africa Union and the New Partnership for Africa’s Development (NEPAD) is therefore daunting but not insurmountable. We of the science and technology constituency should however recognize the unprecedented opportunities the NEPAD initiative offers our continent. The acid test of the bold African NEPAD initiative will be translating words into action and achieving positive results that would ensure Africa’s inclusion in the global economy.

Fortunately, most people assembled in this hall today are leaders in their own right in one field of human endeavour or another. I therefore wish to quote Brian Tracy, a foremost American authority on the management of success. “Leaders think and talk about solutions. Followers think and talk about problems”. As leaders, we are therefore gathered here to critically analyze Africa’s current global economic exclusion problems and proffer pragmatic and sustainable solutions. This requires formulating and implementing innovative science and technology policies that will drive the African economy of the 21st century.

Assembled here is an array of highly qualified and experienced resource persons and participants. I will therefore refrain from delving into intellectual terrains specially assigned to the resource persons invited to this conference and workshop. Furthermore, I also will have an opportunity to share my thoughts and experiences in the interactive Ministers’ Forum with my colleagues from some African countries scheduled for tomorrow afternoon. However, I wish to make some general comments that could be of interest to this conference and workshop.

Let me quote Jim Rohn (an American) to stress a point. “There are only about a half dozen things that make 80 percent of the difference in any area of our lives”. Indeed global management research confirms this at both individual and corporate (organizational) levels. In effect, we need to think critically and identify some fundamental issues that would give us sustainable solutions. Let us invest our talents, time, skills, and resources in areas that will ensure success. Let us do the 20 percent of things that will guarantee us 80 percent success rather than do 80 percent of things that will give us more than 20 percent success. Some major areas we could critically study and proffer creative and innovative science and technology come to my mind.

1. There are now three global economies – industrial, digital and information, and bioeconomy. Africa was hardly part of the old industrial economy, talk more of the new digital and information economy bioeconomy. How do we promote sustainable industrial utilization of Africa’s huge resource base using available cheap labour to solve the pervasive poverty problems? What value-adding manufacturing technologies can we selectively promote to ensure our competitive advantage in the global market? If we do it right, it will enhance Africa’s inclusion in the resource-based global industrial economy. NEPAD could provide the direction through special incentives and science and technology funding mechanisms.
2. How do we capitalize on the opportunity leveller information and communication technologies (ICTs) to



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accelerate Africa's socio-economic and political development processes? That is, how do we turn the digital-divide into digital opportunities to ensure Africa's inclusion in the global digital and information economy? National, sub-regional, regional, and global partnerships are available to drive this process if we are willing to fund ICTs infrastructure development.

3. The modern bioeconomy is just emerging for most countries of the world. How do we ensure Africa's global inclusion in this fast growing economy? Indeed, it is projected that by 2020, about 50 percent of the world economy will be based on bioeconomy. Africa is blessed with a huge bioresources and biodiversity base and therefore should now develop policies that would make her a key player in the global bioeconomy before 2020. How do we sustainably and profitably utilize Africa's abundant bioresources and biodiversity through the linkage of indigenous and scientific knowledge? There is an urgent need to develop scientific knowledge. There is an urgent need to develop science and technology policies aimed at protecting traditional knowledge, including indigenous intellectual property rights protection. This is critical for the rapid development of bioeconomy niches for small and medium enterprises (SMEs) that can benefit from synergy with modern science and technology
4. All the three global economies (industrial, digital and information, and bioeconomy) depend on modern science and technology inputs. If Africa aspires to be globally included economically, Africa must emphasize science, engineering and technology education from primary school level to the tertiary level. Education, more education, and still more education is the sustainable route to Africa's global economic inclusion. We must, of essence, build in every nation and sub-region of Africa, some science and technology institutions of excellence that can be of global competitive advantage.
5. Research and development and integrated capacity building activities are inevitable for any science and technology-driven enterprise or economy. Africa must view funding of science and technology in general, and research and development in particular, not as an expenditure but as an investment. Africa cannot become globally inclusive economically without reasonably increasing her funding of science and technology (including research and development). Indeed, increased science and technology funding and integrated science and technology capacity building should now be considered as new elements of good governance in Africa. Individual, infrastructural and institutional science and technology capacity building must be integrated to ensure Africa's sustainable growth and inclusion in the global economy. Policy frameworks to actualise this tall dream are critical and urgent. Since the global economy is now knowledge-based and science and technology-driven, Africa must emphasize the development of talents and the acquisition of knowledge and skills on a continuous basis. This will call for institutional restructuring in many cases and a change of mindset, including changing societal values to become more science and technology-friendly as well as embracing a culture of research and development.
6. It is not what one knows but what one can do with what one knows that creates wealth. To solve the problems of acute poverty, unemployment and high crime rate etc. Africa must generate employment through job and wealth creation. This is best done through the private sector with government providing the enabling environment. We need to develop policies that would promote the growth of people and environment-friendly, market-driven, science and technology-based SMEs. This will promote the diversification of the economies of African nations. There is a pressing need to intensively promote the design and development of manufacturing equipment and machinery through deliberate capacity building programmes. African SMEs must function critically in all the three world economies (industrial, digital and information, and bioeconomy). Even the economies of technologically advanced nations are driven by SMEs, only that they are knowledge-based, science and technology-driven and globally competitive.

Finally, there must be respect for intellectual property rights if we must attract direct foreign investors and promote innovation and creativity in our national and regional economies. Critical partnerships at the local, national, sub-regional, regional and global levels cutting across the public and private sectors are inevitable. These are some of the major challenges that come to my mind as we consider policy frameworks to use science and technology to promote Africa's economic global inclusion. I look forward to learning from other viewpoints that will emanate from our deliberations. You are welcome to this epoch making conference and workshop.

Thank you all for listening and may God bless us all.



