2

National Policy on Science and Technology: An Integral Component of Development Strategy for African Countries

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Introduction

Africa cannot develop without constructively addressing issues that incorporate the proper development, application and utilisation of science and technology for sustainable development. If the quality of livelihood of the vast majority of the population is to be improved, drastic measures must be taken now to ensure the cultivation, growth, nurturing and utilisation of science and technology as integral components of national development strategies. Up till now, little has been done to incorporate science and technology (S&T) or research and development (R&D) as integral parts of development plans, yet no country has developed by bypassing science and technology. The way forward is for Africa to begin deploying its indigenous knowledge systems together with modern technology for the socio-economic transformation of the continent.

This paper looks at worrying trends in Africa, in relation to science and technology, but also outlines a way in which national policy can be formulated as an integral part of a development strategy that also incorporates gender. Several questions need to be posed regarding national policies for science and technology in Africa. What capacity do African countries have to build national systems for S&T and R&D policy in universities and research institutes? To what extent is the private sector willing to follow government S&T and R&D policies? How can the private sector contribute to S&T and R&D development? What role do political factors play in shaping state capacity? Do political parties have S&T and R&D policy agendas? What is the role of the international community? How should women be

incorporated into S&T and R&D policy formulation, development and utilisation? What is meant by S&T and R&D policy? In what ways can scholars share experiences and learn from each other to jointly contribute to knowledge creation, the necessary platform for empowering women and putting them on the development agenda during an era guided by the unstoppable forces of globalisation, information and communication technologies (ICTs) and genetic engineering? Do the people of Africa *want* to develop? What kind of development is envisioned for them? For whom, by whom and for what purpose is development in Africa to be pursued? How do we want to develop? By what means, when and how should the development come?

These questions are posed mainly to provoke discussion. They cannot be answered here, but some definitions of key terminologies are put forward, together with a survey of scientific and technological capacity in Africa, gender issues in science and technology, key theoretical perspectives and the formulation and implementation of national policy. The chapter ends with suggestions for a way forward.

Definitions of Key Terminologies

First of all, what are science and technology policies? Science and technology policies are forms of state intervention intended to promote the development and dissemination of knowledge and the practical application of research results to the production of goods and services. Science and technology policies contribute to building national innovation systems by introducing new technologies as well as improving on existing indigenous knowledge systems. Policy guidelines should act as a compass to pilot the nation out of underdevelopment, poverty, corruption, exploitation and marginalisation. Policy choices depend on government's capacity for obtaining and using relevant information, and particularly its capacity for taking into account a complex set of social interests while at the same time keeping a degree of independence from social and political pressures. The underlying challenge is how to translate national initiatives and international cooperation in science and technology into concrete activities, programmes and processes. Opportunities abound as Africa responds to its current state of scientific and technological underdevelopment, and a secure technological future can be built by taking advantage of information communication technologies (ICTs) and biotechnology/genetic engineering. The continent can also draw invaluable lessons from the economic history of the Asian 'tigers', many of which, as recently as the 1960s, were far more underdeveloped in terms of GNP per capita than some African countries at the time. A key factor in the successful industrial and economic transformation of these countries was that they were able to formulate and implement policies to harness science and technology for development. Their experience shows that policy implementation depends on administrative competencies as well as on broad political support and consensus at various levels. It requires government intervention to mobilise appropriate information and to develop the consensus necessary for policy implementation. In short, the success of any given policy depends on partnership, participation, responsibility

and benefit-sharing between the state, civil society, the productive sector and the international community, as I argue below. African countries need technological dynamism to address underdevelopment predicaments in three key areas: food production, plant breeding (including fertilizer and pesticide production) and health care systems. To face these challenges, policy guidelines, along with the support of high-level political institutions, in other words, the political will, are crucial.

Lack of Scientific and Technological Capacity

Many African countries do not have comprehensive, coherent science and technology policies. Elsewhere in the world, policies are clear, and industrial productivity is driven by science and technological inventions based on such policies. In most African countries, however, there are weak links between policy, science and industrial activities:

> Local industries generally purchase technology and related know-how from abroad rather than connect to local scientific thrusts. Towards the lower end of the development spectrum there is an almost total disjuncture between science and industry (Adam 2001).

Knowledge too is lacking. The *World Development Report* (1998) on the global explosion of knowledge identifies both threats and opportunities in this regard:

> If knowledge gaps widen, the world will be split further, not just by disparities in capital and other resources, but also by the disparity in knowledge. If we can narrow those knowledge gaps, it may be possible to improve incomes and living standards at a much faster pace than previously imagined (World Development Report 1998).

Gender in Science and Technology

Within the African continent, policy and politics constantly disadvantage women in relation to science and technology. For sustainable, science-driven development to take place, the relationship must move from the minus to the plus side of the development continuum. However, the relationship between scientific and technological change on the one hand and socio-economic development on the other are interrelated and complex. While it is true, as Wad (1982) notes, that there are many differences of opinion about what works and what does not work in terms of gender, science and technology policy, it also remains clear that policy plays a key role in relation to the what, when, how, why and for whom science and technology is done.

