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REPORT TO THE INTERGOVERNMENTAL COMMITTEE ON ENDEGENOUS CAPACITY BUILDING IN SCIENCE AND TECHNOLOGY IN THE AFRICAN REGION

Science and Technology Section
Natural Resources Division
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Endogenous Capacity Building in Science and Technology in the African Region

Introduction

Endogenous Capacity in Science and Technology is essential for the socio-economic development of the African region. One of the main reasons for the underdevelopment of the region is the low level of scientific and technological capacity and an inadequate development and application of science and technology. Though there has been a growing awareness of the crucial role of science and technology in the development process, this awareness has not been matched by adequate allocation of resources to this area in the past decade, because of the international climate and the economic crisis which most African states are facing. The few countries that have invested in endogenous capacity building have succeeded in improving the living conditions of their people, but such success stories are few in the African panorama.

Endogenous capacity building implies the building up of both human capability and institutional infrastructures, besides setting up suitable mechanisms for policy formulation and implementation at the government level. Significant efforts have been deployed in the African region in all these areas, but their impacts on socio-economic development have been marginal for the following reasons:

(a) Science and technology have been construed as high level scientific research and manpower training, while the application of available, off-the-shelf, science and technology has been ignored. This has greatly affected the funding of science and technology.

(b) There has been little effort to apply research results and findings to local development, and no mechanism has been created for the commercialization of research results.

(c) The private Sector, the stake-holders like the bankers, entrepreneurs, consumers, etc, have not been involved in the drawing up of a science and technology programme in a country.

(d) Scientific and technological research and development priorities are not always in line with the country's priority needs.

(e) Scientific and technical education at primary, secondary and tertiary levels are not in tune with the requirements of modern S+T developments, and a scientific culture is not present;

(f) Incentives to scientific and technological personnel, and to developers, users, and entrepreneurs, who can commercialize technology products, are generally missing. New legislations are required.

Because of these, and many other factors, endogenous capacity building in Africa has not been able to contribute adequately to local development, in as much as even the basic needs of the people have not been met after over two decades of independence.

National Policy Mechanisms for Endogenous capacity building

The basis for sound endogenous capacity building is the presence of appropriate policies at national level. Such policies should emanate from concerned groups within the government, acting within the framework of policy-making bodies where the public and the private sector join hands with scientists and technologists. Most of the countries in the region have policy-making bodies for science and technology. Their main functions include the co-odination of science and technology activities at national level, the prioritization of research and development projects, the search for funding and the support of R+D institutions, and generally the promotion of science and technology. As such they have both advisory and executive functions. However these functions are not always supported by adequate funding in view of the cross-sectoral nature of science and technology, the involvement of many ministries dealing with sectoral research and development, and the stress on research and training rather than on application of S+T for development.

While in some countries the policy making bodies are attached to specific ministries like those of higher education and research, or the planning ministries, in a few they are directly under the stewardship of the President or the Prime Minister. In these latter cases, the chances of sucess are higher because of the importance given to this field, and because resource allocation becomes easier when the President or Prime-Minister himself shows an interest in the activities.

The French speaking states have stressed more on scientific research and training than on technological research and development. They have therefore produced scientists of high calibre, who have unfortunately not found the proper outlet through infrastructures

that could retain them, and have often left their countries for better climes. The situation is slightly better in English speaking states of Africa where the setting up of small and medium scale industries have enabled the trained scientists and technologists to find their feet, though even here there is room for improvement.

One of the priority tasks of the science and technology policy making bodies is to formulate explicit science and technology policies and plans, and to integrate these policies and plans in the national socio-economic development policies and plans. This task has been achieved by only a very few selected countries in Africa, and therefore still remains a priority in the area of endogenous capacity building.

Recent studies, conducted by Atul Wad and Radnor (1) and by UNESCO (2), indicate that by 1986 nearly twenty eight countries in Africa had some form of multi-sector body for coordinating scientific research and for policy formulation. This is shown in table I (3).