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APPENDIX 2: KEYNOTE ADDRESS

Speech by Josué Dioné, Director, Sustainable Development Division, United Nations Economic Commission for Africa at the official opening on the 2002 ATPS Annual Conference and Workshop, Abuja, Nigeria

Honorable Prof. Turner T. Isoun, Federal Minister for Science and Technology, Nigeria

Dr. Osita Ogbu, Executive Director, ATPS

Prof. Abubakar Samba, Vice Chancellor, Abubakar Tafawa Balewa University

Distinguished Guests and Experts,

Ladies and Gentlemen,

First, on behalf of the Executive Secretary of ECA, Dr. K.Y. Amoako, I would like to thank the organizers of the conference for providing us with an opportunity to share with you some views on “Science and Technology for Sustainable Development and Africa’s Global Inclusion”. ECA has been invited here to talk about “The role of science and technology in Africa’s sustainable development and new areas of emphasis with respect to innovative science and technology policy, science and technology norms and practices, and institutions and training that would enable Africa to contribute and benefit from the global economy”. These are indeed essential and pressing issues that Africa must address today, and I have no doubt that they will inspire very relevant, important and timely discussions for the next few days.

Honorable Minister, African policy-makers are increasingly recognizing that the transition to sustainable development and the inclusion of Africa into the global economy cannot be achieved without the adoption of a new technological regime. This urge is made explicit in the Program of Action of the New Partnership for Africa’s Development (NEPAD), which, among its priorities, includes science and technology platforms “to generate a critical mass of technological expertise in targeted areas that offer high growth potential”, and “to assimilate and adapt existing technologies to diversify manufacturing production.”

Obviously, a new technological regime could emerge from a better appreciation of the potential and important role and contribution of science and technology for Africa’s sustainable development and global inclusion. Such a regime would call for science and technology policies, which better integrate the main pillars of sustainable development – economic, social and environmental - with the forces of globalization, including market liberalization and technological innovation.

Let me highlight some of the challenges that such a new technological regime must address.

First, economic growth remains elusive in Africa, as much of the continent continues to show dismal performance on almost all measures of human development. Twenty-five of the world’s 30 poorest countries are found in Africa. Thirty-two out of the 48 least developed countries are in sub-Saharan Africa (SSA), which also accounts for 32 percent of all the poor of the world. Fifty per cent of the population in this part of Africa live in extreme poverty, i.e. on less than US\$ 1 a day, and are unable to have access to the minimum basic needs of food, shelter, education and health care. From 180 million currently, the number of SSA’s people currently living below the poverty line is expected to exceed 300 million by 2020. Rural people, who represent 70-80 percent of the total population of the region, are the most affected: about 60 percent of them live in extreme poverty.

Second, agriculture, the backbone of Africa’s economy, displays the lowest yields in the world. This poor performance is due to weak commitment and poor policies for the development of the sector; abiotic factors such as drought, high temperatures, poor soil fertility, abundant marginal lands; biotic stressors such as insect pests, weeds, diseases; and high costs of inputs such as pesticides, herbicides, chemical fertilizers and irrigation. African agriculture has failed to keep pace with population growth and, in most cases it has under-performed the pre-independence period. In the rare cases where high per capita production was observed, growth was mostly a result of area expansion with yield increases accounting for less than 2 percent.

In fact, sub-Saharan Africa is the only major developing region where per capita food-grain output has declined over the last four decades. As a result, some 200 million Africans are chronically hungry. Presently, more than half of the countries and over 20 million people in the continent need food aid. Africa depends on imports for 25 percent of its food grain requirements. While rural households find it difficult to meet their food needs, most urban residents spend more than 70 percent of their earnings on food, leaving only 30 per cent for other basic needs such as health, education and shelter.

Third, Africa also leads the world statistics on the major health problems with 80 percent of the infectious diseases found in SSA. Of the 36 million people infected worldwide with the HIV/AIDS, more than 72 percent reside in Africa. Malaria alone kills two million people and reduces the GDP of SSA by one percent every year. Tuberculosis, a disease of the poor, has re-emerged and, reinforced by drug resistance, is causing havoc



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throughout the continent along with infectious diarrhoea, pneumonia and whooping cough, poliomyelitis, measles, river blindness, sleeping sickness. Infant mortality in the continent stands at 103 per 1000 against an average of 8 per 1000 for the developed world. Fifty four percent of this mortality is ascribed to malnutrition.

Fourth, Africa's natural resources and exquisite biological diversity is under fast degradation, which threatens its economic and physical survival. Escalating soil erosion, declining soil fertility, salinization, soil compaction, soil pollution by agro-chemicals and desertification are some of the factors underlying the observed degradation. Since 1950, some five hundred million hectares of land in Africa have been affected by soil degradation; at least 65 percent of the degraded areas are agricultural land. Increasing deforestation and forest degradation prevail due to a combination of factors including expansion of cultivated area, commercial harvesting, overgrazing, and increasing firewood utilization on which at least 90 per cent of Africans rely for their energy needs. Africa has lost 66 million hectares of forest between 1980 and 1995, with 65 percent of this deforestation occurring in the 1990s. On an average, 5.5 million hectares of land resources are lost every year. The irreversible and ever increasing loss of Africa's biodiversity, under this condition, is considerable.

Fifth, Africa remains essentially a producer of primary goods for the rest of the world. The transformation of the continent's rich endowment of natural resources — most of which are easily exposed to international piracy — and of agricultural raw material into added-value products is limited. In fact, we may add that, in a logic of factor-input complementarity in a production function, Africa's brains are drained out along with its natural resources and raw material to where technology is developed and used to process the latter. To date, no single country in SSA has achieved the 25 percent manufacturing share in gross domestic product (GDP) projected by UN. On the contrary, de-industrialization has taken a toll in this region where manufacturing share in GDP has fallen from 12.5 percent in 1990 and 9.8 percent in 1995. Clearly, the industrial processing of the region's enormous biomass into bio-energy, a valuable economic alternative to the costly fossil fuel, has not received the deserved attention.

