SCIENCE AND TECHNOLOGY IN NATION BUILDING[1]

G. B. Ogunmola. FAS.
President, Nigerian Academy of Science
Laboratory of Biophysical Chemistry, Department of Chemistry
University of Ibadan. Ibadan, Nigeria

([1]Being text (abridged) of a keynote address given at the First International Conference on Science and National Development by the President of Nigerian Academy of Science)

It is a pleasure to be with you on the occasion of your conference and to have the honour of addressing the public on the very important theme of *Science and National Development.* The theme you have chosen is very germane and topical at this critical point in our development as a leading nation in Africa trying to be at par with the world. For this reason there is some sense of issues of urgency to be addressed in respect of our national development.

I wish to address broad issues of significant importance to the technological development of the continent based on the premise that science must first and foremost be domesticated not as alien cultures but as an integral part of our own growth experience to eradicate ignorance, increase our awareness, sensitivity and ability to use all of our endowed factors in creativity and improvement of the quality of life and a sustainable environment.

Science and its role in any society, most especially in its socio-economic development, must be viewed in the broad context of the history of that society. The fact that the peak of the socio economic development of the 19th century was Europe centre also put the centre of sustained scientific activities in Europe and the nations of European origin. North America has since maintained a lead in science in the contemporary time and Japan and the Pacific regions are fast moving into position of eminence in the application of science in economic activities.

The earlier civilization in North Africa with significant science that promotes trades is not sustained and hence those civilisations were lost in the movement of trades and political power. In the rest of Africa at the same time, the absence of written records coupled with the system of beliefs did not allow for a systematic development of sustainable science to enhance economic activities.

To comprehend the basic causes of the problems of the African region, therefore it would be essential to examine the state of science, and its application in technology in Africa before proposing measures to remedy the problems and usher a new era of technological development for the region. A critical examination of the impact of science on the African economy reveals a number of crucial factors. Following Europe's industrial revolution, which was based on the appropriate utilization of scientific innovations. While a country like Japan received, absorbed and developed Europe's technological achievements to suit its development goals and remained politically independent, Africa and technology has to be integrated into indigenous cultures as alien cultures promoted only by its patron for the usefulness of the patrons rather than for the indigenous community.

Africa is not short of human or natural resources, nor the enormous potential of its young population. Currently the region is suffering not only from natural and man-made calamities but also from backwardness in science and technology, mainly because of the failure to take appropriate actions required to bring about sustenance in every aspect of socio-economic change. It is the inadequacy of its scientific potential that has militated at its ability to harness its natural resources and manpower for the advantage of its people.

No country has attained any breakthrough in its economic development without the development of adequate base in science and its application in technology. The kind of development which evolved Europe as a result of advance in science and technology did not evoke the same pattern of development in Africa. The question is why and how do we remedy it?

The African society has remained lacking behind in development due to its low level assimilation of science in its subsistence economy; and the emergence of an urban community that has to be supported on imported technology. Under these conditions, a disequilbrated social structure of African countries emerged to the detriment of the majority of its people.

In addition, there was the emergence of a Europeanized elite group, first as a service class whose aspirations, goals and tastes were similar to those of their colonial masters. Later, this was further strengthened by those who favoured imported technology and the goods it produced. The other groups consisted of the rural poor that depended upon their craft and other low level skill for their existence. This class of cultures created many social problems in an underdeveloped economy which projected an image of a rich and affluent society, and created false aspirations and hopes among the rural poor.

It is against this background that I wish to evaluate the state of science on the continent and the efforts and strategies we must put into place in the future of the continent of Africa. My perspective of science in Africa's future would be based on how well we provide a rationale to integrate education on the science and its application in technology to remove the barriers of under-development and replace it with sustainable science. Efficiency in utilizing education in the sciences to banish ignorance would lead to meaningful use of science and its application in technology to improve the quality of life and mode of production.

The need to gather knowledge of ourself, our environment and our natural resources would lead to further curiosity about what we do not know both of ourself and our resources. It is in such an environment that we would be able to release the culture boundary to the expansion of knowledge of ourself, our resources and its adaptation to improve the quality of life and sustainable environment.

Sustainability of development would evolve and would enhance our survival strategies to combat disasters and improve the performance of our goals of development. These we can do under an articulate dwell planned policy for science and its application in the future of the continent. It would involve each country in Africa defining priorities for the development of science and technology in its development. It would also depend on a co-operative inter-regional programme involving a continental effort. Scientific research is basic to increased food production. It is the research system that would generate the technological package that would lead to increased productivity.

