



***REPORT OF
THE FOURTEENTH
ROUNDTABLE OF AAPAM***

30 DECEMBER 1992

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HELD AT

ARUSHA INTERNATIONAL CONFERENCE
ARUSHA, TANZANIA
30 DECEMBER 1992

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Introduction

The 14th Roundtable Conference of the African Association for Public Administration and Management (AAPAM) took place between 30th November and 5th December 1992 at the Arusha International Conference Centre. The theme of the 1992 Roundtable is 'Managing Science and Technology Policy in Africa'.

A total of 120 delegates and observers, drawn from 21 African countries and various international organizations and NGOs, participated at the Conference.

Formal Opening

The Roundtable was formally declared open on Monday, 30 November 1992 with addresses by the President of AAPAM Mr. W.N. Wamalwa; the Minister of State (responsible for the Public Service) Hon. Fatma S. Ali; and the Prime Minister and First Vice-President of the United Republic of Tanzania, Hon. John Malecela.

In his address, the AAPAM President traced AAPAM roots to Tanzania where the idea to launch the Association was mooted in 1992. According to him, it was only fitting to mark the Association's thirtieth anniversary by returning to the Association's place of birth. Mr. Wamalwa also recalled the support which the Association has, since its inception, received from the Government and people of Tanzania. Apart from providing first-rate conference facilities and extending generous hospitality to delegates attending AAPAM-sponsored seminars and conferences, Tanzania has always identified itself closely with the aspirations and programmes of AAPAM. The President requested that AAPAM's appreciation be conveyed to the Government and people of Tanzania.

Before formally introducing the Prime Minister, the Minister of State responsible for the Public Service, Hon Fatma S. Ali, noted the land-mark contributions which AAPAM had made to the study and practice of public sector management in Africa. She urged the Association to continue to propagate new ideas on public administration and management.

In his key-note address, the Hon. Prime Minister and First Vice-President, United Republic of Tanzania, congratulated the Executive and members of the African Association for Public Administration and Management on the Association's thirtieth

anniversary. He commended the Association for making a positive contribution towards critical evaluation and analysis of various topical problems. Focusing on this year's theme, the Prime Minister was of the view that science and technology needed to be accorded high priority in Africa's development strategies. To this end, he stressed the need for a proper institutional framework for determining and advancing appropriate science and technology in Africa at national, sub-regional and regional levels. According to him, the basic objectives of science and technology policy in Africa should include:

- i) reducing the drudgery of labour;
- ii) improving labour productivity (in agriculture and industry);
- iii) improving food storage systems at the village level;
- iv) improving water supply management systems;
- v) improving the management of natural resources (including water, forest, and the environment);
- vi) improving health delivery systems in both rural and urban areas;
- vii) improving energy sources;
- viii) finding alternative uses for local raw materials.

The Prime Minister further identified the main elements of a science and technology policy viz:

- a) enhancement of capacity building in the scientific and technical fields;
- b) increased funding of science and technology development (including research and development) projects;
- c) training in the acquisition, utilisation and management of science and technology.

The Prime Minister enjoined upon the delegates to take advantage of their presence in Tanzania by visiting places of interest and interacting with the people. He subsequently declared the Roundtable formally open.

Adoption of conference Programme

At the end of the formal opening, the President of AAPAM, Mr. Wamalwa, and the Association's Secretary-General, Prof. A.D. Yahaya,

introduced the programme for the rest of the week. According to the programme, the topics to be discussed at plenary sessions would include:

- (i) Status Review of Science and Technology Policy Management (including an overview of policy on science and technology)
- (ii) Economic reform and technology policy
- (iii) Capacity building for technology policy management
- (iv) Institutional arrangements for technology management
- (v) Commercialization and communication of research and development results.

In addition to the plenary session, the Roundtable was to be grouped into syndicates at which the sub-themes would be critically and closely examined.

Plenary Session One: *Status Review of science and technology policy management.*

Only one paper was presented at the first plenary session. The author of the paper, Dr. John Forje, examined the state of science and technology policy in contemporary Africa. According to him, leadership was a critical factor in national development in so far as it creates an enabling political environment for breakthroughs in science and technology. In a nutshell, representative, accountable and responsive governance was a pre-requisite for the development of science and technology.

Dr. Forje's paper went on to dispel the myth that Africa was "civilised" by colonization. In his view, if colonial rule succeeded at all, it was in destroying indigenous culture and stifling indigenous scientific and technological initiatives. It was then left to the post-colonial regimes to embark on a daunting task of restoring the people's confidence in their innate abilities preparatory to reestablishing a scientific culture, formulating appropriate policies on science and technology, promoting investment, and developing domestic technology options. For instance, during the period 1960-80, science was viewed as a prime mover of development and progress, howsoever defined. The faith in the ability of science to solve major problems was reflected in the Lagos Plan of Action in which the strategic options in Africa's development were outlined.

The paper noted that the efforts to promote science yielded some fruits. Universities and other institutions of higher learning were established, and enrolments at the various educational levels increased substantially. The paper in particular reported that the female population at institutions of higher learning rose significantly, although the dramatic increases were recorded in the food science and nutrition field.

In contrast to the achievements were the palpable draw-backs. The paper high-lighted the following problems: neglect of engineering and technology, shortage of personnel to plan, organise and manage scientific and technological programmes, dependence on external technological 'know-how', the exclusion of indigenous African languages from scientific discourse, and resource constraints.

