

## An Appraisal of the Role of Science and Technology in Promoting National Development Efforts in Nigeria

Sani Abubakar Mashi<sup>1</sup>, Amina Ibrahim Inkani<sup>2</sup>, Abdu Yaro<sup>2</sup>

<sup>1</sup>Department of Geography & Environmental Management, University of Abuja, PMB 117, Abuja, Nigeria

<sup>2</sup>Department of Geography, Umaru Musa Yar'adua University, PMB 1288, Katsina, Nigeria

### -----ABSTRACT-----

Sustainable development of any country has generally followed the development and applications of science and technology (S&T). Many developed countries of the world today achieved their level of development through the adaptation of technology and development of an efficient S&T capacity. The thrust of this paper is to examine the role science and technology has been playing in promoting national development in Nigeria. It was shown in the paper that a wide variety of different policies have been pursued in Nigeria in an effort to foster technological development with the aim of accelerating the pace of economic development. These sectoral development policies were formulated to guide the process of development in relevant areas of the economy. Thus in terms of policy making, it is not an overstatement to say that Nigeria as a country has fared very well. However, we have not largely succeeded as a nation to make effective use of S&T in promoting national development. The major challenges that need to be addressed to make S&T address the developmental challenges in the country have been discussed.

**Keywords:** Science; Technology; National; Development; Nigeria

-----  
Date of Submission: 06 January 2014



Date of Acceptance: 20 February 2014  
-----

### I. INTRODUCTION

Human development history has shown that sustainable development and self-sustaining progress of any country has generally followed the development and applications of science and technology (S&T), controlled by and responsive to the needs and endowment of a country (Adeniyi, 1999). Many developed countries of the world today achieved their level of development through the adaptation of technology and development of an efficient S&T capacity. There is no doubt that the importance of S&T to national development has been recognized by nations who currently are in the forefront of human development index. Consequently, human and national sustainable development are determined largely by the level of indigenous and endogenous scientific and technological research, the communication of research results and on the knowledge acquired and brought to bear on policy making, programme formulation, project implementation, monitoring and impact assessment. Furthermore, any society without indigenous and endogenous S&T research capacity and capability and high level of literacy cannot but continue to remain underdeveloped (Adeniyi, 1999).

Scientific research in all its forms is the cornerstone of a nation's social and economic development (Abiodun, 1999). Though geographical and human size of a nation may be indicators of its potential power, the real power of a country is measured today in terms of its economic progress, that is, the proven capacity to translate scientific knowledge through its judicious and determined exploitation of technologies in economic productivity. It has been observed that the Nigerian society lacks an in-depth understanding of the role of S&T in national development plans (Abiodun, 1999). The need to integrate S&T into national planning has been overemphasized. In reviewing efforts at bringing science and technology to bear on national development, it is important to examine underdevelopment of S&T in less developed countries and relate it to current national underdevelopment. It has been established that science has a function in relation to the development of production. This function is partly driven by economic forces.

The thrust of this paper is to examine the role science and technology has been playing in promoting national development in Nigeria. The paper first looks at the place of science and technology in a society after which the major issues associated with development of science and technology in the country are discussed. The paper then looks at the major characteristics of S&T in Nigeria, after which its evolution in the country are appraised. The paper then briefly reviews the two main science and technology policies in Nigeria after which

the failure of S&T to address national development challenges in Nigeria is examined. The realities being faced and the progress so far made in using S&T to promote national development are then examined. The paper finally examines the strategies and challenges of making science and technology to effectively promote national development in Nigeria.

## **II. PLACE OF SCIENCE AND TECHNOLOGY IN A SOCIETY**

### **2.1 Science as a Social Function**

Karl Marx, a classical economist once observed the importance of economic organization in the development of link between science and production. He argued that the requirements of the economy will eventually have an effect on the direction of scientific development itself. Furthermore, that technological advance generates new specialized skills at the interface between science and production, notably the various types of engineering skills. The new specialists were able to interpret the needs of the entrepreneur to the scientists and economic demand began to affect the orientation of science. The prime mover here is the search for profit. There is no doubt, that economic demands for innovation had tremendous influence in the evolution of science and indeed R&D. The phases in the development of relations between science and production had been identified as follows (Bernal, 1970):

- [1] Early part of the industrial revolution when production technologies were often the source of new scientific discoveries.
- [2] Second phase which started with the development of the electrical and organic chemical industries informed the new relationship between science and production. During this phase, research laboratory became the source of technological innovations and entrepreneurs drew science into closer relationships with production as they began to invest directly in scientific research as a potential source of profit.

The issues raised here attempts to support the belief that science has a social function in relation to the development of production. Furthermore, the demands of the production system can influence the way in which scientific institutions develop and the content of science. Industrialized market economies developed based on the relationship between science and production. The form in which scientific institutions developed and linked to production in advanced countries was further strengthened through linkage of network of engineering institutions and machinery manufacturers and the types of research carried out.

Some schools of thought are of the opinion that scientific institutions such as research institutes, scientific societies, science policy organizations do not have the same social role everywhere. They argued that scientific institutions in less developed countries might as well serve different social purposes from those in advanced countries. They concluded that by building new research institutes, there are indications that they will function in the same way as the existing ones and may have very little to do with the development of production (Cooper, 1978).