Ladies and Gentlemen, a new technological regime is required for Africa to meet the Millennium Development Goals (MDGs) of reducing poverty, hunger, illiteracy and lack of access to water and sanitation. Yet, the emergence of this new technological regime raises difficulties that are so intricate, acute and pervading that the most effective strategy to address them is to make progress simultaneously on many fronts. The underlying principles of the sustainable development paradigm, which underpins development goals and strategies, command policies that are, among other things, 'greener' or pro-environment, pro-poor and pro-innovative. Africa's global inclusion, on the other hand, commands policies that foster international competitiveness and greater participation in the world trading system. Solving this puzzle of competitiveness plus sustainability poses an enormous challenge for largely increased capacities and simultaneous progress in many areas of science and technology policies.

Africa's inclusion into the global economy depends to a large extent upon significantly improved performance in investments, trade and technology. Increased performance in investment is needed because, to meet the MDGs, economic growth must double from the current rates to an average of 7-8 percent per year and be sustained for at least a generation. Such levels of economic growth will necessitate tremendous efforts to mobilize financial resources for investments, through strengthened savings capacity, the setting up of venture capital funds, increased Foreign Direct Investment, alliances and partnerships, fiscal incentives, technology funds, scholarships, and other means.

Africa is rich in natural resources. Yet, the continent has not been able to harness this ample potential and is presently challenged by important scientific and technological developments, which are rapidly transforming international trade and the way business is done. The emerging trends will have far-reaching implications for Africa's development and competitiveness. As dynamic exporters have progressively squeezed out inefficient producers, Africa's competitiveness in its traditional areas of comparative advantage has eroded. The continent's share of global export trade fell from 5.9 percent in 1980 to less than 2 percent at the end of the 1990s, while Sub-Saharan Africa's market share of global manufacturing value added (MVA) was halved from 0.6 percent in 1970 to a low 0.3 percent in the 1990s. As globalization and liberalization advance, companies need to compete not only in foreign markets in order to prosper, but also in their own national markets to survive. Africa, therefore, needs to act promptly to counter the possibilities of this double - internal and external - squeeze and increase its competitiveness and diversify its economies in a globalized environment.

At the core of the erosion of competitiveness are the weak scientific and technological capacities of the continent. Indeed, Africa is almost invisible on the world research map as it accounts for less than 1.0 percent of the world's research and development effort. Investments in technological acquisition and innovation are extremely low. This impairs its capacity to utilize and transform its natural resources and limits possibilities for forward and backward linkages. It also constrains Africa's capacity to diversify away from its traditional exports.



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As the parameters of international trade are gradually shifting in favor of science and technology-based competitiveness, the abundance of natural resources and low-cost labor does not necessarily constitute in itself decisive comparative advantages for the continent. Indeed, the entire technological landscape of the world is witnessing significant transformations, revealed dramatically by the growth of high technology products with substantial research and development input. As they are science-based and knowledge-intensive, they are closely connected to universities and research institutions and rely on growing pools of technical and scientific labor.

Distinguished Guests and Experts, new technologies are changing the technological landscape and affecting competitiveness. Chief among these are information and communication technology (ICT), biotechnology, material technology, solar technology, and manufacturing technology.

ICT is now one of the most important assets of enterprises to compete on the world markets and, therefore, one of the main drivers of global inclusion. It provides the main support to information and knowledge transfer and progress towards inclusion into “the global village.” Most technologically advanced countries are making massive investments in these technologies, and public infrastructure can no longer be conceived only in the traditional terms of roads, railways, power, ports and airports. The availability of fast, affordable and reliable connections to the Internet and development of mobile telephones are some of the new technological infrastructure that African countries need to put in place in order to become and remain competitive. Investment in these technologies is crucial to enabling companies to have a global reach and conduct efficient business transactions.

ECA is providing significant support in this regard, by promoting dialogue, building consensus and capacity, developing partnerships and providing advisory services to African countries. The Commission’s commitments in this area are translated by its involvement in and support to the African Information Society Initiative (AISI), the African Technical Advisory Committee (ATAC), the Partnership on Information and Communication Technologies for Africa (PICTA), the National Information and Communication Infrastructure (NICI), and in national, regional and global conferences and initiatives on ICT.

Biotechnology is another area that deserves greater attention for Africa’s sustainable development and inclusion in the global economy. As the Executive Secretary of ECA emphasized at the recent World Summit on Sustainable Development, “Africa missed the green revolution that doubled cereal production, increased calorie availability by 24 percent and reduced food prices by 50 percent. We nearly missed the IT revolution. We cannot miss the gene revolution.”

Biotechnology is one of the leading technologies of the 21st century, with a wide range of applications in agriculture, health care, and industry, including the processing of agricultural raw materials, energy production, and environmental protection. It can drastically reduce the period of developing products. Biotechnology can address issues of difficult traits such as drought. It offers alternative solutions to shortcomings associated with the green revolution, such as some associated negative environmental effects and the need for increased land, irrigation, fertilizer and pesticides that resource-poor African farmers cannot afford. Biotechnology can contribute to saving Africa’s rich biodiversity including medicinal plants now under serious threat. The continent has a great potential to develop and sustain a commercial production of plant-based medicines, from which the war against HIV/AIDS and drug resistance in malaria cases can benefit significantly through the application of modern biotechnology.

In recognition of this great potential, ECA is increasing its support to enabling African countries to realize the full contribution that modern biotechnology can yield for the region’s sustainable development. The Commission released during the WSSD a report entitled ‘Harnessing Technologies for Sustainable Development’, which argues that new and emerging technologies such as biotechnology can help Africa move towards sustainable development by lowering the incidence of disease, reducing food insecurity, and decreasing vulnerability to environmental damage by allowing more flexible crop management systems. The Report cautions, however, that the expected benefits of both medical and agricultural biotechnology can only be realized if a number of key challenges are addressed, including the extent to which the technologies are relevant to Africa, are pro-poor and mitigate biosafety and related risks. These are clear science and technology challenges for the continent’s sustainable development.