Comments on Paper

Dr. Forje was congratulated on his presentation which, in the view of a number of participants, covered the essential areas. Some participants nonetheless felt that the paper could be improved in some respects. The following conclusions and recommendations emerged at the end of the discussion:

- (i) after thirty years of independence, Africa should stop using colonialism as a whipping boy for its own failures, and begin to accept responsibility for its development;
- (ii) governance is an essential but not a sufficient condition for technological progress; this is borne out by the experience of countries which are well-governed but remain technologically under-developed;
- (iii) before evolving a policy on science and technology, it is necessary to define the basic concepts (science and technology) and indicate how they relate to other concepts such as culture, ideology, modernization, and development;
- (iv) to the extent that Africa takes its ideological cues from the developed world, it will continue to be a follower rather a leader in the area of science and technology;
- (v) the scientific culture should be propagated beyond the confines of the formal educational system - to expose the entire society to the knowledge of the world in which people live;
- (vi) it is necessary to evaluate in a critical way the achievements and orientation of the existing technological training institutions with a view to optimizing their contributions to the development process;
- (vii) while some participants felt that women should be encouraged to practise vocations in which they have greater comparative advantage, others believe that segregation based on gender should be discouraged;
- (viii) all the manifestations of external dependency (e.g. admiration of foreign life-styles, the tendency to disparage indigenous African institutions, reliance on foreign intellectual leadership, and the universities' bias towards foreign publications) need to be quickly addressed if

Africa's confidence in its innate abilities is to be restored and the African mind is to be completely decolonized;

- (ix) conscious efforts should be made to utilize African talent and resources at every stage of development;
- (x) research in science and technology focusing on day-to-day human problems should be encouraged;
- (xi) adequate resources should be channelled into research and development programmes as a means of promoting the application of science and technology to practical problems.

Plenary Session Two: Science and technology policy and Economic Reform

The second session featured presentations by Mr. I Chiri and Prof. S.M. Wangwe on the relationship between economic reform and science and technology policy. Chiri's paper is in four parts. The first part defines the key concepts, namely, science and technology, while the second part traces the development and growth of Zimbabwean economy, culminating in the sweeping economic reform of 1990. The third part examines the role and performance of the manufacturing sector. The last part focuses on measures by the government to improve the performance of this sector through the development of science and technology.

From Chiri's definition, science emerges as a process of understanding the environment through the application of logical methods. Technology, by contrast, is concerned with the spectrum of knowledge, skills, methods and procedures required to manipulate the environment to secure a desired result.

The scientific method is the instrument used to acquire such knowledge and understanding of the environment. When such knowledge is sought for its own sake, it is referred to as basic or pure scientific research. It becomes applied scientific research when it is sought for a specific application. In view of the symbiotic relationship between the two concepts, the author argues that the lines dividing basic and applied science and technology are quite indistinct. He further insists that true acquisition of technology does not lie in the acquisition of a plant or equipment but in the ability to adapt, adopt, use, maintain, update and upgrade the technology.

The author then shifted his attention to the economy of Zimbabwe. Between 1980 and 1990, the country recorded substantial achievements in the social services sector, namely health, education, and agriculture. However, these achievements were not matched by economic growth and increased per capita income. The major reason is the low investment in the production sector of the economy. In order to stimulate investment and remove impediments to economic growth, the Zimbabwe Government embarked on a programme of economic reform. Some of the components of the programme are trade liberalization, domestic deregulation, creation of new infrastructure for science and technology, all of which are underpinned by new measures in fiscal and monetary areas.

On manufacturing, Chiri noted that this sector is the largest contributor to GDP (approximately 25%) and the second largest formal sector employer. In the first five year plan period (1986-1990) the average annual growth rate of the sector is 4.1% compared with the plan target of 6.4%. The shortfall was the net effect of inadequate investment, resulting from the shortage of matching foreign exchange, to replace obsolete equipment and set up additional facilities. This led to reduced output and higher unit cost of products which in turn discouraged fresh investment.

Under the economic reform programme, measures aimed at re-energising the sector would be introduced. These include the development of industries that are export-oriented as well as those that contribute higher value added. Others include the promotion of industrial estates/shelters and encouragement of research and development activities.

The author identifies research and development as a prerequisite for further industrialisation in Zimbabwe. Government has established two institutions to help improve the performance of the manufacturing sector. The first is the Research Council of Zimbabwe (RCZ) which was established in 1984 to advise government in all matters relating to science and technology. In addition, the body is to coordinate research activities of other research institutes and councils. The second body, which is yet to take-off, is the Scientific Industrial Research and Development Centre (SIRDC). It is intended to provide a variety of technical services to industries including the adaptation of foreign technologies, development of new plants, and promotion of the development of technological capacities in such field as energy, material science and biotechnology, to mention a few.

Other measures proposed by the author include:

- i) encouragement of basic research in the Universities through, inter alia, better funding and provision of an enabling environment;
- ii) development of "sound" / quality scientists
- iii) public education/enlightenment;
- iv) effective linkage between research institutes and users of research findings;
- v) intensive training for technicians, technologists and scientists;

- vi) provision of special incentives to encourage private sector organisations to undertake Research and Development activities;
- vii) effective utilisation/application of R & D results.

All the preceding measures and activities were to be pursued within the framework of an "implicit policy" whose basic objectives include directing science and technology efforts along identified goals, facilitating the translation of science and technology results into actual goods and services; and creating and sustaining an endogenous science and technology base through research and development. Although the author sees the "implicit" approach as opposed to an "explicit policy" as a recognition of the need for flexibility for an incipient science and technology system to grow without self-imposed impediments at the outset, there is no doubt that a formal, well-articulated and widely disseminated national policy on science and technology would certainly promote the development of science and technology faster than an 'implicit' policy.

In contrast to Chiri whose focus is on Zimbabwe, Wangwe's approach is both global and comparative. He (Wangwe) undertakes a survey of developments in the world economy, and notes the tendency towards the marginalization of technologically less innovative societies. He calls particular attention to the diversion of technology away from Africa to the NICs. While doubting the effectiveness of technical assistance, he is of the view that a process of technology transfer which involves the enhancement of the recipients' capacity to absorb, adapt, use, and upgrade new technology, may serve Africa's interests in the long run. It was this type of 'technology transfer' which accelerated the pace of transformation in Japan and Newly Industrialised Countries (NICs).