Table II shows the trends in the formation of science and technology policy-making bodies in the period 1973-1986. This table has been compiled from table I (3).

Considering different sectors like agriculture, medicine, industry, environment, etc, the overall number of policy making organs was 69 in 1973, and increased to 197 in 1986. 128 new policy organs were established. The number of ministries responsible for national science and technology policies increased from 5 in 1973 to 18 in 1986. However, only few were actually Ministries of Science and Technology. The portfolio for science and technology has changed hands rapidly in a few countries -Kenya, Tanzania, Senegal, etc. This is principally due to the multi-sectoral nature of science and technology where many ministries have activities in science and technology and do not want to be controlled by one particular ministry. Tanzania has moved from a National Scientific Research Council under the Ministry of Economic Affairs to a National Commission for Science and Technology chaired by the President. ECA studies have brought out that because of the multi-sectoral nature of Science and technology, it is best to have any co-ordinating mechanism for S+T placed under the President himself, or the Prime Minister. This is the case in a few rapidly industrialising countries (N.I.C) of South-East Asia and the Far East, where science and technology have been able to contribute immensely to rapid socio-economic development.

Though the tables I and II show a positive trend in the growth of science and technology policy-making bodies, they do not in anyway bring out the effectiveness of these bodies which have been biassed

towards research, and have given little attention to the application of science and technology.

Development of human resources in science and technology

Apart from a few countries like Botswana, Cameroon, Libya, Malawi, Ghana, Zambia and Swaziland, there is a dearth of adequately qualified manpower in the whole African region for science and technology development and application. Even in the above cited countries, the highly trained manpower in S+T have not had the opportunity to occupy themselves gainfully in the absence of infrastructure for commercialization of R+D, and a strong private sector involved in R+D. This has led to brain-drain and a loss to the countries.

Educational policies are often such as to concentrate either on basic education or high level specialised training, forgetting the middle-level technicians so essential for any industrial development. It is recognized that for every engineer trained, there should be at least ten technicians trained. Then only the engineer can do his job properly; otherwise he ends up as an administrator or manager, and actual engineering and technological development suffer. The informal sector is the major contributor to production of goods and services in most African countries. This sector unfortunately employs mostly unskilled or semi-skilled craftsmen and technicians. Engineers keep away from them because they feel it is not up to their standard of education. Skilled technicians are lacking, and the whole sector suffers from input from qualified people who could contribute significantly in the innovation process so essential for the improvement of products from this sector.

At the secondary school level, the science laboratories are generally ill-equipped for practical classes. So the pupils cannot grasp fundamental principles of science properly for they are not given an opportunity to handle equipment and experience things through experimentation. Most of the school laboratory equipment is imported and with rising cost, the laboratories are unable to replace old, out dated equipment which are still utilized for class demonstration. The need to manufacture school science equipment at national and sub-regional level to meet the demands of the region has been stressed on multiple fora, but up to now there is not a single manufacturing institution able to satisfy even its own national needs. There is an urgent need for policy initiatives, programmes and projects in this field.

Engineers trained in universities and polytechnics are rarely able to have proper practical training in almost all African countries, for there is a dearth of industries where they can acquire such training. So actual engineering work suffers for they are unable to apply their theoretical knowledge properly. There has been suggestions for creating a few sub-regional production cum training centres where engineering graduates could have engineering practice. There suggestions have remained on paper because donors have not been forthcoming to fund such projects essential for scientific and technological manpower development in the region.

There is a general need to dovetail a country's educational policy with its science and technology policy. Primary, secondary and tertiary education should lay more stress on science and technology, and university curricula should aim at giving diplomas and degrees in subjects relevant to the country's priority needs before embarking on long-term development needs. It is unfortunate that most institutes of higher learning in Africa are training an elitist class that goes further and further away from the grass roots, and contributes little to socio-economic development of the masses. This should in no way hamper the training of people able to keep abreast with international scientific and technological progress.