### **2.2 Science, Technology and Dependency**

An alternative view to the current state of development of scientific institutions in less developed countries was linked to “technological dependence”. The dynamics of the underdeveloped economy was observed to create a situation where local scientific institutions were alienated from production. For instance, the import substitution industrialization strategy adopted by most less developed countries encouraged technological dependence. In most countries foreign technology was substituted for technologies that might have been developed by local scientific research and development institutions. The most important element in this view is not that there are import–substitution policy, but simply that the technologies needed generally exist already in the industrialized countries and are often proprietary (ie owned by private enterprises).

This technological dependence adversely affected the thinking and orientation of the potential beneficiaries of local scientific endeavours. For instance, there were cases where local research institutions have successfully developed the types of technology required by local enterprises, but they were rejected in preference to the foreign version on grounds that it is less likely to work.

The consequence of this is that scientific institutions over the years became alienated from production activities. In fact, they became “marginalized” as there were no demands for locally developed technologies from the production sector. Invariably, science became largely for consumption rather than an investment as in the industrialized countries. Also, lack of pressures on science from the local economy, implies that the main determinants of research orientation are the individual decision of research workers. In Nigeria, the situation was not different from other less developed countries. The incapacity of Nigeria to use scientific and

technological research as dynamic elements for social development is a consequence of the characteristics of the prevailing national projects. Unless the approach to implementation of national projects takes into consideration the aspirations of the majority of Nigerian populace, scientific resource will continue to be cultural luxury.

### **III. DEVELOPMENT OF SCIENCE AND TECHNOLOGY IN NIGERIA**

Since after the independence there has been considerable national activity to increase scientific and technological capacity of the country. This is reflected in the number of institutional frameworks for S & T development in the country. Early efforts to promote the development of S & T national capacity after independence centred on direct aid from developed countries. This type of aid include donations and loans for scientific equipment, subsidies for research project, missions of qualified personnel to train nationals or to help formulate S&T policy and scholarships for further study abroad. Though the foundation was laid through foreign assistance, however, very limited efforts were made to build on this foundation and also to strengthen the existing institutional frameworks.

Consequently, scientific and technological systems in the country were very limited and totally unconnected with national problems. In contrast to situation in developed countries, science planning endeavoured to control and direct existing efficient scientific and technological research system. After more than four decades of efforts at S& T development, what are the results? A cursory analysis indicates that in general terms, there has been very limited progress made in absolute terms. One remarkable observation is the quantitative deficiencies of Nigerian R & D system.

In developed countries for instance, most R&D is on subjects that were connected directly or indirectly with national goals such as defence, social development or prestige. In the USA for instance inventions in space technology, mobile communications and ICT were direct results of challenges government gave to R&D institutions to rise up with challenges of time. In countries such as this, scientific development is usually critically reflected in the development of critical sectors such as industry, agriculture, security and several production activities

In Nigeria, considerable numbers of scientific researches were not designed to address the basic societal problems. This lack of connection between the goals of scientific research and the needs of society is a characteristic of underdevelopment (Herrera, 1978). The irrelevance of much scientific works in developing countries is widely acknowledged and hardly requires proof. Even where they happen to be, links between inventions, adaptive technologies and development processes are simply not there.

Evidence abound that agricultural production in Nigeria increased after the second world war, of which two-thirds of the increase was as a result of more land cultivated and not due to increased productivity or yield (Adeniyi, 1999). In contrast to Europe, despite the limited land availability, production increased remarkably due to increase in yield and productivity within the same period. In the industrial sector, the situation is not different either. Industrial technological research is practically non-existent.

The private sector contributes insignificantly to the total R&D investments in underdeveloped countries including Nigeria. In developed countries between 60 and 70% of R&D is undertaken by the private sector while in Nigeria, the private sector undertakes 0 to 0.1% of R&D (Ogbu 2003). An overview of the R&D activities in Nigeria over the years has shown the lack of social relevance. Initial efforts concentrated more on basic research than applied research.

In advanced countries far more were invested in applied and development research than in basic research. However, in Nigeria much more were spent on basic research than in applied research and development. Despite this, basic research has not contributed significantly in addressing societal needs or evoked considerable concern for greater investments in applied research. Consequently, applied research is very weak and there is practically no interaction between the different types of research and production.

The few basic research centres (especially, the Universities) in Nigeria function as isolated enclaves which do little to encourage local R&D. Even, the current state of the universities has further compounded the R&D problems as infrastructures have decayed as well as high turnover rate of seasoned researchers and scientists. These distortions in the S&T systems in most developing countries informed the progressive withdrawal of international funding agencies from national S&T development strategies. For instance, evidence abound that international agencies responsible for programmes of international cooperation are no longer keen in funding S&T development.

Presently, there are more tendencies among international donors to give funds for projects with “direct social interest” like housing investment and health (Coopers, 1978). This underscores why presently, there is limited attention to setting up programmes that would create the scientific and technological capacity to solve basic problems as the visible manifestations of such efforts are only a symptom.

The question that should be asked is “why is the situation like this, and what can be done to redress it? One tends to believe that the complete failure of these efforts is associated with the erroneous suppositions about the problem of incorporating science and technology in the production system. The obstacles to this process are direct consequence of the structure of underdevelopment resulting from insertion of underdeveloped countries into the international system. The bottom line of the whole scenario lies in the prevailing nature of economic and social structure.

Historical records had it that the first sets of research institutes in Nigeria were established during the colonial rule. The essence of establishing these institutions then was to boost agricultural output and thus provide adequate raw materials for industries in Europe (Aluko-Olokun, 1999, Barrow, 2002).

In 1898, the first agricultural research station was established in Ibadan and was called Moore Plantation. Thereafter, similar research stations were established in the then Northern Region at Samaru, Zaria and Umudike, Umuahia in Eastern Nigeria. The Department of Agriculture (or Moore Plantation) was later renamed Federal Department of Agricultural Research in 1954 (Barrow, 2002).