On the relationship between structural adjustment reforms and the development of science and technology, Wangwe refers to the mixed verdicts on the impact of structural adjustment on industrial and agricultural productivity in Africa. On the whole, he believes that the reform measures shifted emphasis from investment in new technology to the rehabilitation of ailing enterprises. Under such circumstances, it was difficult to plan and implement ambitious research and development programmes leading to far-reaching innovations in science and technology, or to the enhancement of capacity to fabricate spare parts and essential components locally. In general therefore, the structural reforms introduced competitive pressures in the macro-economic environment but failed to rectify the major weaknesses in the technological field.

Participants' Comments

In the plenary discussion that followed, delegates sought clarifications and raised a number of issues on specific aspects of the papers. Furthermore, the participants used the opportunity to look beyond the experience of Zimbabwe and to address fundamental issues relating to the environment, institutional arrangements, priorities, funding, as well as monitoring/evaluation of Government programmes in science and technology.

Plenary session three: Capacity building for technology policy management

Two papers were presented at the third plenary session. The first, by Banji Oyeyinka, is titled 'Capacity building for Technology Policy Management in Africa: Performance and Perspectives'. It was presented on the author's behalf by Ijuka Kabumba. The second paper on the same subject was written and presented by Rogers Okot-Uma.

Oyeyinka's paper is divided into three main parts: (i) capacity building for technology policy in Africa, (ii) assessment of the performance of capacity building institutions in Africa, and (iii) perspectives and issues for the future.

The paper begins with two key premises, viz:

- a) acquisition of formal technological knowledge (or education) does not automatically result in technological competence; to this extent, long-term planning and investment in the management of technology is a necessity;
- b) managers of technological projects need to be constantly aware of the emergence of new technologies and the obsolescence of the ones they may be operating.

Central to these two premises is the need to invest in human capital. The human resource is without doubt, the mother of all resources and basis of technological change and advancement.

Oyeyinka examines three major sources of human capital, i.e.

- a) the sources of basic knowledge and skills, e.g. universities and polytechnics;
- b) research and development agencies (including laboratories, and process design firms);
- c) manufacturing firms as well as firms specializing in the production of capital goods, machine tools, spare parts, etc.

According to Oyeyinka, most African countries invested heavily in (a) and (b) but did little to encourage (c). The outcome is limited technological change.

Two institutional forms through which technical change and human capital is generated are used to show the evolutionary path of capacity building and the management of technology in Africa. The two are examples of manufacturing activities and the evolution of institutionalized Research and Development.

Capacity Building and Manufacturing

The steel industry is taken as a key example, and what comes out very clearly is that with a few exceptions investments in the steel industry in Africa has been a story of failures. In most countries in SSA almost every project has experienced delays and widespread cancellations. Financing appears to be a critical factor but other factors such as technological and managerial deficiencies are equally important. This contrasts sharply with the Pacific Rim countries whose steel industry has been a success story. A specific comparison is made by Oyeyinka of Korea's Poscos success and the failure of Nigeria's Ajaokuta Steel Company.

It is further pointed out that once operational technology is established continuous efforts have to be exerted to absorb and improve technological capabilities through local, in-plant and foreign training. The commonality on which the foundation of success rests is the build-up, after technology is imported, of domestic technological capabilities.

For Africa, from Zambia and Tanzania to Nigeria, it has been a case in which technology has been mismanaged.

Capacity Building in R & D in Africa

From the very early years of independence it was recognized that there was need to formulate some guiding principles and policies for the advancement of science and technology as a pre-requisite for national development. However, it would appear that action was limited to R & D policy.

There emerged a sharp dichotomy between R & D institutions on one side, and the end-users of R & D, on the other. These institutions have had very little to share with industry. In other words, the Africa R & D system has been a system with very weak or no linkages at all to industry and other end-users. Viewed as a policy, Africa's R & D has been a failure and the main reason is the attempt at institutional capital building while that has ignored evolutionary

history and the separate contexts of policy making and implementation. Additionally, Oyeyinka noted that:

- (i) Nearly all R and D institutions in Africa are funded by governments. Research is conducted by Government and University laboratories;
- (ii) The private sector plays an insignificant role in research.

Oyeyinka believes that Africa needs a major reform in the management of its science and technology policy and in institutional capacity building. African Governments should, like their Korean and American counterparts, take the lead in research and development and in formulating appropriate science and technology policies, but eventually the private sector must play a more significant role.

Among the issues which Oyeyinka thinks should be examined in the future are:

- (i) Need to develop internal capabilities to acquire, operate and to change the technical basis of production, i.e. need for new institutional structures and the reform of existing ones to make them more relevant to the needs of industry;
- (ii) Africa needs to be prepared to confront the opportunities and challenges of new emerging technologies;
- (iii) there is need for SAPs to address issues relating to science and technology;
- (iv) lastly there is need for new institutional structures for science and technology since technology policy management has become a discipline on its own. There is need to build up capacity for policy analysis and decision making at all levels of Government and the private sector.

Second Presentation

The second paper was presented by Rogers Okot-Uma. The paper attempts to provide a framework for the integration of technology into national development planning. It outlines the salient features of a technology framework, articulates the pertinent managerial implications, and discusses areas of capacity building for science policy management. According to the paper, technology may be conceived in two ways: technology as a factor of production, and technology as a negotiable good or commodity. A nation's development depends on the extent to which it can combine the two

aspects. There is therefore need to integrate technological development plans into national development plans.

Technology as a negotiable commodity embodies transactions like any other commodity. It is bought and sold as capital goods, human labour, information, etc. Technology transfer involves the supply of equipment, tools, and skilled manpower. It can be accomplished through direct investments, movement of individuals between countries, use of expatriates, etc. Technology can also be diffused through licenses, patents, R & D information exchange.