In addition, ECA held, in July 2002, an expert group meeting to deliberate on how biotechnology can help Africa achieve sustainable development. It emerged from the meeting that there is a need to take a comprehensive and detailed stock of the available and unique biodiversity resources, the related traditional knowledge, the relevant new biotechnology and the existing capacity that can be used to add value to these resources. To contribute to responding to these needs, ECA is undertaking a program for promoting biotechnology for Africa’s sustainable development, with special focus on priority issues such as: awareness creation; policy analysis, advocacy and advice; capacity building; strengthening networking and partnerships.



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Dear colleagues, as we all know, the protection of intellectual capital and access to technology are governed by a number of complex international agreements, including a number of new ones. These include the Convention on Biodiversity, which, in its Article 8, recognizes explicitly the importance of traditional knowledge and creates a framework for ensuring that local people share benefits arising from the appropriation and use of such knowledge and of the biological resources of their environment. Plant breeder's rights and farmer's rights are equally recognized in the Convention. These resources are of great importance for Africa's global inclusion and they must receive adequate attention. Plant varieties, which are protected by the International Convention for the Protection of New Varieties of Plants (UPOV) and the International Undertaking on Plant Genetic Resources (IUPGR), constitute unique resources from which Africa can strengthen its global inclusion. In addition to national political sovereignty, these instruments give countries sovereign rights over their genetic resources and traditional knowledge.

African countries have also prepared a model law on community rights and access to biological resources. The African Model Legislation for the Protection of Rights of Local Communities, Farmers, Breeders, and for the Regulation of Access to Biological Resources aims at establishing a framework for national laws to regulate access to genetic resources. All these instruments provide standards, norms, guidelines and options, which African countries can rely on for protecting their indigenous knowledge, technological know-how and biological resources, which can be used in many instances as a springboard for their global inclusion.

The relevance and usefulness of these instruments were discussed in a recent meeting of Experts held at ECA, from which it clearly emerged that African countries need to increase their capacity to deal effectively with the complex issues facing them in this area. There is a great deal of debates on how best African countries can, at the same time, benefit from and respect property rights on intellectual and genetic capital. This is an important policy area for potential help through the NEPAD and the ATPS, in collaboration with other partners, such as WIPO, ARIPO and AOPI. In any case, it remains that, to acquire the scientific knowledge and technology required for a new technological regime, Africa will have to strengthen its capacity to use wisely a mix of channels, including: copying, imitating or duplicating, intelligence gathering, reverse engineering, licensing, FDI, partnering, networking with the Diaspora, overseas studies, technical assistance and international and regional cooperation.

With regard to trade, the Doha Ministerial Declaration, while recognizing the special structural difficulties that least-developed countries (LDCs) face for their effective inclusion in the global economy, commits WTO member states to improve their participation in the multilateral trading system. This involves negotiations and requires actions for which there is a crying need for increased technical capacity in Africa. With January 1, 2005 set as the completion date for most of the negotiations, the quality, content and intensity of technical assistance provided to African countries in the coming months will be critical for the formulation of effective and equitable positions, policies and strategies, including those relating to various aspects of technology, including trade-related and intellectual property rights.

In this area, ECA is contributing to building the relevant capacity by developing a comprehensive training program at the African Institute for Economic Development and Planning (IDEP) in Dakar, with a view to enhancing African trade negotiators' capacities and skills. ECA is also strengthening its activities on high quality trade research and analysis through a new sub-program on trade, which complements the Commission's work on regional cooperation and integration. And, in response to a request from the WTO Africa Group, ECA is establishing an office in Geneva to support African States in their technical analysis and negotiation strategies.

Ladies and gentlemen, in addition to issues related to investments, trade and intellectual property, a new technology regime in Africa must address a number of other difficult issues, especially institutional ones.

First, there is a need for a "democratization" and "popularization of science and technology. All key stakeholders must be involved, through national dialogue, in the policy formulation and implementation process, so as to transcend policies that tend to be too narrowly focused on a few number of isolated, ill-equipped and underpaid researchers and academicians. This will contribute to moving away from "elitist" policies, and to defining and strengthening the respective role of public institutions, international partners, universities, NGOs, women organizations, civil society and the private sector. It would also ensure that policies are tailored primarily with a view to meeting specific needs of end-users and clients. In this regard, the fight against illiteracy should also aim at giving girls and boys must the same chances of being empowered through science and technology.

Second, the new and strengthened technological regime requires a better integration of science and technology and innovation policies — which are cutting across many sectors — with overall development policies. This has far-reaching consequences for policy-making, as it implies that science and technology should move from the periphery to the center of the development policy processes. Success in this realignment and 're-centering' requires strong political commitment vis-à-vis science and technology and the full engagement of the science



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and technology community, as experienced by ECA through its support to the former Presidential Forum on Science and Technology.

Third, the new technological regime calls for special attention to be paid to key areas such as agriculture, energy, mining and water. In these areas, the generation of new knowledge, the development of new technologies and the promotion of innovation are crucial for achieving food security, reducing poverty and protecting the environment and the natural resources base. As all policymakers know, one of the most stubborn issues in this connection is the low level of national resources, which are far too insufficient to create critical masses of national expertise in a given area. Here, sub-regional and regional cooperation and integration are essential as much is to be gained by sharing markets and scientific and technological assets, including in the areas of training, research and demonstration, which cannot always be viable at national levels.

In this regard, ECA is in full support to the NEPAD's commitment to creating sub-regional Centers of Excellence for higher education and research, with a view to promoting science and technology in areas and niches of high priority. Useful can also be the experience of ECA in initiating or sponsoring the creation of more than a dozen regional technology centers in Africa. As half of these centers have been unsustainable and had to be closed down or merged, sustainability must remain a main concern in creating any new sub-regional institutions.