Theoretical Perspectives

There is no clear agreement on the most workable theoretical framework for science and technology policy. One possible framework is system theory, which, according to Easton (1953), is a response by the political system on input and output processes and the decisions brought to bear on it. Fundamental within this conception is the identification of institutions and activities that function to transform

demands (inputs) into authoritative decisions (outputs) necessitating the support of society. Elite theory, on the other hand, sees S&T and R&D policy as reflecting the interests and values of elites, not the demands of the people or the needy. From this perspective, public funds tend to be used not for the interests of the masses but for those of a particular class. Another theoretical framework, group theory, focuses on establishing the 'rules of the game' for the selection of issues, making different groups accountable for their policy preferences, enacting policy options by compromising and balancing various group interests. Policy here depends on consensus, which in turn depends on the relative influence of the different groups. Rational choice theory is a framework drawn from economics that depends on the concept of rational choice, while development theory (also called modernisation theory) offers a critique of traditional models of decision-making constrained by time, cost and intelligence. Finally, language theory emphasises the importance of language for enhancing, promoting and disseminating innovations in appropriate technology to the masses. It stresses that how we communicate with one another is vital in the development process. An appreciation of all these theories should inform policy formulation.

Formulation of Science and Technology Policy

At independence, many developing countries embarked on five-year national development plans, which were intended to provide a basis for the full incorporation of S&T and R&D as integral parts of the national development process. However, over the years, these five-year plans fell by the wayside of the (under-)development process. In their place, ad hoc policy measures and strategies became the order of the day, reducing S&T and R&D to an insignificant role. To date, numerous national and international factors have impacted on state capacity in the formulation and implementation of S&T and R&D policy. Science policy-related activities in African countries have in general evolved almost from scratch in many sectors to fit economic and political goals. The role of government in science policy has varied from country to country and over time.

As a result the practice of S&T and R&D policy in many African countries can be described in terms of:

- gross absence of political will and focus on development
- confusing policies on science and technology
- unrealistic goals
- inability to implement agreed-on policy recommendations
- inadequate financial inputs for S&T and R&D activities.

Where different forms of policy instruments exist, no explicit technology policy can be said to have been effectuated due to non-articulation and non-implementation of policies in respect of the following interrelated factors:

- poor understanding of the relationship between technology and economic, industrial and social development
- unrealistic understanding of the nature of dynamic industries and their technological requirements
- dependency and structural imbalances in the economy
- absence of political will and of indigenous strategic programmes to address underdevelopment.

In contrast, the newly industrialised economies of Asia and Latin America have adopted explicit technology policies directed at addressing the critical areas of:

- managing technology transfer
- managing technology change
- developing technological capacity.

Moreover, in Africa, the knowledge needed to transform existing natural resources into finished consumer products is lacking. It is vital for African countries to formulate policies capable of nurturing these critical areas instead of remaining raw material-exporting countries, Policy should be aimed at developing the capacity to assimilate, adapt and disseminate technologies as well as to innovate and be creative in building up an indigenous scientific and technological base. Human knowledge is extremely important. This explains why resource-poor countries like Denmark, Luxembourg and many others can still dictate to resource-rich African nations.

Therefore, the content of science policy must first be concerned with supporting both research and the utilisation of research findings. In formulating a science policy, at least three themes need to be considered:

- Scientific and technological innovation and the relations between government and industry, so that the necessary conducive environment for development can be put in place
- Issues of disparity between national research and development efforts, so that research results can be translated into consumer goods
- Creating the necessary framework for international scientific networking, so that the quality of domestic research is improved.

Secondly, science and technology policies and policy instruments must be specific in order to address and focus on:

- human resource development and institutional capacity building, which should involve illiteracy eradication, education campaigns and high-quality educational services and infrastructures
- social consensus through participation and political pluralism, i.e., democratic governance and good management incorporating the values of civic responsibility, discipline, stability and ethical values
- incorporation of socio-cultural factors in technological development through the proper use of resource potentials, cultural diversity and indigenous

knowledge systems as input assets, thus promoting and sustaining an indigenous science and technology culture

- development of strong incentives for the commercialisation of R&D results.

Thirdly, for society to move forward by means of technological discoveries and innovations, there is need to marry the four broad functions, the scientific, the professional, the administrative and the political, of government and public affairs. At one end of the spectrum, pure science is concerned with knowledge and truth. At the other end of the spectrum, politics is concerned with power and action. But none ever exists in its pure form.

Institutional malfunction, inadequate theoretical knowledge, poor understanding of technological problems and decision processes, inadequate research resources and inappropriate research methods must end. The academic community must get out of its ivory tower, stop prostituting itself for political posts and, instead, show its professional ethics by addressing the needs of the community. Individual citizens must be prepared to participate in decision-making about technological change, technology policy and good governance.