In Okot-Uma's opinion, there must be a national consensus on technology with explicit recognition of the role of technology for national development. There must also be financial and fiscal support for capacity building.

There is need to acquire the art of organizing and directing human and capital resources towards a number of perceived defined goals and purposes. Technological innovation involves idea formulation, research and development, diffusion and technology utilization, and finally, institution building and upgrading.

Capacity building for technology policy management involves developing the capability for the management of technology. It involves establishing programmes and networking for technology policy management.

Participants' Comments

The following questions and comments accompanied the two presentations:

- (i) What time frame is Africa working on for building technological capacity?
- (ii) How can Africa talk of managing science and technology while most of its people are illiterate?
- (iii) Africa has generally failed to match word with action as far as managing science and technology is concerned. Resources allocated to science and technology are not adequate;
- (iv) Too much emphasis is placed on the role of the state; there is need for a new strategy to involve medium- and small-scale entrepreneurs in R & D. The suppliers of technology have to be closer to the users;

- (v) R & D and science and technology (S & T) institutions are hierachical. There is a need for restructuring;
- (vi) While the role of Government on issues of S & T and R & D is obvious, that of the political leadership is not that clear;
- (vii) Technology transfer and capacity building through donor-assisted projects have not been effective;
- (viii) There is need for local adaptation of externally acquired technology. Local capacity building is absolutely necessary if Africa is to develop;
- (ix) There is need for government to maintain proper surveillance on external infringement or clever adaptation of locally developed technology or ideas; some products patented in Africa have moved to foreign countries after finding little or no support locally;
- (x) Attention should be paid to indigenous scientific and technological knowledge as a possible basis for scientific and technological development.

Recommendations

In addition to the preceding observations, the participants recommended as follows:

- (i) There is need for African countries to commit themselves to mainstream science and technology and to the proper utilization of the results of research in science and technology;
- (ii) While the Government will continue to play a key role, the private sector must play a more visible role than it is currently doing;
- (iii) Technology imitation might be solution in the short-run as was the case with Japan;
- (iv) There is need for networking and intra-Africa transfer of technology - i.e. transfer of technology within Africa;
- (v) Africa must create a socio-economic environment favourable to the pursuit of science and technology;
- (vi) R & D personnel should be adequately remunerated;

- (vii) Artisans engaged in cottage industries should be exposed to proper on-the-job training;
- (viii) capacity building for technological advancement must begin at the primary school level, and the entire educational system should be provided with the necessary infrastructures and facilities to embark on technological training programmes;
- (ix) Adequate resources should be allocated to research and training in science and technology;
- (x) Attention should be paid to the dissemination of the results of applied research in science and technology;
- (xi) Existing patent laws should be critically examined with a view to safeguarding the rights and interests of local inventors and forestalling reverse technology transfer.

Fourth Plenary Session: Institutional Arrangement for Technology Management

Three resource persons made presentation on this subject, viz: J.M.A. Opio-Odongo, Philip Langley, and Rispah N. Oduwo.

Opio-Odongo's paper outlines the various problems facing the different African countries as they seek to develop their economies and improve the living conditions of their peoples. In his view, the immense challenge ahead of Africa is in sharp contrast to the limited technological capacity available to respond to the challenge. But this is so only if technology is defined as an foreign notion. If, however, the huge reserve of knowledge about how to respond to the basic human needs is taken into account, Africa is not without a proud history of technological achievements. He notes the remarkable achievements recorded by the African traditional society in areas such as herbal medicine, iron smelting and metallurgy, salt extraction and farming, to mention a few.

Opio-Odongo then assesses the capacity of the existing (largely "modern", post-colonial) institutions to meet the increasing challenges of development. According to him, at least six institutional models can be identified in sub-Saharan Africa viz;

- (i) the ministry model
- (ii) the autonomous/semi autonomous institutes
- (iii) the university model
- (iv) the research council model
- (v) the private sector research organisations; and
- (vi) the research units of the non-governmental organisations

After comparing the strengths with the weaknesses of each model, he concludes as follows:

- (a) a science-technology culture has been lacking not only among the general population but also in government circles;
- (b) while the role of science and technology in development is appreciated in theory, in practice, African production systems have been operated as if developments in science and technology is of no consequence;

- (c) while African governments have been mandated to promote the use of science and technology, the relationship between science and government remains casual;
- (d) existing institutional arrangements manifest some of the weaknesses referred to above;
- (e) the science and technology field is made up of a growing number of actors (consumer/producers, public and private sector research institutions, the NGOs, the universities and the research councils as coordinators).
- (f) capacity enhancement should be the centre-piece of institution building efforts at the micro- meso, and macro-levels.

Second Presentation

The paper by Rispah N. Oduwo cites the example of India, a developing country which has employed science and technology to achieve self-sufficiency in food and to become a nuclear power. Kenya presently faces a number of challenges which only science and technology can overcome. Such challenges are rapid population growth in the face of declining economic, industrial and agricultural growth; environmental degradation, rising inflation and slow technological development.

To achieve her science and technology objectives, Kenya has established a Ministry of Science and Technology as well as a Council for Science and Technology. Both the Ministry and the Council coordinate the activities of a number of research institutes. There are commodity research institutes for coffee and tea. There are six other research institutes established under the science and technology act of Parliament, almost entirely funded by the Government of Kenya.

The four universities in Kenya also contribute to the development of science and technology. Although the universities have the highest concentration of qualified scientists, research efforts are hampered by the fact that scientists have to spend all their time in teaching due to increase in the number of students. Besides, much of their research activities are academic in nature and therefore fail to address strictly national problems.