The progress of scientific knowledge and its abundant technological applications are constantly transforming human life. Many significant change have occurred in industries and agriculture as a result of recent advances in the physical, chemical and biological sciences. The resources needed to eliminate hunger and disease and improve the human living conditions exist; science and its application in technology are definitely the essential means for developing our creative capacities for meeting the need of the continent.

The first objective of science is to increase knowledge and eradicate ignorance, challenge our system of belief and improve on it. Scientific research therefore is in essence directed towards the exploration of the unknown. But the scope of what we do not know or acceptance of what we do not know is closely linked with our system of beliefs and cultural values. What we need is a science policy with properly selected aims of technology. The first objective of science to increase knowledge will be dependent on the educational situation.

The implanting of science and technology in society is not a mere matter of grafting knowledge, know how, practices and techniques on to the social issue that has not been prepared to receive it. There cannot be a situation with science and technology on one side and society on the other. On the contrary, science and technology must put down deep roots, in society, and their rise depends at one and the same time on material, social, economic, cultural, historical and political realities.

Science and technology policies are based primarily on the needs and aspirations of society. Hence they aim to guide scientific and technological activities towards meeting those needs and aspirations, mobilizing the necessary resources and organising the relationship between the objectives of development - and those of scientific and technological research programmes. The major questions arising today for countries in Africa who are eager to ensure their development include the following: How to translate a society's aspiration into appropriate policies for science and technological development.

Several countries in Africa have set up science policy institutions in order to address these issues. But the role of science and technology policy-making bodies varies within the region, which implies that not all the countries in Africa have science and technology integrated into their development plans.

The research activities of the national institutions were oriented towards developing high-yield hybrids, improving farming methods disease and pest control, development and production of vaccine and food processing and the improvement of local machines and tools. This broad scope of research required adequate human resource development for successful implementation.

The number of universities with science and technology faculties had increased and there are now Specialty University of technology and agriculture. Moreover, the new education policy incorporated the study of science at primary and secondary levels in order to increase student intake in tertiary sincere and technology courses. Unfortunately, this increase in the number of educational and training establishments had not always been matched by a corresponding increase in the number of teachers and the provision of adequate equipment.

In Nigeria inadequate funding was one of the major obstacles impeding scientific technological research and development. However the present government efforts have greatly infused major funding initiative in major research programme in Space Science Informative Technology and Biotechnology.

We in Nigeria have come to accept that the means to national wealth and prosperity lies in the effective combination of science and its application in technology, materials and capital to create sound industrial base. This awareness has been called for among Nigerian students and policy-makers that the adoption of Science and Technology in the national life marks the difference between development and underdevelopment. It is also quite crucial that, support for the Universities would go a long way in promoting development as Universities in Africa would continue to be the base on which development effort would continue to be built.

The growth of a large scientific and technical manpower base is fundamental to the development of science and technology in any country, the principal ingredient of technology being the human know-how. With sixty-six universities, twenty-nine polytechnics, twenty-four research institutes and about thirty-four other establishments rendering scientific and technological services, the personnel in Nigeria involved in research, development, training, services and education in science and technology is not enough. A survey of the scientific and technological potential is being planned and it will form one of the data in the computerized services database technology data bank that is also being established.

Priority areas in the application of Science and Technology for National Development

i) Appropriate structure of National System of Science and Technology
ii) Capacity building for S & T
iii) Intensification of Priority Research and Development
iv) Financing of Science and Technology Activities, and
v) International Exchange and Co-operation in Science and Technology.

By now Nigeria should have been one of the leading industrial countries in the world, considering the vast amount of national resources as well as human resources available. We have very highly trained Nigerians located all over the country as well as all over the world. Science and technology should be elevated to the level of the Presidency to give it a national priority and there is therefore a need for a presidential commission for Science and Technology. The present coordinating council of S & T is serving that purpose.

The Science Education Core Programmes Area:

The decision to start with primary education is appropriate since intervention at this level is likely to have widest ripple effect throughout education systems. In Nigeria, this level of the education system is under-serviced and under-resourced.

Another aspect of the implementation strategy for capacity building that is of some concern is the reliance on an electronic network. It is evident that we in Nigeria that is in dire need of capacity building in science are the least equipped to benefit from programmes that rely on electronic means for their implementation.