Elements of a Framework of Action

The most important element for a framework of action is commitment on the part of the government, civil society and the productive sector to make S&T and R&D integral parts of the overall national development strategy. There has to be a committed political will from the state and other actors. The orientation of national development planning should take account of long-term technological developments and requirements. The major requirements of S&T and R&D development include:

- development of national technological capabilities for technology policy, technology appraisal, diffusion and application, institution building, human resource development and effective exchange of information
- survey and identification of natural resources
- prompt and easy access to relevant technological information
- creation of a demand for local technological capabilities.

An important step in this direction is to put in place interactive structures. The first task is infrastructure development. Building the technological infrastructure capacity base is very important both within the productive sector (private sector) and in government (public sector), universities and research institutes. Universities, research institutes and basic research programmes, along with administrative mechanisms for their funding, coordination and control, have to be established. Multidisciplinary technological research institutes and services related to natural resources, such as meteorology services, oceanographic and geological surveys and mapping/remote-sensing agencies, are also required along with service institutes for testing, standards, quality control and troubleshooting. Finally, the local engineering and consulting industries must be promoted.

These activities require a sustained political commitment at the highest possible level of government, coupled with constant vigilance to ensure that the quality of performance meets international standards and is not undermined by the problems that typically beset government bureaucracy. Also, funding of research should be given top priority. As of now, this constitutes a weak link in the advancement of science and technology in many African countries. University-private sector linkages should be encouraged, with the major industries sponsoring research-related activities in their areas of interest.

Popularisation of S&T and R&D Policies

To popularise science and technology policies, all aspects of communication and dissemination mechanisms have to be developed and deployed in order to:

- find a common language to overcome cross-sector communication barriers and to generate increased understanding of scientific, socio-economic and management issues
- provide science and scaling tools to allow for policy-making aimed at management processes and/or procedures on different geographical and societal levels
- make science responsive to national issues through better linking with socio-economic, cultural, industrial, political and development factors
- bring science and technology nearer to the people and develop indigenous knowledge as inputs in the development process
- use information communication technologies (ICTs) adequately.

The challenge is for the mass media to articulate means and ways of getting the right message to the people on the role and impact of S&T and R&D in the socio-economic transformation of society and as a means of quantitatively and qualitatively improving their living standards.

Political parties, civil society and the general public, especially young people and women, should be encouraged to develop an interest in science and technology disciplines such as mathematics, physics, chemistry, biology and others. Groups, parties and institutions should also have their own policies on science and technology based on the national one. Specifically, this calls for policy measures that:

- promote national and cross-border cooperation and connectivity by utilising both indigenous knowledge systems and the modern knowledge currently available in existing centres of excellence on the continent
- develop and adapt information collection and analysis capacity to support productive activities
- generate a critical mass of technology expertise in targeted areas that offer high growth potential, especially in biotechnology and geo-science
- make use of the expertise of Africans in the diaspora to spur the process of change on the African continent.

Attention should also be paid to the Lagos Plan of Action (LPA), Africa's most articulated strategic policy framework, which failed to take off due the economic crises of the 1980s, and which today has been transformed into the New Partnership for Africa's Development (NEPAD). The LPA calls on African countries individually and collectively to give top priority to science and technology for sustainable development and to move from policy to action-oriented development activities with a human face.

Ways Forward

Science and technology policy in itself is not a panacea for resolving all the problems of the African continent, but it has the potential to transform their economies and achieve sustainable development through the quality and effectiveness of each country's policies and institutions that support science, technology and innovation. It is a means to an end and depends on the vision of leaders, the intensity and quality of interactions among the various stakeholders, the dedication of R&D bodies and policy-making departments and the dynamism of private economic enterprises that determine whether a country or particular region can harness science and technology for development. African countries should also learn from the successes of other countries, particularly in relation to:

- strong democratic government and committed leadership as essential conditions for economic, technological, scientific and industrial-take-off
- state participation in scientific and technological development, as in South Korea, Singapore, Brazil, India, Taiwan and others
- expansion of the education sector while tailoring education to address the specific needs of the society with an emphasis on technical education
- private-sector investment in human-resource capacity-building
- promotion of a culture of hard work, innovation, creativity, responsibility and accountability.

Additionally, just as an isolated human being is unable to share his or her ideas with anyone else or benefit from the ideas of others, a country or continent that tries to stand alone cannot make significant advances in addressing the needs of its people, nor can it take advantage of the rapid advancements in the domain of science and technology in other parts of the world. Africa should not be isolated in an age of globalisation and information communication technology. The move by Nigeria to launch a satellite with the aid of the Russian space station is most encouraging. On the whole, this may be the century to make, or continue to mar, the future of the people of Africa.

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