In the early 20th century, sub-regional research stations were established by the colonial administration with headquarters in Nigeria. These institutions or centres include the following:

- [1] West African Cocoa Research Institute, Ibadan,
- [2] West African Institute for Oil Palm Research, Benin
- [3] West African Institute for Trypanosomiasis Research, Kaduna.
- [4] West African Council for Medical Research, Yaba, Lagos.

Furthermore, the West African Research Office located in the then Gold Coast (now Ghana) had research centres in Nigeria. The research centres include the following: the West African Road Research Institute, the West African Timber Research Unit and the West African Rice Research Station.

Following independence of Ghana in 1957, most of the research institutions and centres became full-fledged national institutes in Nigeria. In 1964, the Agricultural Research Institute Act was enacted by the parliament in Nigeria (Aluko-Olokun, 1999).

The institute was established to coordinate research activities in Nigeria as it relates to agriculture. Following the international conference on the Organization of Research and Training in Africa in 1964, Nigeria established a National Council for Scientific and Industrial Research (NCSIR) by Decree No. 83 of 1966. The Council was expected to act as an advisory body to government and as such, lack executive powers (Aluko-Olokun, 1999). Its mandate was quite narrow and therefore had structural weakness that prevented it from functioning efficiently. The real consciousness of the development of science and technology in Nigeria did not come into force until after the Civil war in 1970.

By the 1970s, concerted efforts were made to promote science and technology development in Nigeria. Within this period, the Nigerian Council for Science and Technology (NCST) was established by Decree No.6 of 1970 to replace the NCSIR (FMST, 1990). The Decree also, approved the establishment of four sectoral research councils, namely;

- [1] The Agricultural Research Council of Nigeria (ARCN). Established by Decree No.25 of 1971;
- [2] The Medical Research Council of Nigeria (MRCN) established by Decree No.33 of 1971;
- [3] The National Science Research Council of Nigeria (NSRCN) established by Decree No. 9 of 1973, and the Industrial Research Council.

The NCST was to coordinate research and development activities in the country in fields such as agricultural science, engineering and technology, medical science, experimental sciences, environmental and social sciences. Aluko-Olokun (1999) observed that much of the development at this period was influenced by the activities of UNESCO.

It will be recalled that in 1974, UNESCO organized the first regional ministerial conference on S&T development in Africa called CASTAFRICA I which was held in Dakar, Senegal (Khalil, 2002). The conference identified and recommended among other issues, the need for African countries to formulate their Science and Technology Policy to guide national development, especially rural and industrial development.

In 1976, the government of Nigeria, in pursuance of its commitment to the resolution reached at the first regional conference, set up an S&T policy review committee which recommended two policy options, namely:

- [1] The establishment of an executive agency to coordinate S&T policy; or
- [2] the establishment of Ministry of Science and Technology with all the Research Institutes under it;

Based on the selection of the first option, the National Science and Technology Development Agency (NSTDA) was established by Decree No. 5 of 1977 with all the research institutes under it. With the emergence of this new institutional framework, the sectoral research councils and the NCST were dissolved. The National Science and Technology Development Agency (NSTDA) had no Minister and were chaired by the then Chief of Staff Supreme Headquarters, Major General Shehu Musa Yar'Adua (Animalu, 2003).

By 1979, additional research institutes were established by this agency bringing the total number to twenty-two made up of 18 agro-based, 3 industrial and 1 medical. NSTDA, in addition to supervising the research institutes, also, funded university-based research (Aluko-Olokun, 1999).

The search for an ideal national S&T structure did not end with the establishment of NSTDA. In 1980, with the emergence of a democratic government and with the apparent realization of the importance of S&T to national development, President Shehu Shagari established the Federal Ministry of Science and Technology (FMST) and dissolved NSTDA through the Science and Technology Act No.1 of January, 1980.

It was at this point that the first Minister of Science and Technology was appointed with all the complement of staff as well as its own budget. Within this period, government established specialized universities to focus attention on expanding the frontiers of knowledge in S&T in addition to training of high-caliber manpower required for the technological age. This period heralded the establishment of universities of technology and more polytechnics.

However, as government changed with the incursion of the military into governance and barely four years after its establishment, the new Ministry of Science and Technology was merged with the Ministry of Education as Federal Ministry of Education, Science and Technology.

In 1985, following the overthrow of the then military administration of Major-General Muhamad Buhari, the Ministry of Science and Technology was once again made a full-fledged Ministry in 1986.

It was during this period that the first "National Policy on Science and Technology" was enunciated. The choice of scientists and technocrats in the running of the Ministry of S&T informed the radical change within this period (Animalu, 2003). Some of the pertinent issues for consideration include the establishment of "National Science and Technology Fund (NSTF) as a source of funding for the implementation of the S&T policy. Also, the identification of the nonexistence in the Federal Ministry of Science and Technology policy framework of an engineering infrastructure, informed the establishment of National Agency for Science and Engineering Infrastructure (NASENI) by Decree No.33 of 1992.

Uncertainty in governance of S&T in Nigeria manifested in the scrapping of the Federal Ministry of Science and Technology by late 1992. In place of the FMST, all research institutes except four were returned to their various sectoral Ministries. The Federal Ministry of Industry and Technology was created while the Sheda Science and Technology Complex (SHESTCO) came on stream vide Decree No.43 of 1991. The expected funding of S&T through the NSTF did not materialize (Animalu, 2003).