The number of scientists and engineers trained in most African countries is far less than what is needed for basic development. In terms of numbers per million inhabitants, most countries in the region have about one third of the corresponding figures in Asia and only 3% of the level in Europe (4). The actual figures for a few selected countries are found in table III. It is noted that figures for technicians are not available in the case of most countries. From the available data, the training of scientific and technological manpower for the region is an issue that deserves high priority in a country's agenda, and adequate resources need to be allocated for this.

Funding of Science and Technology

The R+D expenditure as a percentage of GNP, and the classification of countries according to the number of S+T personnel per million of population is shown in table IV. The table also shows the situation in developed countries.

Table I

SCIENCE AND TECHNOLOGY POLICY-MAKERS
ORGANS IN AFRICAN COUNTRIES - OCTOBER 1986

	Ministry of Science or Ministerial Science Policy Committee	Science Planning Body general	Multisector body for Coordinating Natural Scientific Research	Coordinating bodies for Scientific Research: Science Research	Agricultural Research	Medical Research	Nuclear Research	Industrial Research	Government Research
ALGERIA	*		x		*			*	
ANGOLA						x		*	x
BENIN	A	A	*	A	*			A	
BOTSWANA			A	A	x	x		x	
BURKINA FASO	*	x	x		x			x	x
BURUNDI	A			A	*	*		*	
CAMEROON	A	*	*	A					
CAPE VERDE									
CENT. AFRICA REP.	A	x	*		x				
CHAD	A								
COMOROS			*	A	x	x		x	
CONGO	A		*	x		x		x	x
COTE D'IVOIRE	*	x							
DJIBOUTI				*	*	*	x	*	*
EGYPT	*								
EQUATORIAL GUINEA			*	x		x		x	x
ETHIOPIA				x				x	x
GABON	x	x	*	x	x				
GAMBIA		*	*	x	x	x		*	x
GHANA						x		x	x
GUINEA	*	x	*	x	x				
GUINEA BISSAU									
LESOTHO				x	*	x		x	x
LIBERIA			*		x	x		x	
LIBYA ARAB REP.		A	x						
MADAGASCAR	x		x	x	x			A	
MALAWI	A								
MALI	A	*							
MAURITANIA									
MAURITIUS					*			*	
MOROCCO	A		A						
MOZAMBIQUE								x	
NIGER	A	*	*	x		*		x	
NIGERIA	A	*	*	*	x				
RWANDA	A	x							
SAO TOME & PRINCIPE						x		x	x
SENEGAL	A	*	*	x	x				
SEYCHELLES					A				
SIERRA LEONE			A						
SOMALIA			A			*		*	x
SUDAN	A	*	*	A	*				
SWAZILAND				x	X	X		x	x
TANZANIA	A	*	*		x	X		X	x
TOGO	X		X		X	X			
TUNISIA			*	x	x			A	A
UGANDA		*	*	X	*	x			
ZAIRE	A		*	x		*	*	*	x
ZAMBIA	A	*	*	A	*				
ZIMBABWE	A								

Source: Compiled from ATUL WAD, AND RANDER 1983: Science and Technology in Africa. Priorities and Implications for International Co-operation, North Western University, Evanston, Illinois, U.S.A.

UNESCO: Comparative Study on the National Science and Technology Policy-Making bodies in the countries of West Africa. Science Policy Studies and Documents No. 58, Paris, 1986.

UNESCO: World Directory of National Science and Technology Policy-Making Bodies, Science Policy Studies and Documents No. 59, Paris, 1984.

- National papers submitted to CASTAFRICA II.