Fourth, a renewed technological regime also requires the strengthening of science and technology policy-making and development institutions. These institutions are weak in many African countries, particularly the smaller ones. Here again, within the framework of the NEPAD, the ATPS could contribute to improving the situation in cooperation with ECA. Countries like Eritrea, Chad, Mauritania, Liberia, Sierra Leone, Gabon, Libya, Djibouti, Swaziland, DRC, Angola, Gambia and many others could benefit from a program that addresses institutional capacity gaps for science and technology policy formulation and implementation.

Fifth, the new technological regime for Africa requires the building of an efficient science and technology infrastructure and strengthened funding, popularization and extension, as well as managerial, entrepreneurial and innovation capacities. It also requires the strengthening of coordination capacities, which may be achieved through the setting up of an Interdepartmental Science and Technology Forum and the nomination of high-profile science and technology advisers at the country level. Inter-firms partnerships should be encouraged and linkages between the public and the private sectors should be strengthened.

Sixth, international cooperation must also be enhanced. There is much to be gained by liaising, networking, partnering and collaborating with industrialized, industrializing and developing countries of other regions. ECA is making notable efforts in this regard, through proactive interactions with a number of international organizations, including the G8, so as to raise significantly the profile of Africa on international agendas.

Finally, better mechanisms need to be developed and implemented to monitor science and technology development, using internationally agreed standards and methods. This is also an area where the ATPS could be active, given that current indicators and statistics on science and technology capacity, research and development, innovation and technology flows, are inexistent, poor or totally unreliable for many African countries.

Honorable Minister, ladies and gentlemen,

These observations highlight the complexity of the task before us, as they relate to scientific, technological, economic, social, legal, regional and global issues. They also illustrate the need for governments to do a lot more to put in place enabling environments, effective policies and programmes of actions for a new technological regime, which can effectively contribute to generating employment, income and sustainable livelihoods for the growing population and labor force. Science and technology in Africa are not receiving the attention and priority they deserve. African countries need to adapt to changing times and revise old policies. Time for business as usual is over. It is time to be bold and serious about science and technology.

Thank you.



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APPENDIX 3: WORKSHOP PROGRAMME

MONDAY, 11 NOVEMBER 2002

Room: LAGOS/OSUN (Floor 01)

Opening Ceremony

Chair: Prof Abubakar Samba, Vice Chancellor, Abubakar Tafawa Balewa University

9:00a - 10:30a Brief remarks from Dr. Osita Ogbu, *Executive Director, ATPS*
 Brief remarks from Prof. Norah Olembo, *Chair, ATPS Board*
 Brief remarks from Hon. Prof. Turner T. Isoun, *Federal Minister for Science and Technology, Nigeria and ATPS Board Member*

Keynote Address: Dr. K.Y. Amoako, Executive Secretary,
 United Nations Economic Commission for Africa (UNECA), Addis Ababa

Opening: Chief Olusegun Obasanjo, GCFR, President, Federal Republic of Nigeria

10:30a - 11:00a TEA/COFFEE BREAK



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Session I

Chair: Hon. Prof. Turner T. Isoun, Minister for Science and Technology, Nigeria and ATPS Board member

11:00a - 11:30a “Unlocking Africa’s Future: Science and Technology in the New Partnership for Africa’s Development (NEPAD)” by Dr. John Mugabe, *Executive Secretary, African Commission on Science and Technology*

11:30a - 12:00p Open discussion

12:00p – 12:30p “Global Governance and National Innovation Systems: Why Africa remains excluded?” by Prof. Banji Oyelaran-Oyeyinka, *Senior Researcher, United Nations University, Institute for New Technologies (The Netherlands)*

Discussant: Prof. Lynn Mytelka, *Director, United Nations University, Institute for New Technologies (The Netherlands) and ATPS Board member*

12:30p – 1:00p Open discussion

1:00p - 2:00p SPECIAL LUNCHEON: VENUE — BORNO/RIVERS (FLOOR 02)
 “Science in a Globalising World: Implications for Africa” by Prof. Awele Maduemezie, *Professor of Physics*

Plenary Session

ATPS/FMST Conference and Workshop
 Science & Technology and Africa’s Global Inclusion

Session II

Chair: Dr. Osita Ogbu, Executive Director, African Technology Policy Studies Network (ATPS)

2:00p – 2:30p “African Women in Science and Challenges of Globalisation” by Prof. Alele Williams, *Former Vice-Chancellor, University of Benin, Nigeria*

Discussant: Prof. Norah Olembo, *Director, Kenya Industrial Property Institute (Nairobi) and ATPS Board Chair*

2:30p – 3:00p Open discussion

3:00p – 3:30p “Foreign Direct Investment, Technology Transfer and Poverty Alleviation: Africa’s hopes and dilemmas” by Dr. Moses Ikiara, *Kenya Institute for Public Policy Research and Analysis (KIPPRA)*

3:30p – 4:00p TEA/COFFEE BREAK

4:00p – 4:30p “Technology Transfer in a Globalizing World: Many promises, lack of responsibility and challenges for Africa” by Dr. Mohamed Khalil-Timamy, *University of Nairobi*

Discussant: Prof. Melvin Ayogu, *Dept. of Economics, University of Cape Town*

4:30p – 5:30p Open discussion

5:30p – 7:00p Marketplace/Exhibition and Networking

7:00pm onwards Cocktail Reception (Fountain Area)

Plenary Session

ATPS/FMST Conference and Workshop

Science & Technology and Africa's Global Inclusion

TUESDAY, 12 NOVEMBER 2002

Session III

Chair: Prof. Pat Utomi, Director, Lagos Business School

8:30a - 8:55a "The Future Generation of ICT Experts: Can Africa lead the way?" by Prof. Emmanuel Aniebonam, *George Washington University and President, Nigerian IT Professionals in America*