During discussions, participants felt impressed with Kenya's institutional arrangements for the management of science and technology. They enquired as to what factors contributed to such success and why there is no brain drain in Kenya. The writer replied

that Kenya is prosperous and has a stable government. Kenyan scientists are therefore contented to remain and work at home.

Third Presentation

The paper by Philip Langley deals with a socially appropriate and environmentally sound technology (SAEST) as an essential component of the search for alternative development strategies which will respond to peoples' needs and be equitable, sustainable and based on democratic practices. Science is as important in relation to social issues as it is in the area of biology, chemistry, physics and mechanics.

Scientific method is the basis of science: such method is seen to be the basis for popular knowledge of the environment, of plant and animal breeding and production, of the weather, of soils, of illness and of social organisation etc. The knowledge derived from popular science is produced often through experiment and transmitted through an educational system.

In the field of agriculture, taken as an example, such knowledge is deliberately ignored and seen as archaic. Extraneous models of the agricultural holding are thrust on farmers which are economically untested, ecologically unsound and socially disastrous. It is as if no one had ever looked at what the farmer does and what she/he already knows: mixed cropping to ensure regular food supply, protect the soil and increase yield per unit of labour; existence of two farm holdings in a monogamous household (one managed by the woman, the other managed by the man) etc.

The paper maintains that educational systems in African and the dominant ideology denigrate popular science and technology and alienate intellectuals from an objective appraisal of their key role in development. Popular science and technology often no longer responds to present day needs in a profitable or satisfactory manner and are open to critical appraisal; but so is the technology proposed by the World Bank to solve the crisis in developing countries (i.e. SAP) as well as the economic theories on which the technology is based.

Popular science and technology can be improved by joint action and made useful for profitable enterprises, competitive with industrialised goods.

Several types of institutions are needed to promote R & D and S & T and to manage the policy which will facilitate it. These are:

- grassroots organisations - in some African countries these are growing into rural leagues or unions with a focus on development (FOND in Senegal, UFGN in Burkina Faso, ORAP in Zimbabwe etc).
- support organisations providing either overall support to grassroots development efforts or specific sector support (agriculture, management advice, industrial technology, transport, energy, health etc.).
- political institutions based on democratic practices and in which there is ample awareness of science and technology issues.

Eight other types of institutions have specific roles to play:

- collecting, processing and disseminating information on R & D and S & T;
- technical research and testing of R & D and S & T;
- banking functions to collect savings and provide capital and financial advice;
- management support services and, in general, support to small enterprises including grassroots and women's income-generating enterprises; this means also the creation of a favourable environment (for SMES, micro-enterprises and the so-called informal sector);
- training and educational institutions for children, adults, technicians which combine practice with theory;
- media organisations which will encourage freedom of expression as well as information on S & T
- Planning/coordinating body, taking care to avoid a centralized, monolithic, bureaucratic organisation, but ensuring an opening-out to civil society.

Participants' Comments

A number of issues were raised in the discussions that ensued. First it was noted that there existed a causal relationship between

science and technology which needed clearer definition so as to avoid any mis-understanding as to where scientific processes begin and where technology applications end. The example was cited of the informal sector workers who often engage in technology development without much grounding in scientific theory. By contrast, many academics in the universities are steeped in scientific knowledge which they have never been able to apply towards the production of technology. It was therefore important to keep in mind the fact that although science should ideally lead to technology, in many instances, technology did go on without science. However, when the symbiosis between the two does occur, the results often become far more enriched. It is the duty of science and technology institutions to ensure that this symbiosis does take place, and that the purpose of scientific research goes beyond the publication of research results.

It was felt also that accumulation of wealth was neither a sufficient nor a necessary condition for the development of science and technology. The elimination of deprivation among the African people was perhaps a more compelling reason for doggedly pursuing science and technology development policies. This subtle, but important distinction between the two would have implications for the definition of the institutional requirements for science and technology development, as the production and replication of knowledge on the one hand, and science and technology development as the application of knowledge on the other, for the policy and institutional foci and priorities would, inevitably be different. Furthermore, within the African context, it would help if it were possible to develop a praxis of social change to which could be appropriated the praxis of science and technology change, in ways that would make for the requisite institutional arrangements to emerge naturally.

The question of institutional linkages involving the agents of science and technology development as well as the relevant information systems was also raised. It was observed that professional relationships among African scientists and technologists were far from being strong. There were few opportunities for reporting research and research findings among the research community in Africa: scientists do not know each other or each other's work; serious indigenous research journals, newsletters etc. are few and far between; and the research networks existing are oriented more towards the North than to the indigenous African research community. The linkages between the latter and the policy makers are equally weak. The little of what exists in this respect is further weakened by a communications problem emanating from the dense and highly technical language with which the scientist addresses the policy-maker.

The inadequate flow of information also affects the ability of African countries to protect and commercialize their local inventions. Equally, the relationships between the scientist and the change agents such as extension workers get weakened over time, as the former, by virtue of his or her limited access to new ideas and development in his or her field, becomes more and more redundant and of less use to the latter in his or her quest for new ideas which he or she could take to the user.

Science and technology development institutions should address these very serious constraints with a view to having them removed internally within countries and intra-regionally among African countries.

The issue of racism or gender-bias in the universal sharing of scientific and technological knowledge was also raised. The examples of new AIDS or contraceptive drugs, developed in the West and being tested on Africans was cited and deplored. It was noted that with stronger institutions in place in African countries, the racial or culturally biased application of certain Western technologies in Africa could be checked.

Many participants underscored the importance of educational institutions in the development of science and technology in African countries. Emphasis was placed on the need for curricular change and more frequent reviews at all levels of the education system as well as for more rational linkages to be established between levels of the systems.

Finally, the point was made that the development of science and technology in Africa should not be wholly entrusted to the private sector although it should be encouraged to play its part. It could not be left to the NGO community either, as this community could not guarantee an "interest-free" funding of science and technology. It was agreed therefore that government was the most natural and secure home for the development of science and technology in African countries. This is a challenge which every responsible government in the industrialized world has, throughout history, had to shoulder.