Note:

1. X indicates institution which existed before 1979
2. * indicates institution which existed in 1973
3. A indicates institution existing after 1979

Table II

TRENDS IN THE FORMATION OF SCIENCE AND TECHNOLOGY POLICY-MAKING BODIES 1973-1986

	1973	1979		After 1979	Total 1986
		Increase	Total		
Ministry of Science or Ministerial Science Policy Council	5	+ 4	9	+18*	27
Science Planning Body in General	12	+ 6	18	+ 2	20
Multisector Body for Co-ordinating Scientific Research	18	+ 6	24	+ 4	26
Natural Science Research	2	+14*	16	+ 9	25
Agricultural Research	15	+15*	30	+ 2	32
Medical Research	6	+14*	20	+ 1	21
Nuclear Research	3	+ 1	4	-	4
Industrial Research	7	+15*	22	+ 3	25
Environmental Research	1	+13*	14	1	15
Total	69		157		
Increase		88		40	
Grand Total			157	40	[illegible]

* Indicates bodies with rapid increase.

Source: Compiled from Table 4, 1986

It can be seen that most African countries, 21 of them, spend less than 0.2% of their G.N.P. in R+D activities. 15 countries spend between 0.2 to 0.4% of the GNP, while 7 countries spend between 0.5 and 0.99%, as of 1980. Recently a few countries, including Egypt, have met the target of 1% of their GNP Marked for S+T activities, as per the Lagos Plan of Action. These can be compared with what the developed countries spend on R+D, where in many case they go far above 2% of GNP.

African countries have not been able to meet the target of 1% of GNP in the eighties because of the adverse and critical economic condition they are facing. Inadequate funding of S+T activities leads to a weak S+T base, and a weak S+T base leads to inadequate application of S+T to exploit the natural ressources, or to develop the country through agricultural and industrial developments. The vicious circle can go on for a while, unless African member states pool their resources together through cooperation, and decide to adopt policies that can enhance such cooperation. Reliance on external aid cannot solve the problems, all the more since such aid is going to be scarcer in the days to come.

Management of Human S+T Resources

It is not only enough to have adequately trained manpower in S+T, but it is equally important to retain such manpower. The best trained people are attracted by better salaries, better living and working conditions and better prospects for personal professional improvement in the more developed countries of the west. Hence it is essential to have policies that can offer the incentives necessary to keep the trained manpower.

Unfortunately such policies are absent, or, if present, are not implemented properly. In most African Universities, scientists, and engineers are barred from undertaking outside work. Consultancies are not encouraged. Even if consultancies are allowed, the bureaucratic hurdles and the percentage that goes to the University tend to frustrate the enterprising scientists and technologists. In countries where the private sector is fairly well established, these people leave the university or the public sector and prefer to join the private sector. In other countries the easiest way out is to emigrate to more favourable climes. The solution to this is to have policies and programmes to provide the trained people with genuine career prospects backed by healthy living and working conditions, and recognition within the community. This recognition will make the scientists and technologists feel socially useful and integrated and thereby enhance their capcity to contribute to local socio-economic development.

Table III

TOTAL STOCK OF

ECONOMICALLY ACTIVE SCIENTISTS, ENGINEERS AND TECHNICIANS

AS PER MILLION INHABITANTS IN SELECTED AFRICAN COUNTRIES

1975 TO 1983

	Scientists & Engineers				Technicians			
Country	1975	1980	1982	1983	1975	1980	1982	1983
Botswana	1245	-	-	-	1174	-	-	-
Cameroon	1331	-	-	-	-	-	-	-
Congo	-	-	-	-	2403	-	-	-
Egypt	13006	-	-	-	-	-	-	-
Gambia	897	-	-	-	-	-	-	-
Ghana	861	-	-	-	1752	-	-	-
Kenya	383	-	900	-	439	-	2573	-
Libya	3711	14592	-	-	4729	3030	-	-
Malawi	723	-	-	-	-	-	-	-
Nigeria	353	274	-	-	276	1387	-	-
Rwanda	-	366		-	-	-	-	-
Seychelles	5357*	-	-	-	-	-	-	-
Sudan	572*	-	-	-	105*	-	-	-
Swaziland	2730	-	-	-	-	-	-	-
Togo	229	-	-	-	-	-	-	-
Tunisia	606*	-	-	-	1367*	-	-	-
Zambia	2353	-	-	-	5561	-	-	-

* Provisional or estimated.