The Decree No.39 of 1987 which informed the establishment of the Raw Materials Research and Development Council (RMRDC) for the promotion of raw materials development was amended in 1992 and provided with a risk fund realized from the value added tax or surcharge on imported raw materials (Animalu, 2003). The Federal Ministry of Science and Technology was re-established in 1993 and since then has maintained a stable functioning till date.

#### **IV. CHARACTERISTICS OF S&T IN NIGERIA**

The major characteristics of S&T in Nigeria are:

- [1] Nigerian situation in the evolution of S&T indicates an initial failure to recognize the critical role of S&T instruments to national development.
- [2] The country lacked the science culture that is required to create awareness on the need to use scientific methods in economic activities.
- [3] The institutional frameworks for S&T development in Nigeria include research institutions, universities and polytechnics. Also, scientific research activities in the industries were limited and there was no private commercial R&D laboratory.
- [4] Although, the oldest research institutes in Nigeria were over 80 years, the larger part of the current S&T capability was however, built after independence, between 1960 and 1990. This was a period characterized mainly by military rule in Nigeria. The peak periods in the establishment of research institutions in Nigeria were in the 1960s and 1970s.
- [5] The Government is the major stakeholder and financier of S&T activities with limited or no support from the private sector.
- [6] The overall funding mechanism of S&T in the country is weak as budgetary allocation is proportionally low over years.
- [7] The S&T institutions inherited from the colonial masters and the new ones established thereafter, lacked the necessary linkage with the productive sector. This problem reflected in the various development plans embarked after independence.
- [8] The S&T institutions are weak to serve as delivery system for national development as their mandates have for long been on generalities and short on specifics.
- [9] Personnel with requisite qualifications for effective research work, especially those with PhDs, are limited in most S&T institutions. There are more support staff in the employment of many S&T institutions than researchers.
- [10] Though many research activities are being executed in the S&T institutes, consultancy and extension services were sparingly carried out to the direct benefit of the society as the capacity to render consultancy and technology extension services is lacking due, primarily to limited skilled personnel trained in these areas.
- [11] Scientific and technological researches in Nigeria have demonstrated a pronounced bias towards agriculture. The bias was also characterized by a narrow diversity of specialization that inclined more to food crops.

#### **V. APPRAISAL OF EVOLUTION OF S&T IN NIGERIA**

Scientific institutions in Nigeria emerged during the colonial period particularly around mid-1960s, during which National Research Council was established. It is pertinent to note that the current S&T capability was built between the late 1960s and the 1980s, a period characterized by military rule in Nigeria. During this period, there was growing concern of some military and civilian authorities to build up the country's S&T competence as part of a broader project of national growth and self-sufficiency. The concern to build up scientific, technological and industrial self-sufficiency within this period however, did not receive the desired support in the productive sector.

Consequently, it remained for the most part, restricted to special segments of the state bureaucracy and the academia. For most firms, including the multinationals and state-owned corporations, the origin of technologies used in their production activities was immaterial than their cost and reliability.

Furthermore, there was little or no understanding of the effective mechanisms and policies leading to technological innovation in the productive sector. Also, the need to strengthen Nigeria's basic technological infrastructure, metrology, normalization, quality control and certification received minor attention.

The main initiatives taken to date include the following:

- i. Educational reforms of the early seventies with emphasis on science and technical education.
- ii. The integration of science and technology under the national economic policy.
- iii. The creation of institutional frameworks for science and technology such as Federal Ministry for Science and Technology.
- iv. The establishment of a few centres for research and development.
- v. The formulation of National S&T policy.

Despite the initial efforts made in promoting S&T development in the country, there were several constraints, among which were the following:

- [1] There was very weak linkage between S&T and the productive sector.
- [2] There was lack of strategy for acquisition of advanced technology in an economic environment characterized by protectionism and reliance on cheap labour and natural resources.
- [3] The exception to this situation was in the field of agriculture where the sector benefited from research on the introduction of high yielding crop varieties, disease resistant crops with significant gains in productivity. This development marginally boosted the export oriented sector of agriculture.
- [4] Within this period, in the universities, research and graduate education remained isolated from the productive sector. The quality of scientific institutions created and expanded in the seventies started diminishing.
- [5] The 1990s brought a great instability and uncertainty in the S&T sector as attested to by the various changes in the existence of the Ministry of Science and Technology as well as its governance. Within this period, there were great institutional turmoil of bureaucratization and budgetary uncertainty.
- [6] It was also, in this period that funding of S&T gradually feasted out due to increasing budgetary constraints and inflation. The Structural Adjustment Programme (SAP) further accentuated the fiscal constraints.
- [7] The operators in S&T sector started going about with cap in hand pressing for more resources often with partial or no success at all.
- [8] The early nineties saw a renewed effort to resuscitate the S&T infrastructure, albeit by creating new ones with a view to making S&T more directly relevant to industrial competitiveness. This heralded the birth of Technology Business Incubators, Science Parks, Agencies for Engineering Infrastructures, Raw Materials Research and Development Council, among others.
- [9] Given the persistence of economic stagnation and political uncertainty in the early nineties, the impact of the renewed efforts could not be felt.
- [10] Consequently the research institutions were deprived of funds and support which affected their work ability and contributed to both internal and external "brain drain".
- [11] Even, universities suffered from budget limitations as well as increasing salary costs and the absence of incentives for performance efficiency.