Plenary Session Five: Resource allocation for Technology Policy Management

Paul Vitta's paper on resource allocation for technology policy management was the only one presented at the fifth plenary session. There is general dissatisfaction both with Africa's attempts to define the content of technology policy and with the efforts to manage such policy once its content has been defined. The paper is concerned, however, primarily with the region's management of technology policy.

The most serious constraint in this regard is the stifling lack of resources. This problem is aggravated by corruption which not only directs resources away from policy management but also thwarts policy enforcement itself. Prospects of increase in resources for the management of technology policy are not particularly bright as yet.

The paper concludes by describing two possible sources of funding - one is structural adjustment, the other, political liberalization.

Participants Comments

It was noted that while research in science and technology was carried out in institutions of research and higher learning, integration of the results took place in sectoral institutions (ministries). The necessity of collaboration between these two institutions was emphasized.

It was also felt that corruption thrived because there was a lack of sanctions and the enforcement was weak. Institutions of policing the system were also corrupt. The problem became how to police the policeman, and audit the auditor.

The need to evaluate research and development institutions was emphasized.

Recommendations

The participants recommended that:

- (i) an anti-corruption culture be developed and the anti-corruption laws and institutions strengthened;
- (ii) Research institutions must expend their resources on core activities;

- (iii) African countries should set aside more resources for research in science and technology;

Plenary Session Six: Commercialization of Research and Development Results

The main issue addressed by I.M. Omari in his paper is how to market and manage ideas on science and technology. The paper deals with the important process of how to move knowledge from the point of generation to the point of utilization. The paper notes that there has been a priority of avenues for dissemination of new information, and emphasizes the need to develop information and technologies that are relevant, accurate, economic, and timely. These will aid their dissemination. So too will the use of languages with which people are familiar, which are free of sophistry and jargon. Paper also calls for differentiation of message according to target population, implication of message, and to market those ideas with appropriate aggressiveness.

Participants Comments

Participants noted with appreciation the choice of this topic which tends to be frequently ignored.

The utility of collaborative or group research was emphasized. Unlike individual research, group work facilitates cross fertilization of ideas, timely release of information in research design and implementation.

The importance of writing for the African audience was emphasized; so was the need to carry out research and innovations among the people, in rural areas, and at places of work.

Recommendations

- (i) The area of dissemination and utilization of research results should be given increased attention;
- (ii) Collaborative and group research should be encouraged
- (iii) Managers and users of research results should be involved in research where possible;
- (iv) African researchers should package and disseminate information in forms accessible to the majority of our people.

Plenary session seven: Managing Science and Technology in Africa (an Overview)

Two papers were presented at the final substantive session. The first is by W.N. Wamalwa and C. Grey-Johnson, and the second, by J.H. Oyugi.

The Wamalwa-Johnson paper begins with a historical perspective on science and technology in Africa by stating that there exists on the continent a gaping void as far as the development of science and technology is concerned. The crises of hunger, disease, low productivity and environmental degradation reflect Africa's inability to apply science and technology to master and transform its natural environment. The paper therefore sets forth proposals as to how to improve the management of science and technology for the sustained development of Africa.

The paper further states that while science is neutral and of universal application, and of universal application, technology is socially conditioned. To address the issue of poverty in Africa, it is essential that an explicit policy on technology be formulated. Many African countries do not have such policies, and where they exist, scant resources are allocated for its enforcement.

The Wamalwa-Johnson paper further stresses the need to specify the role of the government vis-a-vis the private sector. While the former should be responsible for setting broad guidelines on science and technology and outlining the strategic options, the private sector should be in the forefront of technological innovation.

The paper notes that institutional back-up facilities for science and technology development are inadequate. The roles of these institutions need to be clearly defined and the linkages to national development objectives ought to be strengthened.

Second Presentation

The second presentation (by JH Oyugi) is based on the results of the on-going administrative reform programme in parts of sub-Saharan Africa. Civil service reform is linked closely to good governance and to human development. It is the paper's argument that science and technology are critical to sustained productivity and economic development.

The Oyuqi paper underscores the importance of the capacity for policy analysis and policy management. This is the only credible alternative to a situation whereby the contents of policies are dictated by external institutions, particularly, the IMF and the World Bank.

The "total personnel management approach" advocated by the paper places strong emphasis on proper diagnosis of civil service problems rather than on an arbitrary pruning of civil service establishment.

Participants' Comments

The participants commented on the two presentations as follows:

- (i) science and technology must take into account issues of social justice;
- (ii) science and technology are not a panacea for development;
- (iii) the link between the supplier of technology and the consumer is weak or non-existent;
- (iv) there is need for intra-African cooperation in the development of service and technology;
- (v) the future thrusts in the reform of the civil service should be toward increased professionalization;
- (vi) there is need for the various African countries to take the lead not only in the reform of their civil services but also in the formulation of socio-economic policy.

Recommendations

Based on the preceding observations, the participants further recommended that:

- (i) efforts should be made to develop institutions which underpin good governance;
- (ii) government should concentrate on what it is best placed to do, i.e. laying broad policies and outlining strategic options, while the private sector becomes more active in the implementation of innovation;

- (iii) indigenous technology options should constantly be developed, and opportunities for technology upgrading/improvement should be optimized;
- (iv) the linkages between the suppliers and users of technology should be strengthened;
- (v) networking, as a concept, should be increasingly utilized.