The issue of the mode of delivery of technology education takes on an additional dimension. Scarce resources for the teaching of science and technology as separate subjects must be balanced against the need to ensure that the outcomes of both are adequately realized. Capacity building in science, in the context of Nigeria is the strengthening of the endogenous capacity and the development of the knowledge content and understanding of technologies.

It has been long realized that a symbiotic relationship exists between fundamental research, which has to do with the structure of science, and applied science research. Fundamental research produces the know-how on which applications are based. In the same vain, applications both stimulate and facilitate further progress in fundamental research. The issue at stake is the optimization of the interaction between these two components and the scientific effort within any given societal system.

A New Dimension

What needs to be done in order to improve this system and make it run at its best in a new dimension is quite simple; we need to join the needs society with answers which the mathematical, physical and natural sciences can offer, using the most advanced technology. And this needs to be implemented in every phase in the understanding and finally the valorisation in the need of society.

We must organize our scientific enterprise along well defined working groups with a good mix of the science and technology activities at the universities, research institutions and industry as

i) ***Research Institutes***: As a permanent research structure which has the scope of conducting research related to a scheduled objectives and in line with the general research direction of the country. The University will provide space and operating expenses. We would seek funding from International agencies and national organization for its operation.

ii) ***Science and Technology Development Centre:*** for studying temporary structure created by University researchers jointly supported with the Institutes and Departments, and other public and private organizations by a special renewable five year agreement to develop particular studies and advanced research would be developed.

iii) ***Research Groups:*** Working with Institutes, Research centres and temporary structures of five years duration for conducting research which involves organizations of research for more than one person and scientific discipline would be established.

iv) ***Special Project:*** would consist of coordination of research and development where the objective is to acquire knowledge and innovation, which can be transferred to the production sector. The economy and social relevance to the national, relative to the theme considered priority in the area of economic programme. Examples are Human health, Food sources and security, Poverty alleviation, Environment, energy sources and Information technology, Biotechnology, Economy, Public administration and Conservation.

The Concept of Innovating Collaboration

Innovation has become a crucial survival issue. A society that pursues well-being and prosperity for its members must pursue innovation seriously can no longer treat it as an option.

To achieve and maintain a high academic member of an innovative community, we must do four things well:

- First, we must build and sustain our infrastructures and processes that support innovation

that are competitive while sustaining the natural environment.

- Second, we must ensure that our over staff develop and continually update the knowledge, competencies, abilities and skills that are required to produce innovative products and services.
- Third, we must nourish and support the effective potential of our members (and their)

commitment to a common purpose, collaboration and enthusiasm through defining meaningful roles.

- Fourth, we must build and sustain relationships, within ourself and with other collaborators

that enable us to interact productively, both for our own and for mutual benefit; and we must do so with a long term-view, considering spans of generations.

Requirements underlying Collaboration in Science and Technology Research

The base requirements for a Science and Technology (S & T) development which is consistent with a vision of innovation in Nigeria are:

- Enhancing the quality of research
- Developing human resources
- Working towards environmental sustainability
- Promoting an information community

In addition to these crucial areas, there are three important dimensions of science and technology which should inform our strategies in Nigeria:

- The importance of knowledge generation
- The role of the human sciences in innovation
- Finance, management and performance

Enhancing Quality of Research

Nigeria's support structure for creating and sustaining micro-enterprises and small businesses will require a strong technology component.

Public investment in Research and Development (R & D) needs to be redistributed to support:

- collaborative research, until a culture develops in the private sector where such research is seen as a business imperative;
- areas where entry barriers related to equipment and human resources are high;
- areas where the activity is considered to be a service which the Government has a duty to provide; and
- areas of public good in which, to achieve the great benefit, the research results and technology transfer need to be placed in the public domain.

The objective is to enhance the quality of technology transfer and diffusion from the science and technology (SET) sector by the provision of quality human resources, effective hard technology transfer. Government, via the Growth and Development Strategy, is seeking to achieve an annual economic growth rate of 6%. In a country which is currently under-investing in S&T and innovation, this target will require a greater than 6% per annum growth rate in the national investment in these activities. In particular, those sectors destined for export growth will not achieve their targets if this investment does not occur.

The means must be established to ensure that the government research portfolio gives due attention to those areas of R & D that have the capacity to affect the quality of life.

- Environmental sustainability.
- Health care provision
- Meeting basic needs at the community level
- Reducing the total cost of infrastructure provision
- Providing safety and security for all who live and work in Nigeria.

The Government has a duty to ensure that an appropriate portion of the money it spends on science is utilized in these areas.