Source: Compiled from Unesco Statistical Digest, 1985, Paris.

Table IV

Classification of countries according to the number of scientists and engineers engaged in R&D activities per million population and R&D expenditure as percentage of GNP* (for 1980)

R&D Expenditure as % of GNP	[illegible] 50	50 - 99	100 - 499	500 - 1999	≥ 2000
≥ 2%				United Kingdom	Bulgaria*(1) Fed. Rep. Germany Hungary*(1) Israel Japan (1) Switzerland U.S.A. (1) USSR* (1)
1 - 1.9%				Austria Canada (1) Denmark France	Australia Belgium Finland Netherlands (1) Norway Poland* (1) Rumania Sweden
0.5-0.99%		Côte d'Ivoire Madagascar Senegal Zambia	Cameroon Egypt Togo		
0.2 - 0.49%	Burkina Faso Chad Nigeria Sierra Leone United Rep. Tanzania	Kenya Liberia Morocco Swaziland	Algeria Congo Ghana Mauritius Sudan Tunisia		
[illegible] 0.2%	Angola Benin Burundi Central Afr. Republic Ethiopia Gambia Lesotho Libyan Arab Jam. Malawi Mali Mauritania Mozambique Niger Rwanda Seychelles Somalia Uganda Zaire	Botswana Guinea	Gabon		

→ Number of scientists and engineers engaged in R&D activities per million population

Source: Extracted from "Estimated World Resources for Research and Experimental Development, 1970-1980, Unesco, 1983 (CSR-S-17)

* in percentage of Net Material Product (NMP)

(1) not estimated

Adequate working and living environment for scientists and technologists demands higher government input in terms of funding. Apart from a few French speaking states of West AFrica which receive external funding for R+D, it is a characteristic of most developing countries in Africa that nearly 100% of the funding comes from government, the major employer of S+T personnel. Where as the contribution of the private industrial sector to R+D in developed countries is over 50%, in developing countries this is marginal. National S+T policies should favour the input of the private sector to R+D, and this can only be achieved if government legislates in favour of reducing taxes against the private sector. So the management of human resources for S+T goes hand in hand with the management of funding for S+T.

Measures to promote research and development

Few countries in Africa have enacted adequate legislations to enable the private sector to contribute to R+D (5) Such legislations should favour:

(a) Cost and risk reduction incentives, including financial, fiscal and institutional incentives.

(b) Post R+D incentives aimed at assisting the commercialization of and market development for R+D results, whether new products or processes;

(c) Statutory incentives such as provisions to allow firms to form research associations.

Financial incentives include low-interest lending programs by national banks and government commissioning R+D activities to private sector. Fiscal incentives include various types of tax deductions on campanies undertaking R+D activities, accelerated depreciation on R+D investment and reduction on capital gains tax of venture capital campanies. Institutional incentives help the setting up of National Research and Development Cooperations that are responsible for financing the development of new technologies for industrial application and for commercializing research results from research institutes and universities. This also includes post R+D incentives to manufacturers, adopters and users of new products and processes who need favourable financial and fiscal incentives.

Co-operation in the field of S+T in Africa

One of the main features of an S+T policy is the need for co-operation with a view to make optimal use of available resources, and with a view to enhance the development and application of science and technology.

Inter-ministerial co-operation at the national level is enhanced by the existence of structures and mechanisms that can enable the S+T community to mix and share experiences in their different fields. The existence of National Unions for Science and Technology can go a long way in fostering such cooperation. As a non-governmental body this can unite scientists and technologists at the national level, and sponsor such activities as the community demand. Such unions are not common in most African countries, though a few do have associations for the advancement of sciences. Scientists, technologists and engineers can join hands and cooperate for the national good through national unions for science and technology.