Discussant: Prof Clement Dzidonu, *President, & CEO, International Institute for Information Technology (Ghana)*

8:55a - 9:20a Open discussion

9:20a - 9:45a "Bridging the Digital Divide: The American experience and lessons for Africa" by Warigia Bowman, *Harvard University*

Discussant: Prof. Gabriel O. Ajayi, *Director, National Information Technology Development Unit, Federal Ministry of Science & Technology (Nigeria)*

9:45a - 10:10a Open discussion

10:10a - 10:40a TEA/COFFEE BREAK

Session IV

Chair: Chief Festus Odimegwu, Managing Director, Nigerian Breweries, PLC

10:40a - 11:10a "Indigenous Knowledge and Global Inclusion: Recent Advances in Africa's Biopharmacy Research and Application" by Prof. C. Omaliko, *Director, National Biotechnology Development Agency, Nigeria*

Discussant: Prof. Joseph Massaquoi, *Professor of Engineering and Senior Programme Specialist, UNESCO*

11:10a - 11:35p Open discussion

11:35p – 12:00p "New Forms of Partnership for Africa's Entry into the Biotechnology Revolution" by Dr. John Mugabe, *Executive Secretary, African Commission on Science and Technology*

Discussant: Prof Oliver Saasa, *Research Professor, Institute for Social and Economic Research, University of Zambia*

12:00p – 12:25p Open discussion

12:25p – 12:50p "Materials Science Challenge for Africa in a Globalised World" by Prof. O.O. Adewoye, *Director/CEO, Engineering Materials Development Institute*

12:50p – 1:15p Open discussion

1:15p – 2:30p Special luncheon "Science and Technology and Globalisation: *Perspectives from the private sector*" by Bashorun J. K. Randle, *Chief Executive, KPMG*

Concurrent Sessions

(Afternoon Session)

GROUP A: Agricultural Technology Policy

Chair: Prof. Elizabeth U. Anyakoha, Professor of Education, University of Nigeria, Nsukka

Rapporteur: Ms. Bitrina Diyamett

2:30p - 3:30p A1: "Cost Sharing as an Alternative to Financing Agricultural Technology Transfer in Nigeria" by Dr. Agwu Ekwe Agwu and Chukwuone Nnaemeka

3:30p - 4:30p A2: "The Feasibility of Computer-aided Agricultural Extension (CAEx) and E-commerce Application to Zimbabwe Agriculture" by Philemon Kwaramba, B Hanyani-Mlambo, O Chimanzi and J Gotosa



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4:30p - 5:00p TEA/COFFEE BREAK

5:00p - 6:00p A3: "Small and Medium Enterprises (SMEs) in Grain Drying and Storage in Ghana: A Study of Technology Issues in the Agricultural Sector" by *Komla Agbeko Dzisi, Daniel L. Lamptey and Lucy A. Gyiele*

6:00p – 7:00p A4: "Millet Production in a Semi-Arid Environment of Nigeria: A Comparative Analysis of Indigenous Modern Research and Development Technologies" by *Prof. Peter Egwuonwu Odo*

GROUP B: Information and Communication Technology

Chair: Dr. Moses Ikiara, Senior Research Analyst, Kenya Institute for Public Policy Research and Analysis (KIPPRA)

Rapporteur: Mr. Alex Gacuhi

2:30p - 3:30p B1: "Determination of Support Required to Promote, Adopt and Apply Information and Communications Technologies [ICTs] in Swaziland: Implications for Policy Formulation" by *M.D. Dlamini and M. Dube*

3:30p - 4:30p B2: "ICT and Livelihood Opportunities among Rural Poor Communities in Uganda: Investigating the Role of Telecentres in Agricultural Development" by *Dave Khyayangayanga and James Kakooza*

4:30p - 5:00p TEA/COFFEE BREAK

5:00p - 6:00p B3: "Telecommunications in Zambia and World Trade Organisation's Multilateral Liberalisation" by *Musa Kenny Mabandhla*

6:00p – 7:00p B4: "Information Technology in Financial Institutions and its Impact on Economic Development in Post- War Sierra Leone" by *Philip Sulaiman Koroma, Gerald Hinga Ganda and Momoh Lansana Sesay*

(The ministers and policy makers forum will be held concurrently in the NIGER room) Concurrent Sessions

GROUP C: Biotechnology, Gender and Food Technology Policy

Chair: Prof. Olabisi Aina, Professor of Sociology, Obafemi Awolowo University, Ile-Ife, Nigeria

Rapporteur: Dr. David Ezeh

2:30p - 3:30p C1: "Development of Ghana's Biotechnology Policy Framework – A Participatory Approach" by *Alex Owusu-Biney and Josephine Nketsia-Tabiri*

3:30p - 4:30p C2: "Livestock Biotechnology Policy in Ethiopia: A Situation Analysis, Challenges and Opportunities" by *Dr. Dejene Aredo, Dr. Markos Tibbo and Mr. Abraham Gebeyehu*

4:30p - 5:00p TEA/COFFEE BREAK

5:00p - 6:00p C3: "Impact of Biotechnology on Food Quality – Biosafety Analysis in Swaziland and Nigeria" by *F. M. Badejo and L. O. Sanni*

6:00p – 7:00p C4: "Adoption of Biotechnology in Rice Production in Nigeria: Prospects, Problems and Implications for Rice Development Policy" by *Dr. J. Gbemiga Adewale*

GROUP D: Innovation, Technology Transfer, Environmental Technology Policy and National Technology Policy Issues

Chair: Prof. Lynn Mytelka Director, United Nations University, Institute for New Technologies (The Netherlands) and ATPS Board member

Rapporteur: Mr. Ernest Aube

2:30p - 3:30p D1: "Harnessing Natural Resources in Lesotho in Support of National Development" by *M.D. Mpharoane, E.L. Thamae and S. Majara*.