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Summary of Country Presentations

Tanzania

Tanzania participated fully in the evolution of science and technology for development since 1963 culminating in the formulation of the Tanzania National Policy for Science and Technology in 1985. In that policy, sectoral roles were defined, and mechanisms proposed for establishing the coordination of research and development activities, establishing funding and capacity building. But like many other African countries, Tanzania has experienced low utilization of technologies, and has not evolved an effective research and development and industry linkage, as well as a national research funding mechanism. It is yet to diffuse technologies to the populace. The current national science and technology policy formulated during the epoch of economic crisis is unable to meet the present demands of economic reforms. There is need to update the science and technology policy, build a human resources capacity and capability, and adapt its approach to research and development (in view of current economic reform trends and needs of the society) and increase funding from the present 0.35% of GNP to at least 1% of GNP.

Uganda

Uganda's science and technology infrastructure comprises national research and development institutions, universities and colleges, the private sector and regional as well as international research and development agencies. The mandates of these organizations and programmes are prescribed by their governing bodies and parent ministries. Often, this is done independently and in isolation. Consequently, it has been difficult to develop a coherent explicit national science and technology policy although such a policy is implicitly expressed in sectoral science and technology policies. Further, coordination of research and development activities and administration of research are major problem areas.

The government created the Uganda National Council for Science and Technology to advise itself on all matters relating to scientific and technological activities and as a mechanism for rationalizing the integration of science and technology in national socio-economic development. It is apparent that science and technology policy interventions must be preceded by identification of

technology policy measures responsible for stimulating and promoting technology for economic development.

Among the factors constraining the status of science and technology in Uganda are inadequate application and utilization of available technologies, low priority attached to science and technology education, lack of a coordinated approach among national science and technology implementing institutions, and poor funding of research and development (R & D).

Because of the strategic nature and threat of new and emerging technologies, Uganda is pondering on what the policy should be for their management.

Human resource capability is a critical factor for the success of integrating science and technology in national development process. Uganda aims in the long term at a 1:4:20 ratio of Scientists and Engineers/technicians/artisans as an ideal level of manpower for application of science and technology although this level of human resources capacity will certainly take some time to achieve.

Several overriding factors in the successful management of science and technology policy in Uganda include: elevation of the priority attached to science and technology by government, institutional arrangements for technology management and the enhancement of technology policy management, inter-institutional cooperation and linkages, and adequate allocation especially of financial resources for the promotion and development of science and technology and for the management of science and technology.

Summary of Conclusions and Recommendations

In addition to the discussions which took place at plenary sessions, four syndicate groups critically examined aspects of the main theme. The conclusions and recommendations listed here-under summarize the position of the 14th Roundtable on topics ranging from science and technology environment and policy, through institutional and capacity building, and resource allocation, to the dissemination and utilization of the results of research.

S & T Environment and Policy

The Roundtable noted that:

- (a) Africa is currently struggling with multiple crises – the food and agriculture, balance of payments, external debt, population, environmental, refugee, and basic-needs crises, to mention a few;
- (b) the region's poor record in finding solutions to these crisis is a sad reflection on its limited mastery of science and technology, which further translates in to a limited control over its destiny;
- (c) the journey to socio-economic recovery and to sustainable development will begin only when science and technology is accorded the importance it deserves in the policy planning and resource allocation processes;
- (d) notwithstanding the publicly stated position on the subject, science and technology is yet to be accorded the importance it deserves in the policy process;
- (e) the failure to back words with deeds is reflected not only in the absence of a clearly articulated policy on the development, utilization and promotion of science and technology, but also in the failure to make resources available for the development of science and technology;
- (f) the Lagos Plan of Action represented the first major initiative to outline the strategic options in science and technology with a view to transforming the economies of Africa;
- (g) the prolonged socio-economic crisis has hampered efforts aimed at implementing the guidelines in the Lagos Plan

of Action, particularly, as regards the need to earmark a specified percentage of GDP to Research and Development in science and Technology;

- (h) the adoption of SAPs further impaired efforts at increasing investment in science and technology;
- (i) an environment which is conducive to the development of science and technology - including a stable polity, accountable and responsive governance, and appropriate institutional infrastructure - is yet to be established in a number of countries in Africa.

Recommendations

To enhance the policy management capacity for the development of science and technology, the Roundtable recommended that steps be taken to:

- (i) create an awareness among policy makers, users of science and technology, and the society at large, on the importance of science and technology and on a culture that underpins scientific and technological endeavors;
- (ii) strengthen the capacity of institutions and personnel associated with science and technology ventures;
- (iii) evolve a system of rewards and incentives targeted at African inventors and innovators who are actively engaged in extending the frontiers of science and technology;
- (iv) institute policy measures which effectively check all manifestations of external dependency and restore the African peoples' confidence in their own innate abilities;
- (v) promote research aimed at finding workable solutions to basic human problems, including the problems encountered by the majority of the people residing in rural communities;
- (vi) establish funds for research and development in different areas of science and technology;
- (vii) enhance the status of science at all educational levels;
- (viii) incorporate science and technology policies in national development plans and programmes, and ensure that the

objectives of such policies are pursued right down to the level of project implementation;

- (ix) get AAPAM to communicate with member states on how these recommendations could influence production methods and patterns in the various African countries.

Institutional and Capacity-Building

As regards the institutional and capacity-building measures which need to be instituted in support of science and technology, the Roundtable began with a number of observations, viz:

- (a) the organizational arrangement for science and technology policy management has both structural and functional components;
- (b) the success of capacity-building initiatives in science and technology hinges on the prevailing political environment, the policy and institutional infrastructure available, the competence and motivation of research and development personnel, and the dissemination and utilization of results of research in science and technology;
- (c) the effectiveness of science and technology institutions can be measured in terms of how far they succeed in achieving science and technology policy objectives, the quantity and quality of products/ideas produced, and the range of socio-economic problems tackled;
- (d) among the essential tasks which science and technology institutions are expected to carry out are policy formulation and strategic planning; programme management, monitoring and evaluation; project design; resource mobilization; coordination of science and technology activities; personnel selection, training and motivation; dissemination of research results; and institutional evaluation.