At the sub-regional level cooperation in the field of science and technology exists through the different sub-regional economic groupings. These are the CEAO, Communauté Economique de l'Afrique de l'Ouest including seven countries of West Africa; the CEEAC, Communauté Economique des Etats de l'Afrique Centrale, including ten French speaking countries of Central Africa; the CEPGL, Communauté Economique des Etats des Pays des Grands Lacs, including three countries around the great lakes in Central Africa; UDEAC, Union douanière et économique de l'Afrique Centrale, including six countries; ECOWAS, Economic Community of West African States; including sixteen countries; SADCC, the Southern African Development Co-ordination Conference, with 9 countries of Southern Africa; and recently the PTA, the Preferential Trade Area including eighteen countries of Eastern and Southern Africa. Efforts are being made to create a PTA for the North African sub-region. In all these sub-regional groupings some co-operative projects in the field of science and technology are being implemented. What is missing is a sub-regional policy for S+T in each sub-region. The UN Economic Commission for Africa has set up five sub-regional working groups of the Intergovernmental Committee of Experts for Science and Technology Development (IGCESTD), which meet and implement projects bearing sub-regional dimensions.

At the regional level cooperation in science and technology has been taking place principally through the ECA Intergovernmental Committee of Experts for Science and Technology Development (6), which meets regularly and decides on regional orientation of S+T activities

in line with new developments in the world. Many specialized agencies of the United Nations organize regional conferences, seminars and workshops on specific themes in the area of science and technology, like the CASTAFRICA conferences of UNESCO.

Specialized regional organizations and centres have been set up under the joint sponsorship of UN Economic Commission for Africa and the Organization of African Unity. These are:

(i) The African Regional Standards Organisation (ARSO)

(ii) The African Regional Centre for Technology (ARCT)

(iii) The African Regional Centre for Engineering Design and Manufacturing (ARCEDEM)

(iv) The African Regional Remote Sensing Council (ARRSC)

(v) The African Regional Industrial Property Organization (ARIPO)

Two non-governmental organizations have been set up in the recent past. The African Academy of sciences (AAS), and the Pan African Union for Science and Technology (PUST). There are a few scientific associations at panafrican level, but they are not very active as they have financial problems.

Besides undertaking co-operative programs and projects these sub-regional and regional organizations also attempt to lay the foundations for sound policies in the African region. Such policies, Unfortunately are still far from being clearly formulated and implemented, with the result that the dependence syndrome gets perpetuated. Sub-regional and regional policies in science and technology should be seen as the first step in the direction towards interdependent and self-sustained development.

Policies and Political will

National policies that have not emanated from a national debate through popular participation concerning scientifc and technological development tend to be weak and lack political support. In those countries where national workshops and conferences have been organized to deliberate on S+T issues that could form the basis for S+T policies,

sound policies have resulted, and their implementation is easier. This is the case in Ethiopia, Nigeria, Ghana, Kenya . It is essential to involve all the stake-holders with representatives from the political, social, and economic milieux, including the researchers, technologists, entrepreneurs, bankers and market specialists who are aware of the realities in the country. National conferences and workshops are occasions when political commitment can be ensured by having the political leaders participate at the opening and closing sessions.

In many developing countries of Africa there has been an indiscriminate acquisition of foreign technologies without regard to possible implications for the future of national S+T efforts (7). The public sector which is the main importer of technology, has favoured the purchase of big and sophisticated 'turnkey' systems which in no time, have degenerated and closed down. Such an approach has not favoured local endogenous capacity building. Such would not have been the case if accountability and popular public participation in decision making had been there and scientists and technologists had taken a keen interest in influencing political decisions.