3:30p - 4:30p D2: "Foreign Technology Acquisition and Indigenous Capability Building: A case study of Kaduna Petrochemical Complex in Nigeria" by *Mr. Isaac Madueke Nwaedozie, Dr. Jonathan N. Maduekegbu and B. N. Osuno*

4:30p - 5:00p TEA/COFFEE BREAK

5:00p - 6:00p D3: "Promoting Female Participation in Science and Technology for Sustainable Development and Poverty Alleviation in Cameroon" by *John Forje*



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6:00p – 7:00p D4: “Private Sector Development and Energy Sector Reforms in Africa: A Comparative Analysis of the Technological Implications of Independent Power Producers in Kenya” by *Dr. M.H. Khalil Timamy*

WEDNESDAY, 13 NOVEMBER 2002

GROUP A: Agricultural Technology Policy

Resource Persons: Prof. E.U. Anyakoha, Dr. Osita Ogbu, Dr. Eric Eboh, Prof. Olu Ajakaiye

Morning Session:

Chair: Prof. Akpan Ekpo, Vice-Chancellor, University of Uyo, Nigeria

Rapporteur: Dr. Joseph Obua

8:30a - 9:30a A5: “Impact of Conservation Tillage Technologies on Small Holder Agriculture in Semi-Arid Lands of Kenya” by *Daniel A. Mutuli*

9:30a - 10:30a A6: “The Influence of Modern Technologies on Indigenous Knowledge in Farming Systems of Morogoro District, Tanzania” by *Adolf F. Makauki and Josephat Itika*

10:30a - 11:00a TEA/COFFEE BREAK

11:00a - 12:00a A7: “The Role of Institutional Intervention in Promoting Technological Learning, Innovation and Accumulation: A Study of Nigeria’s Agricultural Mechanization Institutions and their Clientele Artisans” by *Dr. Peter A, Onwualu and Dr. Eddy I. Ahaneku*

12:00a - 1:00p A8: “Smallholder Agro-Systems to Alleviate Poverty: The Case of Bwisewe Intensive Smallholder Land Use Project (BISLUP) in Bungoma District, Kenya” by *Eric Barasa*

1:00p - 2:30p LUNCH BREAK

Afternoon Session:

Chair: Dr. Emmanuel Denenu, Special Assistant to the Federal Minister of Science and Technology, Nigeria

Rapporteur: Dr. Musa Dube

2:30p - 3:30p A9: “Performance of Alternative Irrigation Technologies in Ethiopia” by *Yilma Seleshi and Dejene Aredo*

3:30p - 4:30p A10: “An Examination of Aspects in Indigenous Knowledge which can be Integrated in Modern Agricultural Practices: A case study of Uganda” by *William George Kiiza Waako*

4:30p - 5:00p TEA/COFFEE BREAK

5:00p - 6:00p A11: “The Effect of Green House Technology on Indoor and Outdoor Environment in Kenya: Policy Issues” by *Dr. J. T. Mailutha, Onyango Watako, Douglas Shitanda and Mr. Livingstone Mulamu*

6:00p – 7:00p A12: “The Impact of The Katrin’s Rice Research Programme on the Productivity of the Surrounding Communities: Implications for Policy Reforms” by *Anthony Alifa Chamwali*

GROUP B: Information and Communication Technology

Resource Persons: Prof. Oliver Saasa, Prof. Banji Oyeyinka, Prof. Clement Dzionu, Prof. G. Ajayi, Prof. Melvin Ayogu, Prof. Manny Aniebonam

Morning Session

Chair: Prof. Oliver Saasa, Research Professor, Institute for Social and Economic Research, University of Zambia

Rapporteur: Mr. Ernest Aubee

8:30a - 9:30a B5: “The Relationship between Information Communication Technology (ICT) and Rural Development (RD) in Five Selected Rural Communities in Oyo and Osun States of Nigeria” by *Arc Ayodeji Olorunda and Prof. Olu Longe*

9:30a - 10:30a B6: “A Study of the Effect of Computerisation on the Performance of Government Institutions in Sierra Leone” by *Sarah. F. Bendu and Abu Kamara*

10:30a - 11:00a TEA/COFFEE BREAK

11:00a - 12:00a B7: “Transfer and Adoption of Information and Communication Technology in Botswana School Mathematics and Science Curricula” by *Dr. Luckson M. Kaino and Ms. K.M. Matongo*



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12:00a - 1:00p B8: "Information Technology as Stimulus of Manufacturing Competitiveness in Nigeria" by *John Adeoti, Ph.D.*

1:00p - 2:30p LUNCH BREAK

Afternoon Session:

Chair: Prof. Melvin Ayogu, Professor of Economics, University of Cape Town, South Africa

Rapporteur: Mr. Benson Zwizwai

2:30p - 3:30p B9: "Investigation of Lesotho's ICT Readiness and Formulation of ICT Policy Framework" by *Teferi Kebede and Ntsibane Ntlatlapa*

3:30p - 4:30p B10: "Strengthening Policy Interventions for ICT-based Science Education: An Evaluation of Science Resource Centres in Ghana" by *Kenneth S. Aikins*

4:30p - 5:00p TEA/COFFEE BREAK

5:00p - 6:00p B11: "Gender Differences in the Use and Benefits of New Communication Technologies in Urban and Rural Cameroon" by *Dr. Enoch Tanjong*

6:00p - 7:00p B12: "Assessing the Effect of Information and Communication Technologies on the Status of Reproductive Health Among Refugee Communities in Western Uganda" by *I.N. Barugahara, G.W. Kiyingi and Rita Mijumbi*

GROUP C: Biotechnology, Gender and Food Technology Policy

Resource Persons: Prof. Norah Olembo, Dr. David Ezeh, Dr. Olabisi Aina, Prof. C. Omaliko

Morning Session

Chair: Prof. Norah Olembo, Director, Kenya Industrial Property Institute (Nairobi) and ATPS Board Chair