## **VI. SCIENCE AND TECHNOLOGY POLICY IN NIGERIA**

The major features of S&T policy in Nigeria can be summarised as follows:

- The first explicit national policy on S&T was formulated in 1986. The philosophy for the national policy on S&T affirmed that it shall form the basis of Nigeria's development and shall influence the thinking and working process.
- The contribution of S&T to competitiveness and economic growth of the country was established. However, its role in national development is not clear and cannot be quantified in absolute terms.
- The currently existing policy was produced in 2003 to frame and accelerate technological change and facilitate structural change with the overall objective of achieving economic growth.
- The issue of national project and building of national technological capabilities are being addressed through the implementation of 2003 S&T policy. The training of Nigerian scientists and engineers to acquire capability to launch and manage the space satellite system is a classical example.
- Also, three phases of policy process were identified from the critique on national S&T policy formulation which include; strategy formulation, programme identification and design, programme implementation and assessment. These phases must be supported by impact assessment which will form part of the feedback control mechanism.

## **VII. FAILURE OF SCIENCE AND TECHNOLOGY TO ADDRESS NATIONAL DEVELOPMENT CHALLENGES IN NIGERIA**

A wide variety of different policies have been pursued in Nigeria in an effort to foster technological development with the aim of accelerating the pace of economic development. These sectoral development policies were formulated to guide the process of development in relevant areas of the economy. These policies include among others, the following:

- [1] Science and technology policy, which aims to provide innovative initiatives for development in all aspects of social well-being such as agriculture, industry, health, etc.
- [2] Industrial policy, which aims to increase productivity through the application of modern technologies and machineries.
- [3] Agricultural policy, which aims to increase food production in order to ensure food security with minimum degradation to the environment.
- [4] Other policies include health policy, environmental policy, economic and trade policy, and social policy.

Thus in terms of policy making, it is not an overstatement to say that Nigeria as a country has fared very well. However, the key questions that can readily come to someone's mind here are:

:

- [1] Has the S&T policy been a critical determinant of national development performance?
- [2] Has the application of S&T contributed to the development of industries in Nigeria as well as increase the industrial productivity?
- [3] How has S&T impacted on agricultural production leading to increase in food production and ensuring food security and poverty reduction?
- [4] What relationship exists between S&T policy institutions and the socio-economic frameworks established for national development?

Explained in quite simple terms, we have not largely succeeded as a nation to make effective use of S&T in promoting national development. Factors responsible for this include:

- [1] dearth of people-oriented, market-driven, job-creating dynamic S&T policies to guide national development efforts;
- [2] minimum investment in the training of skilled human resources to sustain scientific creativity and technological innovation and failure to create an enabling environment for active S&T research and development;
- [3] low investments in S&T infrastructure;
- [4] inefficiently managed S&T institutions with duplicating mandates;
- [5] poor intra-government cooperation and collaboration among key S&T stakeholders;
- [6] lack of an integrated approach to national development efforts by policy makers, administrators, academicians/ researchers, development bankers, financiers, industrialists and entrepreneurs;
- [7] faulty mechanisms for creating an interface between S&T, industry and government.

### **VIII. PROGRESS MADE AND REALITIES**

Despite the shortcomings and failures, some measures of progress were made in using S&T to address development challenges.

- [1] The basic scientific and technological competence acquired by Nigeria in the past five decades was an important asset for continuous drive for social and economic modernization.
- [2] The institutional frameworks established as delivery systems for S&T development are currently on ground and require only restructuring and modernization to make them more relevant once again.
- [3] The realities of the experiences of the 1980s and 1990s informed a re-think on the assumptions made at that time that S&T is an "endless frontier" worth expanding for cultural reasons and its promises in terms of practical applications.
- [4] At that time there was the belief that all field of knowledge were equally deserved and all projects and initiatives must get public support.
- [5] Furthermore, the notion that scientists should be funded by the state, free to control their institutions and distribute research resources according to their own criteria gradually changed.

During the era of import substitution economic policy of Nigeria, the development of S&T was seen as part of a broader pattern of import substitution strategy with the clarion call for self-reliance and inward looking. The call for protection of local infant industries and local sourcing of raw materials was not marched with increased support and funding of S&T. The "protectionist syndrome" further closed the doors for international interchanges of knowledge and collaboration with scientific communities. Research institutions and programmes were hardly exposed to international standard of quality and evaluation. Finally, considerations about regional inequalities and short-term needs as well as political pressures for the creation of academic and research institutions throughout different geopolitical zones/states in Nigeria eventually led to the weakening of the criteria for resource allocation by the government agencies.



## **IX. MAKING SCIENCE AND TECHNOLOGY TO EFFECTIVELY PROMOTE NATIONAL DEVELOPMENT IN NIGERIA**

Science and technology policy and its impact on society depend on a number of factors that are related to contribution to development of fundamental knowledge and technology. Also, consideration is given to its contribution to development of scientific and technical human capital. These parameters are often used to evaluate the impact of science and technology policy on the society.

Science and technology policies are generated by both the internal stakeholders (S&T family) and the external stakeholders (end-users of S&T), while the successful implementation depends on the cooperation of all, including the greater society (Ajoku, 2004). The role of the institutional framework for policy implementation is very critical in determining impact of the policy on the user subsystem. It is obvious that the second subsystem (R&D institutions) must be able to play a key role in terms of institutional support to the productive sector and the society at large which form the user subsystem. If the second subsystem is weak or unable to discharge its functions effectively, the impact of the first subsystem (policy framework) can not be felt and even measured (Ajoku, 2004). It is imperative therefore that the subsystems should interact on a continuous basis to achieve the desired impact. This concept provided the basis for the research methods and procedures for the study which focused on the impact of S&T policy on national development.