Conclusion and recommendations:

Endogenous capacity building is the first step towards enabling a country to stand on its own legs, with the minimum of dependence on external aid. It requires a strong political will backed by policies and plans, the involvement of the private sector and stake-olders in the economy, adequate financial support, appropriate incentives through legislation to all concerned, institutional structures, and co-operation at sub-regional and regional level to optimise on the scarce resources available. The following recommendations are worth considering:

1. Science and technology policies are essential both for short term and long term planning of socio-economic development having a strong component of scientific and technological development. Such policies should be evolved through popular participation of stake-holders, namely the policy-makers, researchers, entrepreneurs, bankers, market specialists and representatives of social scientists and the public, at national conferences or workshops on S+T policy, and integrated into national development plans.

2. For an accelerated scientific and technological development, the involvement of both public and private sectors is essential in the creation and running of infrastructures for research and development, with emphasis on the application of science and technology and the

commercialization of research results. The setting up of National Research and Development Corporations that take care of this, should be seen as a priority.

3. Fiscal, financial, institutional and other types of incentives are necessary and governments should provide such incentives to the entrepreneurs and the local S+T community to encourage them in S+T activities. Universities should be liberal on allowing their researchers to undertake counsultancies, and the government should provide healthy living and working environments and give due recognition to local scientific and technological talents, with a view to avoid brain drain and encourage local development.

4. Any sound S+T policy should encourage industrialization in the context of a self-reliant and sustainable development that prevents perpetuation of a dependency syndrome (8) While heavy industries are indispensable for long term objectives of restructuring the economy and for building a technological and industrial base, the immediate twin objectives of increased employment and adequate supply of basic consumer goods can be met by cotage, small and medium scale industries.

5. Investment in S+T capacities require the encouragement of not only researchers but also of engineering consultancy capabilities and technical capabilities at the production sites. For sustained and long term technological capacity building a selective disengagement of the national economy from the global economy is necessary, though the international community should continue to support African endogenous capacity building for some time to come.

6. With the advent of new and frontier science and technology in the developed world which is having a damaging impact on the value of African commodities, the world market price of which is plummeting, African member states should enhance their efforts to capitalize on these new technologies by increased R+D that can enable them to diversify their production and find alternative markets for processed goods and materials. Particular attention is to be given to biotechnology and new materials technologies.

7. Member states should ensure that their S+T policy should cater for a proper regulation of technology imports by suitable legislations that encourage investors and local technology capacity that can handle unpackaged technology.

8. A science and technology culture is still absent in the African scene. The popularization of science and technology using all available modes of propagation- folk dramas, folk songs, music, science clubs.

audio-visual channels, news-papers, exhibitions, etc has to be the basis for such an S+T culture. Cultural dimensions have to be integated in all S+T programmes and projects in order that they can be effective, and S+T policies should cater for these.

9. For an S+T policy to be effective, the S+T community should interact closely with policy makers and politicians, and encompass in their sphere of influence the political system and the apex decision makers, while still striving to maintain high standards in their S+T activities. They should not fight shy of local politics if they want to see their views prevail.

10. Cooperation in science and technology should aim at enhancing the development of domestic S+T bases through relevant training of technical personnel. Sub-regional and regional co-operation should aim at safeguarding a proper market for goods and services generated in Africa, and this requires sound sub-regional and regional policies in science and technology.

11. Africa cannot afford to lag behind in the area of scientific and technological development, otherwise it will always depend on the benevolence of the outside world community to fill its begging bowl when it is itself rich in natural resources. Science and technology policies have so far not been strong enough, and have not enjoyed the political support they need to redress the sad situation prevalent throughout the region. A sense of commitment is required from the entire S+T community who should have the interests of the common man at heart in order to be able to contribute their mite in this world of stiff competition and unscrupulous market forces. Only such policies and attitudes can favour the endogenous capacity building in science and technology so essential for overall socio-economic development.

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