Rapporteur: Prof. Z.A. Matsela

8:30a - 9:30a C5: "Determination of the Use of Biotechnology in the Agricultural Industry in Swaziland: Implications for Policy Development" by *A. M. Dlamini and M.A. Dube*

9:30a - 10:30a C6: "Intellectual Property Rights and Biotechnology: Options and Implications for Agricultural Research in Ethiopia" by *Wondwossen Belete, Kidanemariam Jembere and Hailu Geletu*

10:30a - 11:00a TEA/COFFEE BREAK

11:00a - 12:00a C7: "Improvement of Processing and Preservation Technologies of Traditional Foods in the Northern Tanzania: A Strategy in Implementing the National Food and Nutrition Policy" by *Andrew B. Gidamis*

12:00a - 1:00p C8: "Acceptance of Cassava/Legume-Based Prepared Foods as a Supplement to Maize in Alleviating Hunger and Malnutrition in Swaziland" by *E.M. Ossom, O.T. Edje and K. Mabuza*

1:00p - 2:30p LUNCH BREAK

Afternoon Session

Chair: Prof. C. Omaliko, Director, National Biotechnology Development Agency, Nigeria

Rapporteur: Prof. Femi Olokesusi

2:30p - 3:30p C9: "Gender Dynamics of Agricultural Technological Change: Implications of Income Poverty Alleviation in Southeastern Nigeria" by *Dr. A. I. Achike*

3:30p - 4:30p C10: "Technological & Policy Issues Constraining Farmers from Establishing Micro and Small Food Processing Enterprises in Machakos, Lamu and Murang'a in Kenya" by *Dr. Roselyn W. Gakure, Dr. E. Kahangi and L. Mwajumwa*

4:30p - 5:00p TEA/COFFEE BREAK

5:00p - 6:00p C11: "Issues in Transferring Agro-processing Technology to Rural Women in Uganda" by *Catherine Komugisha Tindiwensi, Constance Owaori and Florence Kyoheirwe Muhanguzi*

6:00p - 7:00p C12: "Food Insecurity in Lesotho: A Case Study" by *Francis Makoa*

GROUP D: Innovation, Technology Transfer, Environmental Technology Policy and National Technology Policy Issues



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ATPS 2002 ANNUAL CONFERENCE AND WORKSHOP REPORT

Resource Persons: Prof. Lynn Mytelka, Prof. Joseph Massaquoi, Prof. Jide Alo, Dr. Moses Ikiara

Morning Session

Chair: Prof. Joseph Massaquoi, Professor of Engineering and Senior Programme Specialist, UNESCO

Rapporteur: Ms. Charlotte Wonani

8:30a - 9:30a D5: "The Effect of Solid Waste Management Technologies Acquisition on Performance in Nigeria: Implications for Environmental Technology Policy" by *Robert Chikwendu Asogwa*

9:30a - 10:30a D6: "Techno-Institutional Regimes and Rangeland Management in the Southern Ethiopian Savannah: The Role of Information Technology in Devising Sustainable Strategies" by *Abdurahman Ame, Mengistu Wube and Esayias Sahillu*

10:30a - 11:00a TEA/COFFEE BREAK

11:00a - 12:00a D7: "Development of a Framework for Science and Technology National Plan for Botswana" by *Dr. John Mothibi and Prof. Isaac Mazonde*

12:00a - 1:00p D8: "National Science and Technology Policy and Practice in Cameroon" by *John W. Forje*

1:00p - 2:30p LUNCH BREAK

Afternoon Session

Chair: Prof. Lynn Mytelka Director, United Nations University, Institute for New Technologies (The Netherlands) and ATPS Board member

Rapporteur: Mr. Chris Squire

2:30p - 3:30p D9: "Identification, Description and Classification of Sesotho Indigenous Technologies" by *Motlomelo, S. et. al.*

3:30p - 4:30p D10: "Technology Diffusion Strategies among Various Rural Communities in Zambia" by *M.K. Banda and E Nkonde*

4:30p - 5:00p TEA/COFFEE BREAK

5:00p - 6:00p D11: "Privatization and Transfer of Technology in the Energy Sector of the Gambia" by *Lamin A.M. Njie and Sherif Yunus Hydera*

6:00p - 7:00p D12: "Scientific-Knowledge Based Clinical Judgements by Nurses: Myth or Reality: The Case of Nurses in Fako Hospitals" by *Dr. Sylvester Ndeso Atanga and Prof. Mcmoli Theodosia*

THURSDAY/FRIDAY, 14-15 NOVEMBER 2002

8:30a - 1:00p Board Meeting

METHODOLOGY WORKSHOP

9:00a - 9:30a Presentation on Research Methodology by *Dr. Mohamed Khalil-Timamy*

9:30a - 10:00a Open discussion

10:00a - 10:30a Presentation on Writing Skills by *Mr. Magayu K. Magayu*

10:30a - 11:00a Open discussion

11:00a - 11:30a TEA/COFFEE BREAK

11:30a - 12:15a Presentation of final research paper by *Dr. Eric Eboh*

12:15a - 1:00p Presentation of final research paper by *Dr. Boladale Abiola*
(The ATPS Board Meeting will be held concurrently with the Methodology Workshop)

1:00p - 2:00p LUNCH BREAK



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ANNUAL GENERAL MEETING

Chair: Prof. Norah Olembo

2:00p - 3:30p Annual General Meeting

3:30p onwards Educational Tour

FRIDAY, 15 NOVEMBER 2002

9:00a – 1:00p National Co-ordinators' Meeting



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APPENDIX 4: LIST OF PARTICIPANTS

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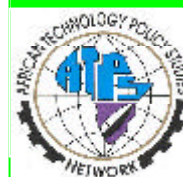
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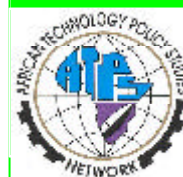
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