Realities on the ground are indicating that for S&T, there some prospects towards meeting up with the challenge of making S&T to address developmental realities in Nigeria. The major indicators for this are:

- [1] S&T are much closer to industry and markets than before. Industries are externalizing for the development of new management skills, processes and products. The fallout of these are increase in R&D investments, the setting up of specialized laboratories and research departments and search for new linkages with universities.
- [2] The pace of technical innovation and competition in industry accelerated, requiring from firms a permanent capability to change its organization, absorb new technologies and processes and generate new products.
- [3] Science is now more global than ever as the speed, quality and low cost of international information flows brings researchers and research sites into immediate contact. It is now much easier to have access to the international scientific community than in the past.
- [4] There is an emergence of scientific enterprises which is compelling R&D to be market-driven.
- [5] There is a change in the old system of S&T development that starts with basic research to applied research/invention and terminates with entrepreneurial innovation; thereby creating new products and processes which can later be diffused through imitation or reverse engineering. The current situation is more complex with scientific discoveries assuming the context of application. The consequence of this changing landscape is the loss of support for basic research if it is not linked to identifiable products and results.
- [6] New patterns of international scientific cooperation are emerging resulting in the establishment of large scale international ventures. Examples include human genome project, biotechnology and genetic engineering, global research activities in fields of meteorology, global climate change, renewable energy, etc. Such cooperation is characterized by large scientific installations and networks of scientists and research groups.
- [7] Resulting from the above, considerable number of new activities and disciplines linked to scientific assessment emerged in areas such as technological forecasting, technology assessment and evaluation of environmental effects of innovation.

There are however some fundamental challenges that need to be faced squarely for us to reach the promised land:

- [1] The very foundation upon which S&T started in Nigeria was faulty. The foundation was laid during the colonial period to put in place structure that very much satisfies the international system and the country remaining as peripheral dependent economy, exporting raw materials and importing manufactured goods from the large industrial countries of the world. The country is to serve as source of raw materials for foreign enterprises and to enjoy limited industrialization to produce a few basic consumer goods. These schemes of development generated no local scientific and technological demand. Invariably, there was no stimulus for development of technological research, with basic research mainly related to few disciplines with social demand such as medicine and agriculture.

- [2] The reduction of resources for most existing S&T programmes largely as a fallout of declining national resource base.
- [3] Lack of perspective for new projects and initiatives even when multilateral assistances which require matching funds were concerned.
- [4] Institutional and financial instability. At certain point in time, the agency established for S&T development changed name and status several times;
- [5] Budget allocated to S&T institutions fluctuated and actual delivery of the funds was not guaranteed (Ogbu 2003).
- [6] Lack of consensus in government, public opinion or international agencies about the importance and role of scientific research.
- [7] S&T agencies have limited capacities to grant resources for research projects.
- [8] The administration of some federal agencies for S&T suffered from the effects of over bloated bureaucracies, low salaries, low morale and political militancy of employees reflected in terms of number of labour strikes or work-to- rule (Ajoku, 2004). Some agencies were under staffed and unable to recruit competent persons to fill the vacancies. Operational activities were paralyzed by lack of resources and incentives.
- [9] Emigration of skilled researchers from Nigeria in search of greener pastures. It has been reported that “there are as many Nigerian Scientists in the West as expatriate living and working than there are Europeans in Nigeria (Ajoku, 2004, Khalil, 2002).
- [10] The public institutions which were mainly funded by the Nigerian government were poor payers compared with the private sector or even the private universities. This situation resulted in the flight of skilled and experienced researchers to the private sector and private universities, leading to what is termed “**internal brain drain**”.
- [11] General lack of capacity of S&T personnel in Nigeria in the art of translating R&D results and patents into commercializable products and services. There is thus strong disconnect between the S&T institutions and the wider consuming society, especially the organized private sectors in the country.
- [12] Inability of S&T institutions to carryout researches that are supportive to the emerging industries or even adopt technologies developed abroad contributed to the current declining international competitiveness of the local industry (Abubakar and Ajoku, 2001).
- [13] National S&T policies largely aim towards creating a scientific and technological system which will only help to solve minor problems without putting the system itself in question as much of what is in place is not utilized or even patronised. Gulma (1999) observed that though Nigeria is well endowed with human and material resources, including technologists and engineers, it is however, deficient in technology as the human and material resources are not properly utilized. For instance, in the area of power generation, of the 8 power plants established after independence, both hydro, steam and gas turbine, all the suppliers of the equipment were foreign vendors from UK, Sweden, Japan, Austria, USA, Switzerland and Germany. Apart from minor maintenance work, all other works including civil and electro-mechanic were carried out by foreign experts (Gulma, 1999). Furthermore, in 1973, the Federal Government of Nigeria set up 6 centres for vehicle assemble which include Mercedes at Enugu, Volkswagen at Lagos, Leyland at Ibadan, Peugeot at Kaduna, Fiat at Kano and Steyer at Bauchi. Unfortunately, these vehicle assembling plants had limited local content, despite the ambitious goal of achieving 90 per cent of local sourcing of component within 10 years of operation. The petrochemical industries, refineries, steel rolling mills, the aluminum smelting plants, paper mills, steel complexes, machine tools, etc are core strategic national projects that could have launched Nigeria into technology development (Abdullahi and Ajoku, 2001). The major S&T players in these sectors are till today largely foreign. Other projects like Kainji, Zobe and Bakolori dams and Lake Chad projects, Nigeris Communications Satellite Project, Aerostat balloon project (Ile-Ife) and the Nigerian Radar Project on Vegetation Mapping (NIRAD) present similar examples. Furthermore, the \$3 billion iron and steel sector was established at Ajaokuta Steel Plant without planning for technological capability building.
- [14] No serious effort is made towards seriously prioritizing technology transfer. South Korea used the instrument of technology transfer to develop her capabilities in the technologically mature sectors such as the labour-intensive textile sector and heavy chemical industries. Today many of the vehicles used around here, for instance, are made in Korea.