Recommendations

In the light of the preceding observations, the Roundtable recommended that:

- (i) The three-tier national organizational structure comprising a council at the apex, (supported by the implementing

- agencies and closely linked with the clients) should be adopted and adapted as the model;
- (ii) in restructuring and streamlining the existing S & T institutions, due attentions should be paid not only to the national strategic objectives in science and technology but also to the tasks identified under (d) above as part of the observations;
 - (iii) independent visitation panels should be periodically instituted by the Government to review the mandate, performance and effectiveness of the various S & T institutions, and propose changes deemed appropriate in structure, function, and interagency relationships;
 - (iv) the capacity of the S & T institutions to negotiate with external technical assistance institutions should be enhanced;
 - (v) the institutions responsible for coordinating the activities of S & T institutions and for mobilizing resources should be suitably located in the machinery of Government and be accorded high level political support;
 - (vi) as much as possible, multidisciplinary teams should be constituted to mount joint attacks on S & T problems, provide for cross-fertilization of ideas, and develop the team spirit which is so critical to breakthrough in science and technology.
 - (vii) emphasis should be placed on the development and enhancement of indigenous policy analytic capacity (through the organization of senior policy seminars and in-plant training programmes targeted to policy-makers, business executives, and professional scientists and technologists).

Resource Allocation

The Roundtable observed that:

- (a) resource allocation to science and technology is determined by several factors – political, cultural, economic, administrative and managerial;
- (b) other inhibiting factors are the poor performance of institutions established to promote S & T, corrupt and wasteful allocation of resources, the tendency to dis-

parage indigenous technology and locally manufactured products, the not-so-cordial relations between government and industry, and between policy-makers and research institutions;

- (c) some of the constraints can be over-come if, in addition to addressing them, steps are taken to prepare sound feasibility studies leading to economically sound projects in S & T;
- (d) many R & D agencies lack the capacity to plan for S & T financing and mobilise resources;
- (e) technology transfer and external technical assistance tend to perpetuate dependance on external sources of technology, particularly, where conscious efforts are not taken to follow up matters such as technology adaption, utilization renovation and upgrading;
- (f) recent developments in Africa (particularly, the movement towards pluralism, the morbid fear of the increasing marginalization of a backward Africa, and the modest gain recorded in recent years in S & T) may reverse the currently negative trend.

Recommendations

The Roundtable subsequently recommended as follows:

- (i) the training of technicians and technologists so critical to the development of S & T should be intensified;
- (ii) government and its agencies should identify local craftsmen, artisans, black-smiths, iron mongers, mechanics and steel facricators, and assist them to upgrade their level of competence;
- (iii) a programme of education and public enlightenment should be mounted and sustained to sensitise key individuals and institutions to the challenges ahead;
- (iv) educational institutions (at the primary, secondary and tertiary levels) should be staffed with qualified personnel, equiped, funded, and motivated to promote the teaching of science and technology;
- (v) a programme of financial and technical assistance should be developed to assist small-scale and medium-size

enterprises to implement modest S & T development schemes;

- (vi) government should initiate and sustain dialogue with the private sector with a view to obtaining the latter's support and commitment to the implementation of S & T policy and programmes;
- (vii) governments' tendering and procurement procedures should be closely tied to efforts at encouraging the development of indigenous technology;
- (viii) steps should be taken to create an environment conducive to R & D in S & T and the necessary institutional linkages and infrastructural support should be provided;
- (ix) small farmers and grass-roots organizations should be considered part of the private sector, and encouraged to undertake R & D in S & T;
- (x) the future thrust should be towards the development of sustainable and appropriate technology, bearing in mind that if "small is not beautiful", it is, at least, easy to manage;
- (xi) a specific proportion of national resources should be earmarked for R & D in S & T.

Disseminating and Optimising Results of Research

The Roundtable noted that:

- (a) the dissemination, commercialization and utilization of the results of research fall far below expectations;
- (b) the scientists are mainly to blame for the "communication block" as they seem content to speak a language which the policy makers and the people do not understand;
- (c) the results of their research are also seldom made available to industry with a view to assessing their marketability;
- (d) there must be some loopholes in our patent laws which foreign entrepreneurs exploit to the disadvantage of indigenous African inventors.

Recommendations

In the light of the foregoing, the Roundtable recommended that:

- (i) the results of research should be disseminated among the scientific community through publications, seminars, workshops, conferences etc., and the policy implications of these research findings should be couched in simple, lay man's language;
- (ii) the exchange of publications should be promoted;
- (iii) the scientific community should constitute itself into special interest groups and establish professional bodies which will, among others, serve as vehicles for the propagation of novel ideas;
- (iv) the non-scientific community should be disaggregated into three groups or categories for purposes of dissemination of research results viz:
 - (a) the policy makers,
 - (b) entrepreneurs in the industrial and manufacturing sector, and
 - (c) the general public;
- (v) the communication which is addressed to policy makers should be presented in a concise and readable form;
- (vi) policy makers should make it a point of attending seminars, conferences, symposia etc. at which new ideas in S & T are to be discussed;
- (vii) chambers of commerce, manufacturers associations and individual entrepreneurs should also be kept up-to-date on developments in the local scientific community;
- (viii) the general public should be reached through the mass media (including mobile cinema, and community viewing centres), exhibitions, extension services, community groups and associations, etc.
- (ix) to achieve the aim of commercialization, S & T projects should be preceded by sound feasibility studies;
- (x) S & T and R & D personnel should be exposed to business management training (with emphasis on marketing and

production management; cost-benefit analysis; project evaluation, analysis, and management; patents and agency legislation; plant layout; human resource management; and case studies in project design and programme management);

- (xi) extant patents and copyrights legislation should be critically reviewed to protect the interest of indigenous scientists and inventors, and facilitate dialogue between them and the financiers of R & D projects.