## X. CONCLUSION AND RECOMMENDATIONS

Science and technology are today more important than ever for Nigeria, if it is to raise the standards of living of its people, consolidate a modern economy and participates as a significant partner in the global arena. This implies that the economy must be modernized and be competitive. In this regards, a new policy paradigm anchored is required to make S&T to:

- [1] stimulate the freedom, welfare, initiative and creativity of the S&T researcher
- [2] establishing strong links between the S&T researchers' work and the requirements of the economy, the educational system and of society as a whole
- [3] make Nigerian S&T truly international
- [4] strengthening the country's educational and S&T capabilities
- [5] link up and integrate very well with the larger body of consumers of innovations arising from S&T, including especially the private sector

To achieve these, requires a competitive environment based on public incentives and private opportunities that rewards achievements and provides adequate resources to R&D in order to pursue strategic goals. To do these, there I the need to:

- [1] to increase the linkages between applied and academic research with the productive sector, and to increase their share in the national effort for scientific and technological development. This requires a significant increase in private investments in R&D;
- [2] to promote research and development through the application of appropriate system of rewards and incentives for scientists, appropriate career structures and increased public support for S&T;
- [3] to invest considerably in the development of innovative capabilities of the productive system through incentives, extension services and strengthening of the national infrastructure for S&T;
- [4] to make government agencies for science and technology more flexible and predisposed to peer review procedures in order to track the impact of S&T activities.
- [5] to encourage and stimulate S&T institutions as well as research groups to search for opportunities for collaborative research and partnerships from different sources including the private sector, non-governmental organizations so as to reduce the dependence on government.

## REFERENCES

- [1] Abdullahi, A. (2004). An Impact Assessment of Science and Technology Policy on National Development of Nigeria. PhD Dissertation in Management, St. Clements University, USA.
- [2] Abdullahi, A and K. B. Ajoku (2001). *Capacity Building for Sustainable Industrial Development: A Nigerian Perspective*. Raw Materials Research and Development Council, Abuja, Nigeria pg.30-40.
- [3] Abdullahi, Ado K and K. B. Ajoku (1998). *Raw Materials Information Network for Africa: A new Agenda for Development*. Raw materials Research and Development Council, Abuja, Nigeria pg.172-173.
- [4] Abdullahi, A and K. B. Ajoku (2001). *Capacity Building for Sustainable Industrial Development: A Nigerian Perspective*. Raw Materials Research and Development Council, Abuja, Nigeria pg.30-40.
- [5] Abdullahi, Ado K and K. B. Ajoku (1998). *Raw Materials Information Network for Africa: A new Agenda for Development*. Raw materials Research and Development Council, Abuja, Nigeria pg.172-173.
- [6] Abiodun, A. A (1999). Research: The foremost prerequisite for Sustainable Development in Nigeria. In: Adeniyi P.O. ed, Research Capacity Building for Sustainable Development in Nigeria, Unilag Consult, Lagos, Nigeria Pg.13-27.
- [7] Ahrens, J (2002). Governance and the Implementation of Technology Policy in Less Developed Countries. *Economics of Innovation*. New Techns, Vol. II (4-5) pg. 441-476.
- [8] Ajoku, K. B (2004). Institutional Framework for Science and Technology in West Africa" A paper presented at First Conference of West Africa Ministers of Science and Technology. Organized by ECOWAS Secretariat Abuja, Nigeria 1st – 4th November, 2004.
- [9] Aluko-Olokun, I (1999). "The Way Forward for Strengthening R&D Capacity-Building in Tertiary Institutions and Research Institutes. In: Adeniyi P.O ed. Research Capacity Building for Sustainable Development in Nigeria, Unilag Consult, Lagos Nigeria.
- [10] Animalu, A. O.E (2003). "Hot Issues in Contemporary Nigerian Science and Technology Policy." A Paper Presented at the 16th Anniversary of the "Scientific Revival Day for Africa" organized by the African Technology Policy Studies (ATPS) Network, Abuja, Nigeria pg. 8-15.
- [11] Anandakrishnan, M and H. Monta-lou, (1998). "Indicators of Science and Technology for Development" In: Atal Wad ed, Science, Technology and Development, Westview Press, Boulder, Colorado, IT Publications, London, England pg, 293-304.
- [12] ATPS Network (2002). "Science and Technology and Africa's Global Inclusion". African Technology Policy Study (ATPS) Network, Nairobi, Kenya pg.1-20.
- [13] Bamiro, O. A (2004). "Technology Transfer and the Development of National Technological Capacity: The Case of Nigeria Liquefied National Gas (LNG) Project". A paper presented at ATPS/RMRDC Training Workshop on Science Writing for Science Writers, Abuja Nigeria pg.1-23.
- [14] Bernal, J. D (1970). *Science in History* London, Penguin pg 24-25.
- [15] Boer, F. P (1999). *The Evaluation of Technology: Financial Issues in R&D*. New York, John Wiley and Sons pg. 25-30
- [16] Boer, F. P (2002). "Financial Management of R&D in 2002". In: July-August Research and Technology Management, Industrial Research Institute. Inc. Vol. 45 No. 4, 22.
- [17]

- [18] Cooper, C (1978). (ed.) *Science, Technology and Development: The Political Economy of Technical Advance in Underdeveloped Countries*. Frank Cass & Co. Ltd.) pg. 3-4.
- [19] Emovon, E. U (1999). "National Research Policy and Sustainable Development: In: Adeniyi P.O ed. Research Capacity Building for Sustainable Development, Unilag Consult, Lags, Nigeria pg 31-36.
- [20] Ergas, H (1987). "Does Technology Policy Matter?". In: Guide B. R. and Brooks H. (eds), *Technology and Global Industry, Companies and Nations in the World Economy*, Washington, D. C. National Academy Press. Pg191-245.
- [21] Evenson, R. E and L. E. Westphal (1995). "Technological Change and Technology Strategy". In: Behrman, J and T. N. Srinivasan (eds.) *Handbook of Development Economics*, vol.34, Amsterdam: Elsevier pg 2209--2299.
- [22] Evenson, R. E. and G. Ranis (1990). "Introduction". In: Evenson, R. E and G. Ranis (eds). *Science and Technology Lessons for Development Policy* Boulder: Westview Press pg. 1-15.
- [23] FMST (1986). *National Policy on Science and Technology Federal Ministry of Science and Technology*. Directorate of Social Mobilization (MAMSER) Lagos, Nigeria pg.1-20.
- [24] FMST (1990). *Fact Sheet on the Federal Ministry of Science and Technology and its Research Institutes/Parastatals*. Federal Ministry of Science and Technology Lagos, Nigeria Vol. 2<sup>nd</sup> Ed pg.1-26.
- [25] FMST (2003). *National Policy on Science and Technology. Federal Ministry of Science and Technology*, Abuja, Nigeria pg. 1-425.
- [26] Frippiat, J (2002). "Adding Value to Research and Development Efforts in Nigeria: The Role of External Assistance. In: Maiyaki, J. Y and C. I. Okeke (ed) *Research and Development in Nigeria*, Centre for Management Development, Lagos, Nigeria pg. 104-109.
- [27] Gulma, M. A (1999). National Research Policy with Focus on Engineering and Energy. "In: Adeniyi, P.O (ed). *Research Capacity Building for Sustainable Development in Nigeria*, Unilag Consult, Lagos, Nigeria pg. 51-57.
- [28] Gaillard, J and A. F. Tullberg (2001). *Questionnaire Survey of African Scientists*. International Foundation for Science, Stockholm pg. 25-82.
- [29] Khalil, M. H (2002). "State of Science and Technological Capacity in sub-Saharan Africa". ATPS Special Paper Series No.12, African Technology Policy Studies (ATPS) Network, Nairobi, Kenya pg.1-70.
- [30] Kasper, R. G (1972). *Technology Assessment: Understanding the Social consequences of Technological Applications*. Praeger Publishers, New York, USA.
- [31] Lau, S (1992). "Technological Capabilities and Industrialization". *World Development* 20 (2), pg.165-186.
- [32] Muturi, P (2002). "Scientific and Technological Research and Development". A Paper Presented at the OAU/STRCREPTEM Conference on Science and Technology, Nairobi, Kenya, March 26-29, pg. 1-19.
- [33] Nsa, L.E (2003). "*An Analysis of the Management of Research and Technology Organizations in Nigeria*" PhD Thesis in Management, St. Clements University, USA. pg.1-216.
- [34] Oragwu, F.C. N (2000). "Commercialization of R&D Outputs in Africa: Implications for Budgetary Financing and Policy Support". Paper Presented at National Conference on Sustainable Private sector-Driven Industrialization and Development, Abuja, Nigeria pg. 1-20.
- [35] Oragwu, F.C.N (2002). "Technological Development Capacity Building for Technology Innovation in the Economy." A Paper Presented at Conference on Science and Technology for the OAU/STRC-REPTEM, Nairobi, Kenya pg. 1-20.
- [36] Schwartzman, S (1993) "Science and Technology Policy in Brazil: A new policy for a global world". <http://www.schwartzman.org.br/simon/scipol/newpol.htm>. pg.3-55.
- [37] UNESCO (1979) *Science, Technology and Governmental Policy*. A Ministerial Conference for Europe and North America (minespol II). UNESCO Science Policy Studies and Documents No. 44 pg. 52-55).
- [38] UNESCO (1992) *Science, Technology and Endogenous Development in Africa- CASTAFRICA II*. UNESCO Policy Studies and Documents No.69 pg. 16-88.
- [39] UNCTAD (2004) *The Role of Science and Technology in the Achievement of the MDGs*. United Nations Conference on Trade and Development.
- [40] United Nations Millennium Project (2004) "Science, Technology and Innovation: Challenges and Opportunities for Implementing the Millennium Development Goals. Intern. Report of the Task Force on Science, Technology and Innovation pg.1-22.
- [41] Wad, A (1988) (ed). "Science, Technology and Development". Westview Press, Boulder, Colorado. IT. publications. London, England pg. 293-304.
- [42] WAITRO (1999) "Best Practices for the Management of Research and Technology Organizations; Special Report" World Association of Industrial and Technological Research Organizations, Denmark pg.1-20.
- [43] Westphal, L. E (2002) "Technology Strategies for Economic Development in a Fast Changing Global Economy". *Economics of Innov. New Techn.*, Vol.II (4-5) pg 275-320.